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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 12.14.1 Release 12)**

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# Contents

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# 1 Scope

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

# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.


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

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

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

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

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

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

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

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

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

[10] 3GPP TS 23.303: "Technical Specification Group Services and System Aspects; Proximity-based services (ProSe); Stage 2".

[11] 3GPP TS36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".


# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

NOTE: As defined in TS 23.303 [10].

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

NOTE: As defined in TS 23.303 [10].

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

NOTE: As defined in TS 23.303 [10].

**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 |
| $F_{agg\_alloc\_low}$ | Aggregated Transmission Bandwidth Configuration. The lowest frequency of the simultaneously transmitted resource blocks. |
| $F_{agg\_alloc\_high}$ | Aggregated Transmission Bandwidth Configuration. The highest frequency of the simultaneously transmitted resource blocks. |
| $F_{Interferer}$ (offset) | Frequency offset of the interferer |
| $F_{Interferer}$ | Frequency of the interferer |
| $F_C$ | Frequency of the carrier centre frequency |
| $F_{C\_agg}$ | Aggregated Transmission Bandwidth Configuration. Center frequency of the aggregated carriers. |
| $F_{C,block, high}$ | Center frequency of the highest transmitted/received carrier in a sub-block. |
| $F_{C,block, low}$ | Center frequency of the lowest transmitted/received carrier in a sub-block. |
| $F_{C\_low}$ | The centre frequency of the *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, or the respective power spectral density of each interfering cell relative to $N_{oc}$ is defined by its associated Es/Noc value. |
| $N_{Offs-DL}$ | Offset used for calculating downlink EARFCN |
| $N_{Offs-UL}$ | Offset used for calculating uplink EARFCN |
| $N_{otx}$ | The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing) simulating eNode B transmitter impairments as measured at the eNode B transmit antenna connector |
| $N_{RB}$ | Transmission bandwidth configuration, expressed in units of resource blocks |
| $N_{RB\_agg}$ | The number of the aggregated RBs within the fully allocated Aggregated Channel bandwidth. |
| $N_{RB\_alloc}$ | Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth. |
| $N_{RB,c}$ | The transmission bandwidth configuration of component carrier *c*, expressed in units of resource blocks |
| $N_{RB,largest\ BW}$ | The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks |
| $N_{RX}$ | Number of receiver antennas |
| $N_{UL}$ | 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*. |
| $\Delta T_{ProSe}$ | Allowed operating band transmission power relaxation due to support of E-UTRA ProSe on an operating band. |
| $\rho_A$ | According to Clause 5.2 in TS 36.213 [6] |
| $\rho_B$ | According to Clause 5.2 in TS 36.213 [6] |
| 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 | Intra-band contiguous CA of component carriers in one sub-block within Band X where X is the applicable E-UTRA operating band |
| CA_X-X | Intra-band non-contiguous CA of component carriers in two sub-blocks within Band X where X is the applicable E-UTRA operating band |
| CA_X-Y | Inter-band CA of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating band |
| CA_X-X-Y | CA of component carriers in two sub-blocks within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating bands |
| CC | Component Carriers |
| CG | Carrier Group |
| CPE | Customer Premise Equipment |
| CPE_X | Customer Premise Equipment for E-UTRA operating band X |
| CW | Continuous Wave |
| DC | Dual Connectivity |
| DC_X-Y | Inter-band DC of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating band |
| DL | Downlink |
| DIP | Dominant Interferer Proportion |
| EARFCN | E-UTRA Absolute Radio Frequency Channel Number |
| 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 |
| MCG | Main Carrier Group |
| MOP | Maximum Output Power |
| MPR | Maximum Power Reduction |
| MSD | Maximum Sensitivity Degradation |
| OCNG | OFDMA Channel Noise Generator |
| OFDMA | Orthogonal Frequency Division Multiple Access |
| OOB | Out-of-band |
| PA | Power Amplifier |
| PCC | Primary Component Carrier |
| P-MPR | Power Management Maximum Power Reduction |
| ProSe | Proximity-based Services |
| PSBCH | Physical Sidelink Broadcast CHannel |
| PSCCH | Physical Sidelink Control CHannel |
| PSDCH | Physical Sidelink Discovery CHannel |
| PSS | Primary Synchronization Signal |
| PSS_RA | PSS-to-RS EPRE ratio for the channel PSS |
| PSSCH | Physical Sidelink Shared CHannel |
| PSSS | Primary Sidelink Synchronization Signal |
| RE | Resource Element |
| REFSENS | Reference Sensitivity power level |
| r.m.s | Root Mean Square |
| SCC | Secondary Component Carrier |
| SCG | Secondary Carrier Group |
| SINR | Signal-to-Interference-and-Noise Ratio |
| SNR | Signal-to-Noise Ratio |
| SSS | Secondary Synchronization Signal |
| SSS_RA | SSS-to-RS EPRE ratio for the channel SSSSSSS Secondary Sidelink Synchronization Signal |
| TDD | Time Division Duplex |
| UE | User Equipment |
| UL | Uplink |
| UL-MIMO | Up Link Multiple Antenna transmission |
| UMTS | Universal Mobile Telecommunications System |
| UTRA | UMTS Terrestrial Radio Access |
| UTRAN | UMTS Terrestrial Radio Access Network |
| 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, ProSe, Dual Connectivity, UE category 0)

The requirements in clauses 5, 6 and 7 which are specific to CA, UL-MIMO, ProSe, Dual Connectivity and UE category 0 are specified as suffix A, B, C, D, E where;

a) Suffix A additional requirements need to support CA

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

c) Suffix C additional requirements need to support Dual Connectivity

d) Suffix D additional requirements need to support ProSe

e) Suffix E additional requirements need to support UE category 0

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

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

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

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

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

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

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

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

- the UE is associated with PCell on the ProSe carrier, or
- the UE is not associated with PCell on the ProSe carrier and is provisioned with the preconfigured radio parameters for ProSe Direct Communications that are associated with known Geographical Area.

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

## 4.4 RF requirements in later releases

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

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

# 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 $F_{UL\_low}$ – $F_{UL\_high}$ | | | Downlink (DL) operating band BS transmit UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | | | Duplex Mode |
|---|---|---|---|---|---|---|---|
| 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] |
| 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | FDD |
| 31 | 452.5 MHz | – | 457.5 MHz | 462.5 MHz | – | 467.5 MHz | FDD |
| 32 | N/A | | | 1452 MHz | – | 1496 MHz | FDD[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 $F_{UL\_low}$ – $F_{UL\_high}$ | | | Downlink (DL) operating band BS transmit / UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| CA_1 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| CA_2 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| CA_3 | 3 | 1710MHz | – | 1785MHz | 1805MHz | – | 1880MHz | FDD |
| CA_7 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| CA_12 | 12 | 699 MHz | – | 716 MHz | 629 MHz | – | 746 MHz | FDD |
| CA_23 | 23 | 2000 MHz | – | 2020 MHz | 2180 MHz | – | 2200 MHz | FDD |
| CA_27 | 27 | 807 MHz | – | 824 MHz | 852 MHz | – | 869 MHz | FDD |
| CA_38 | 38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |
| CA_39 | 39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 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 |
| CA_42 | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |

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

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit $F_{UL\_low}$ – $F_{UL\_high}$ | | | Downlink (DL) operating band BS transmit / UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| CA_1-3 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| CA_1-5 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_1-7 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| CA_1-8 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| CA_1-11 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 11 | 1427.9 MHz | – | 1447.9 MHz | 1475.9 MHz | – | 1495.9 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_1-20 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 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_1-26 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | |
| CA_1-28 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | |
| CA_1-41 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| CA_1-42 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |
| CA_2-4 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| CA_2-4-4 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| CA_2-5 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_2-2-5 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_2-12 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_2-13 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_2-2-13 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 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_2-30 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 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_3-19 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| CA_3-20 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CA_3-26 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | |
| CA_3-27 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 27 | 807 MHz | – | 824 MHz | 852 MHz | – | 869 MHz | |
| CA_3-28 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | |
| CA_3-42 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |
| CA_4-5 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_4-4-5 | 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_4-4-7 | 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_4-4-12 | 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_4-4-13 | 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_4-27 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 27 | 807 MHz | – | 824 MHz | 852 MHz | – | 869 MHz | |
| CA_4-29 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| CA_4-30 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_5-7 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| CA_5-12 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_5-13 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_5-17 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| CA_5-25 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | |
| CA_5-30 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_7-8 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| CA_7-12 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 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_7-28 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | |
| CA_8-11 | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| | 11 | 1427.9 MHz | – | 1447.9 MHz | 1475.9 MHz | – | 1495.9 MHz | |
| CA_8-20 | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_8-40 | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| | 40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| 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 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CA_12-25 | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | FDD |
| | 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | |
| CA_12-30 | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | FDD |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_18-28 | 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | FDD |
| | 28 | 703 MHz | – | 733 MHz | 758 MHz | – | 788 MHz | |
| CA_19-21 | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | FDD |
| | 21 | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | |
| CA_19-42 | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | FDD |
| | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | TDD |
| CA_20-32 | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| | 32 | N/A | | | 1452 MHz | – | 1496 MHz | |
| CA_23-29 | 23 | 2000 MHz | – | 2020 MHz | 2180 MHz | – | 2200 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| CA_25-41 | 25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| CA_26-41 | 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | FDD |
| | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| CA_29-30 | 29 | N/A | | | 717 MHz | – | 728 MHz | FDD |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_39-41 | 39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | |
| CA_41-42 | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 MHz | |

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

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit $F_{UL\_low}$ – $F_{UL\_high}$ | | | Downlink (DL) operating band BS transmit / UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| CA_1-3-5 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_1-3-8 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| CA_1-3-19 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| CA_1-3-20 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_1-3-26 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| | 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | |
| CA_1-5-7 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| CA_1-7-20 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_1-18-28 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 18 | 815 MHz | – | 830 MHz | 860 MHz | – | 875 MHz | |
| | 28 | 703 MHz | – | 733 MHz [1] | 758 MHz | – | 788 MHz [1] | |
| CA_1-19-21 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| | 21 | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | |
| CA_2-4-5 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| CA_2-4-12 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_2-4-13 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_2-4-29 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| CA_2-5-12 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_2-5-13 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_2-5-30 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_2-12-30 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_2-29-30 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_3-7-20 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| CA_4-5-12 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_4-5-13 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| CA_4-5-30 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_4-7-12 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| CA_4-12-30 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_4-29-30 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 29 | N/A | | | 717 MHz | – | 728 MHz | |
| | 30 | 2305 MHz | – | 2315 MHz | 2350 MHz | – | 2360 MHz | |
| CA_7-8-20 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| NOTE 1: The frequency range in band 28 is restricted for this CA band combination. | | | | | | | | |

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

| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band<br>BS receive / UE transmit | | | Downlink (DL) operating band<br>BS transmit / UE receive | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| | | $F_{UL\_low}$ | – | $F_{UL\_high}$ | $F_{DL\_low}$ | – | $F_{DL\_high}$ | |
| CA_2-2 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| CA_3-3 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| CA_4-4 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| CA_7-7 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| CA_23-23 | 23 | 2000 MHz | – | 2020 MHz | 2180 MHz | – | 2200 MHz | FDD |
| 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 |
| CA_42-42 | 42 | 3400 MHz | – | 3600 MHz | 3400 MHz | – | 3600 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**

# 5.5C Operating bands for Dual Connectivity

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

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

| E-UTRA DC Band | E-UTRA Band | Uplink (UL) operating band BS receive / UE transmit $F_{UL\_low}$ – $F_{UL\_high}$ | | | Downlink (DL) operating band BS transmit / UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | | | Duplex Mode |
|---|---|---|---|---|---|---|---|---|
| DC_1-3 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | |
| DC_1-5 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| DC_1-7 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| DC_1-8 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| DC_1-19 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| DC_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 | |
| DC_2-4 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | |
| DC_2-13 | 2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| DC_3-5 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | |
| DC_3-7 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| DC_3-8 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | |
| DC_3-19 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | |
| DC_3-20 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| DC_3-26 | 3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| | 26 | 814 MHz | – | 849 MHz | 859 MHz | – | 894 MHz | |
| DC_4-7 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| DC_4-12 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| DC_4-13 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 13 | 777 MHz | – | 787 MHz | 746 MHz | – | 756 MHz | |
| DC_4-17 | 4 | 1710 MHz | – | 1755 MHz | 2110 MHz | – | 2155 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| DC_5-7 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | |
| DC_5-12 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 12 | 699 MHz | – | 716 MHz | 729 MHz | – | 746 MHz | |
| DC_5-17 | 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| | 17 | 704 MHz | – | 716 MHz | 734 MHz | – | 746 MHz | |
| DC_7-20 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | |
| DC_7-28 | 7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| | 28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | |
| DC_19-21 | 19 | 830 MHz | – | 845 MHz | 875 MHz | – | 890 MHz | FDD |
| | 21 | 1447.9 MHz | – | 1462.9 MHz | 1495.9 MHz | – | 1510.9 MHz | |
| DC_39-41 | 39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| | 41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | |
| NOTE 1: The DC configurations will follow corresponding CA configurations as defined in Table 5.6A.1-2. | | | | | | | | |

# 5.5D Operating bands for ProSe

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

**Table 5.5D-1 E-UTRA ProSe operating band**

| E-UTRA ProSe Band | E-UTRA Operating Band | ProSe UE transmit $F_{UL\_low}$ – $F_{UL\_high}$ | ProSe UE receive $F_{DL\_low}$ – $F_{DL\_high}$ | ProSe Duplex Mode | ProSe Direct Disc. | ProSe Direct Comm. |
|---|---|---|---|---|---|---|
| 2 | 2 | 1850 MHz – 1910 MHz | 1850 MHz – 1910 MHz | HD | Yes | |
| 3 | 3 | 1710 MHz – 1785 MHz | 1710 MHz – 1785 MHz | HD | Yes | Yes |
| 4 | 4 | 1710 MHz – 1755 MHz | 1710 MHz – 1755 MHz | HD | Yes | |
| 7 | 7 | 2500 MHz – 2570 MHz | 2500 MHz – 2570 MHz | HD | Yes | Yes |
| 14 | 14 | 788 MHz – 798 MHz | 788 MHz – 798 MHz | HD | Yes | Yes |
| 20 | 20 | 832 MHz – 862 MHz | 832 MHz – 862 MHz | HD | Yes | Yes |
| 26 | 26 | 814 MHz – 849 MHz | 814 MHz – 849 MHz | HD | Yes | Yes |
| 28 | 28 | 703 MHz – 748 MHz | 703 MHz – 748 MHz | HD | Yes | Yes |
| 31 | 31 | 452.5 MHz – 457.5 MHz | 452.5 MHz – 457.5 MHz | HD | Yes | Yes |
| 41 | 41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | HD | Yes | |

# 5.5E Operating bands for UE category 0

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

# 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.

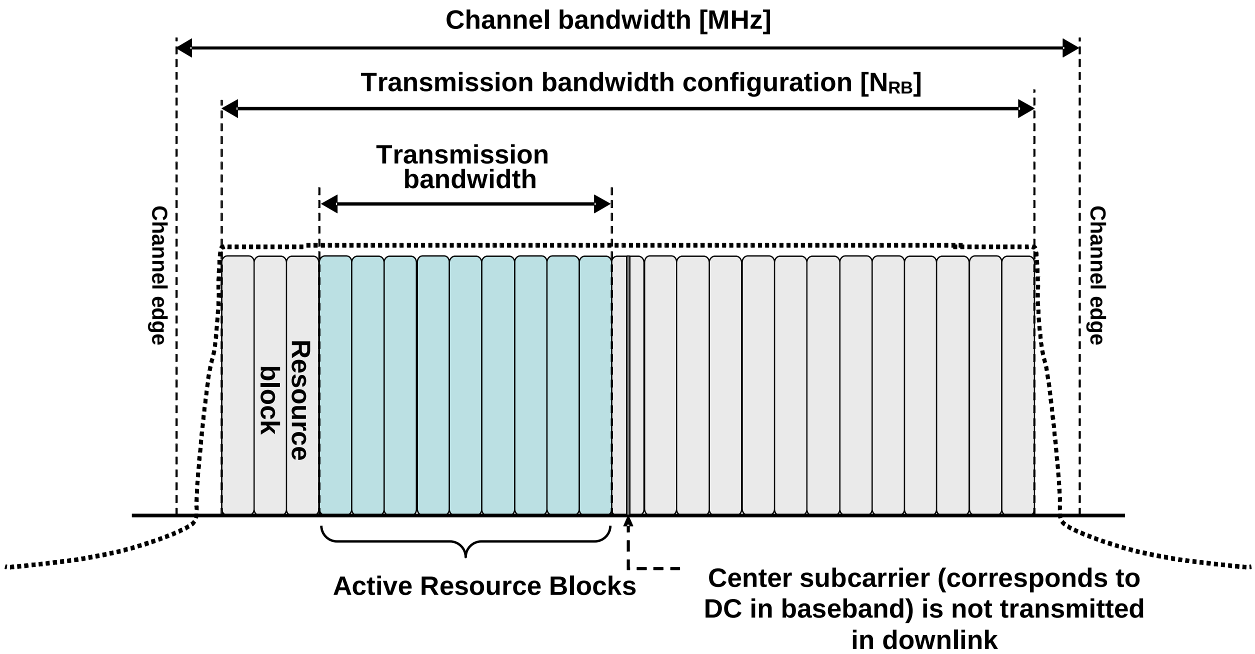


**Figure 5.6-1: Definition of channel bandwidth and transmission bandwidth configuration for one E-UTRA carrier**

## 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] |
| 30 | | | Yes | Yes[1] | | |
| 31 | Yes | Yes[1] | Yes[1] | | | |
| ... | | | | | | |
| 33 | | | Yes | Yes | Yes | Yes |
| 34 | | | Yes | Yes | Yes | |
| 35 | Yes | Yes | Yes | Yes | Yes | Yes |
| 36 | Yes | Yes | Yes | Yes | Yes | Yes |
| 37 | | | Yes | Yes | Yes | Yes |
| 38 | | | Yes | Yes | Yes[3] | Yes[3] |
| 39 | | | Yes | Yes | Yes[3] | Yes[3] |
| 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.<br>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<br>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.

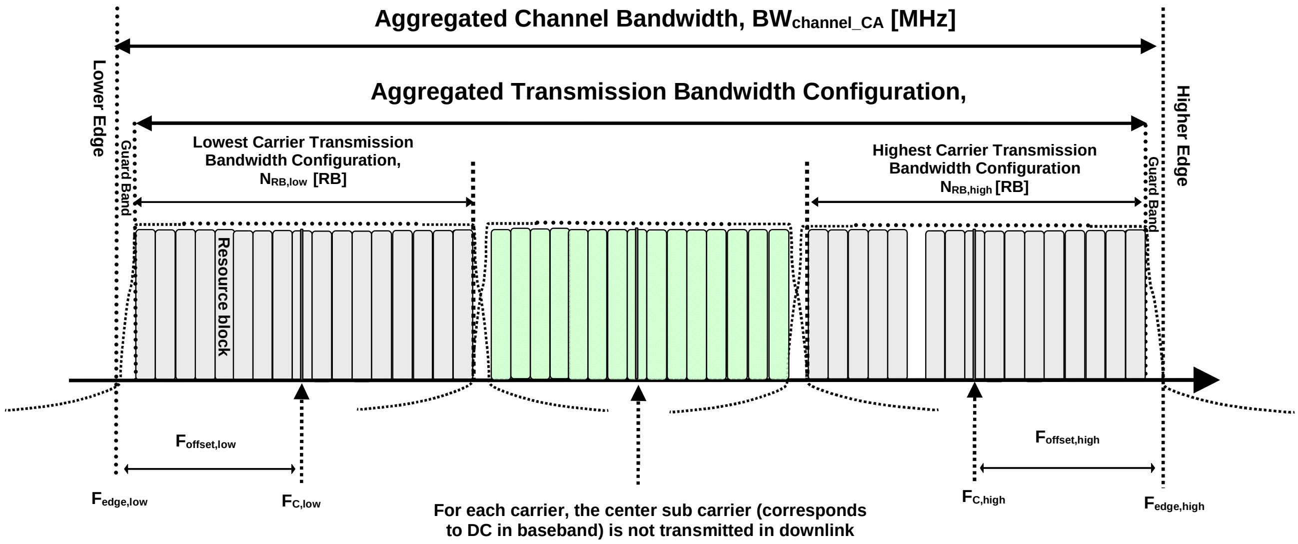


**Figure 5.6A-1. Definition of Aggregated channel bandwidth and aggregated channel bandwidth edges**

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.

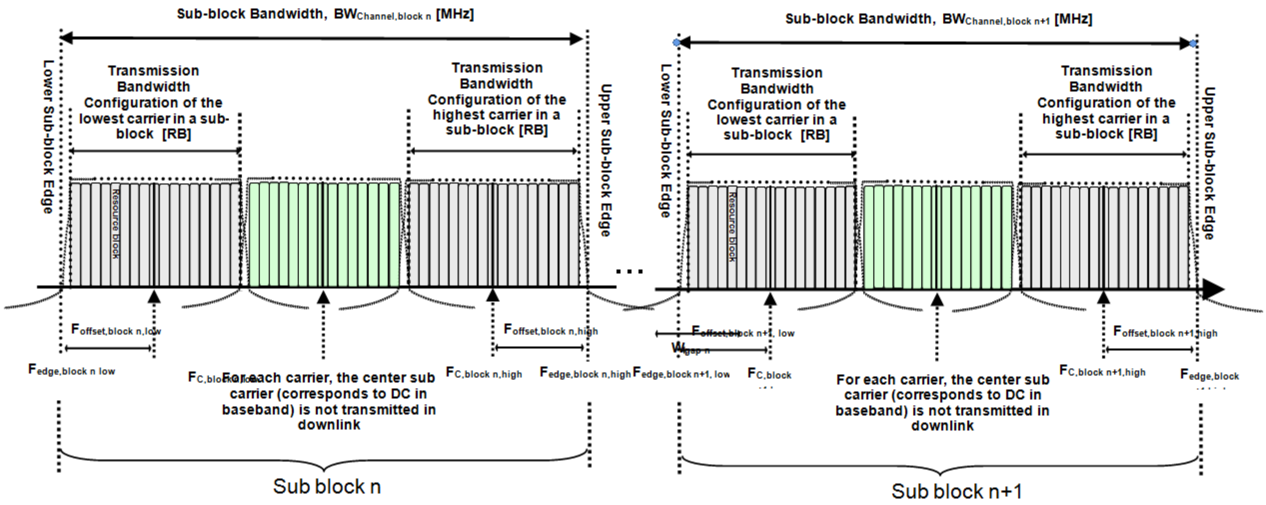


**Figure 5.6A-2. Non-contiguous intraband CA terms and definitions**

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:

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

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

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

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

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

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

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

| CA Bandwidth Class | Aggregated Transmission Bandwidth Configuration | Number of contiguous CC | Nominal Guard Band $BW_{GB}$ |
|---|---|---|---|
| A | $N_{RB,agg} \le 100$ | 1 | $a_1\ BW_{Channel(1)} - 0.5\Delta f_1$ (NOTE 2) |
| B | $25 < N_{RB,agg} \le 100$ | 2 | $0.05\ max(BW_{Channel(1)},BW_{Channel(2)}) - 0.5\Delta f_1$ |
| 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 | $0.05\ max(BW_{Channel(1)},BW_{Channel(2)}, BW_{Channel(3)}) - 0.5\Delta f_1$ |
| E | $300 < N_{RB,agg} \le 400$ | 4 | NOTE 3 |
| F | $400 < N_{RB,agg} \le 500$ | 5 | NOTE 3 |
| NOTE 1: $BW_{Channel(j)}$, j = 1, 2, 3, is the channel bandwidth of an E-UTRA component carrier according to Table 5.6-1 and $\Delta f_1 = \Delta f$ for the downlink with $\Delta f$ the subcarrier spacing while $\Delta f_1 = 0$ for the uplink.<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 and Table 5.6A.1-2a. Requirements for intra-band non-contiguous carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-3.

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

**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] | Channel bandwidths for carrier [MHz] | | |
| CA_1C | CA_1C | 15 | 15 | | 40 | 0 |
| | | 20 | 20 | | | |
| CA_2C | | 5 | 20 | | 40 | 0 |
| | | 10 | 15, 20 | | | |
| | | 15 | 10, 15, 20 | | | |
| | | 20 | 5, 10, 15, 20 | | | |
| CA_3C | CA_3C | 5, 10, 15 | 20 | | 40 | 0 |
| | | 20 | 5, 10, 15, 20 | | | |
| CA_7C | CA_7C | 15 | 15 | | 40 | 0 |
| | | 20 | 20 | | | |
| | | 10 | 20 | | 40 | 1 |
| | | 15 | 15, 20 | | | |
| | | 20 | 10, 15, 20 | | | |
| CA_12B | - | 5 | 5, 10 | | 15 | 0 |
| CA_23B | - | 10 | 10 | | 20 | 0 |
| | | 5 | 15 | | | |
| CA_27B | - | 1.4, 3, 5 | 5 | | 13 | 0 |
| | | 1.4, 3 | 10 | | | |
| | | | | | | |
| CA_38C | CA_38C | 15 | 15 | | 40 | 0 |
| | | 20 | 20 | | | |
| CA_39C | CA_39C | 5,10,15 | 20 | | 35 | 0 |
| | | 20 | 5, 10, 15 | | | |
| CA_40C | CA_40C | 10 | 20 | | 40 | 0 |
| | | 15 | 15 | | | |
| | | 20 | 10, 20 | | | |
| | | 10, 15 | 20 | | 40 | 1 |
| | | 15 | 15 | | | |
| | | 20 | 10, 15, 20 | | | |
| CA_40D | CA_40C | 10, 15, 20 | 20 | 20 | 60 | 0 |
| | | 20 | 10, 15 | 20 | | |
| | | 20 | 20 | 10, 15 | | |
| CA_41C | CA_41C | 10 | 20 | | 40 | 0 |
| | | 15 | 15, 20 | | | |
| | | 20 | 10, 15, 20 | | | |
| | | 5, 10 | 20 | | 40 | 1 |
| | | 15 | 15, 20 | | | |
| | | 20 | 5, 10, 15, 20 | | | |
| | | 10 | 15, 20 | | 40 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 15 | 10, 15, 20 | | | |
| | | 20 | 10, 15, 20 | | | |
| CA_41D | CA_41C | 10 | 20 | 15 | 60 | 0 |
| | | 10 | 15, 20 | 20 | | |
| | | 15 | 20 | 10, 15 | | |
| | | 15 | 10, 15, 20 | 20 | | |
| | | 20 | 15, 20 | 10 | | |
| | | 20 | 10, 15, 20 | 15, 20 | | |
| CA_42C | CA_42C | 5, 10, 15, 20 | 20 | | 40 | 0 |
| | | 20 | 5, 10, 15 | | | |

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.
NOTE 2: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.
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 (two bands)**

| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **E-UTRA CA Configuration** | **Uplink CA configurations (NOTE 4)** | **E-UTRA Bands** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Maximum aggregated bandwidth [MHz]** | **Bandwidth combination set** |
| CA_1A-3A | CA_1A-3A | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| CA_1A-5A | CA_1A-5A | 1 | | | | Yes | | | 20 | 0 |
| | | 5 | | | | Yes | | | | |
| | | 1 | | | Yes | Yes | Yes | Yes | 30 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| CA_1A-7A | CA_1A-7A | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| CA_1A-8A | CA_1A-8A | 1 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 8 | | | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | | | 20 | 1 |
| | | 8 | | | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 8 | | Yes | Yes | Yes | | | | |
| CA_1A-11A | - | 1 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 11 | | | Yes | Yes | | | | |
| CA_1A-18A | - | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 18 | | | Yes | Yes | Yes | | | |
| | | 1 | | | Yes | Yes | | | 20 | 1 |
| | | 18 | | | Yes | Yes | | | | |
| CA_1A-19A | CA_1A-19A | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 19 | | | Yes | Yes | Yes | | | |
| CA_1A-20A | - | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 20 | | | Yes | Yes | Yes | Yes | | |
| CA_1A-21A | CA_1A-21A | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 21 | | | Yes | Yes | Yes | | | |
| CA_1A-26A | - | 1 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 26 | | | Yes | Yes | Yes | | | |
| | | 1 | | | Yes | Yes | | | 20 | 1 |
| | | 26 | | | Yes | Yes | | | | |
| CA_1A-28A | - | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 28[5] | | | Yes | Yes | Yes | Yes | | |
| | | 1 | | | Yes | Yes | | | 20 | 1 |
| | | 28[5] | | | Yes | Yes | | | | |
| CA_1A-41A[5] | - | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 41 | | | Yes | Yes | Yes | Yes | | |
| CA_1A-41C[5] | - | 1 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | | | | | | |
| CA_1A-42A | - | 1 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 42 | | | Yes | Yes | Yes | Yes | | |
| CA_1A-42C | - | 1 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | |
| CA_2A-4A | CA_2A-4A | 2 | Yes | Yes | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| | | 2 | | | Yes | Yes | | | 20 | 1 |
| | | 4 | | | Yes | Yes | | | | |
| | | 2 | | | Yes | Yes | Yes | Yes | 40 | 2 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| CA_2A-4A-4A | - | 2 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 4 | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | | |
| CA_2A-5A | - | 2 | | | Yes | Yes | Yes | Yes | 30 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | | | Yes | Yes | | | | |
| | | 2 | | | Yes | Yes | | | 20 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| CA_2A-2A-5A | - | 2 | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| CA_2A-12A | - | 2 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| | | 2 | | | Yes | Yes | Yes | Yes | 30 | 1 |
| | | 12 | | Yes | Yes | Yes | | | | |
| CA_2A-12B | - | 2 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 12 | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | |
| CA_2A-13A | CA_2A-13A | 2 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 13 | | | | Yes | | | | |
| | | 2 | | | Yes | Yes | | | 20 | 1 |
| | | 13 | | | | Yes | | | | |
| CA_2A-2A-13A | - | 2 | See CA_2A-2A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| | | 13 | | | | Yes | | | | |
| CA_2A-17A | - | 2 | | | Yes | Yes | | | 20 | 0 |
| | | 17 | | | Yes | Yes | | | | |
| CA_2A-29A | - | 2 | | | Yes | Yes | | | 20 | 0 |
| | | 29 | | Yes | Yes | Yes | | | | |
| | | 2 | | | Yes | Yes | | | 20 | 1 |
| | | 29 | | | Yes | Yes | | | | |
| | | 2 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 29 | | | Yes | Yes | | | | |
| CA_2C-29A | - | 2 | See CA_2C Bandwidth Combination Set 0 in table 5.6A.1-1 | | | | | | 50 | 0 |
| | | 29 | | | Yes | Yes | | | | |
| CA_2A-30A | - | 2 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 30 | | | Yes | Yes | | | | |
| CA_3A-5A | CA_3A-5A | 3 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 3 | | | | Yes | | | 20 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| | | 3 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 5 | | | Yes | Yes | | | | |
| CA_3A-7A | CA_3A-7A | 3 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| CA_3A-7C | - | 3 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 7 | See CA_7C Bandwidth combination set 1 in table 5.6A.1-1 | | | | | | | |
| CA_3C-7A | - | 3 | See CA_3C Bandwidth Combination Set 0 in table 5.6A.1-1 | | | | | | 60 | 0 |
| | | 7 | | | Yes | Yes | Yes | Yes | | |
| CA_3A-8A | CA_3A-8A | 3 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 8 | | | Yes | Yes | | | | |
| | | 3 | | | | Yes | | | 20 | 1 |
| | | 8 | | | Yes | Yes | | | | |
| | | 3 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 8 | | Yes | Yes | Yes | | | | |
| CA_3A-19A | CA_3A-19A | 3 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 19 | | | Yes | Yes | Yes | | | |
| CA_3A-20A | CA_3A-20A | 3 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| | | 3 | | | Yes | Yes | Yes | Yes | 40 | 1 |
| | | 20 | | | Yes | Yes | Yes | Yes | | |
| CA_3A-26A | CA_3A-26A | 3 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 26 | | | Yes | Yes | Yes | | | |
| | | 3 | | | Yes | Yes | | | 20 | 1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 26 | | | Yes | Yes | | | | |
| CA_3A-27A | - | 3 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 27 | | | Yes | Yes | | | | |
| CA_3A-28A | - | 3 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 28 | | | Yes | Yes | Yes | Yes | | |
| CA_3A-42A | - | 3[5] | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 42 | | | Yes | Yes | Yes | Yes | | |
| CA_3A-42C | - | 3[3] | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 42 | See Table 5.6A.1-1 | | | | | | | |
| CA_4A-5A | - | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | Yes | Yes | 30 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| CA_4A-4A-5A | - | 4 | See CA_4A-4A Bandwidth Combination Set 0 in table 5.6A.1-3 | | | | | | 50 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| CA_4A-7A | CA_4A-7A | 4 | | | Yes | Yes | | | 30 | 0 |
| | | 7 | | | Yes | Yes | Yes | Yes | | |
| CA_4A-4A-7A | - | 4 | | | Yes | Yes | | | 40 | 0 |
| | | 4 | | | Yes | Yes | | | | |
| | | 7 | | | Yes | Yes | Yes | Yes | | |
| CA_4A-12A | CA_4A-12A | 4 | Yes | Yes | Yes | Yes | | | 20 | 0 |
| | | 12[5] | | | Yes | Yes | | | | |
| | | 4 | Yes | Yes | Yes | Yes | Yes | Yes | 30 | 1 |
| | | 12[5] | | | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 12[5] | | Yes | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | | | 20 | 3 |
| | | 12[5] | | | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | Yes | Yes | 30 | 4 |
| | | 12[5] | | | Yes | Yes | | | | |
| CA_4A-4A-12A | - | 4 | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| | | 12[5] | | | Yes | Yes | | | | |
| CA_4A-12B | - | 4 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 12[5] | See CA_12B Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | |
| CA_4A-13A | CA_4A-13A | 4 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 13 | | | | Yes | | | | |
| | | 4 | | | Yes | Yes | | | 20 | 1 |
| | | 13 | | | | Yes | | | | |
| CA_4A-4A-13A | - | 4 | See CA_4A-4A Bandwidth Combination Set 0 in Table 5.6A.1-3 | | | | | | 50 | 0 |
| | | 13 | | | | Yes | | | | |
| CA_4A-17A | CA_4A-17A | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 17[5] | | | Yes | Yes | | | | |
| CA_4A-27A | - | 4 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 27 | | Yes | Yes | Yes | | | | |
| CA_4A-29A | - | 4 | | | Yes | Yes | | | 20 | 0 |
| | | 29 | | Yes | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | | | 20 | 1 |
| | | 29 | | | Yes | Yes | | | | |
| | | 4 | | | Yes | Yes | Yes | Yes | 30 | 2 |
| | | 29 | | | Yes | Yes | | | | |
| CA_4A-30A | - | 4 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 30 | | | Yes | Yes | | | | |
| CA_5A-7A | CA_5A-7A | 5 | Yes | Yes | Yes | Yes | | | 30 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| CA_5A-12A | CA_5A-12A | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| CA_5A-13A | - | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 13 | | | | Yes | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CA_5A-17A | CA_5A-17A | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 17 | | | Yes | Yes | | | | |
| CA_5A-25A | - | 5 | | | Yes | Yes | | | 30 | 0 |
| | | 25 | | | Yes | Yes | Yes | Yes | | |
| CA_5A-30A | - | 5 | | | Yes | Yes | | | 20 | 0 |
| | | 30 | | | Yes | Yes | | | | |
| CA_7A-8A | - | 7 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 8[5] | | Yes | Yes | Yes | | | | |
| CA_7A-12A | - | 7 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| CA_7A-20A | CA_7A-20A | 7 | | | | Yes | Yes | Yes | 30 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| | | 7 | | | | Yes | Yes | Yes | 40 | 1 |
| | | 20 | | | Yes | Yes | Yes | Yes | | |
| CA_7A-28A | CA_7A-28A | 7 | | | Yes | Yes | Yes | Yes | 35 | 0 |
| | | 28 | | | Yes | Yes | Yes | | | |
| CA_8A-11A | - | 8 | | | Yes | Yes | | | 20 | 0 |
| | | 11 | | | Yes | Yes | | | | |
| CA_8A-20A | - | 8 | | | Yes | Yes | | | 20 | 0 |
| | | 20 | | | Yes | Yes | | | | |
| | | 8 | | Yes | Yes | Yes | | | 20 | 1 |
| | | 20 | | | Yes | Yes | | | | |
| CA_8A-40A | - | 8 | | | Yes | Yes | | | 30 | 0 |
| | | 40 | | | Yes | Yes | Yes | Yes | | |
| CA_11A-18A | - | 11 | | | Yes | Yes | | | 25 | 0 |
| | | 18 | | | Yes | Yes | Yes | | | |
| CA_12A-25A | - | 12 | | | Yes | Yes | | | 30 | 0 |
| | | 25 | | | Yes | Yes | Yes | Yes | | |
| CA_12A-30A | - | 12 | | | Yes | Yes | | | 20 | 0 |
| | | 30 | | | Yes | Yes | | | | |
| CA_18A-28A | - | 18 | | | Yes | Yes | Yes | | 25 | 0 |
| | | 28 | | | Yes | Yes | | | | |
| CA_19A-21A | CA_19A-21A | 19 | | | Yes | Yes | Yes | | 30 | 0 |
| | | 21 | | | Yes | Yes | Yes | | | |
| CA_19A-42A | - | 19 | | | Yes | Yes | Yes | | 35 | 0 |
| | | 42 | | | Yes | Yes | Yes | Yes | | |
| CA_19A-42C | - | 19 | | | Yes | Yes | Yes | | 55 | 0 |
| | | 42 | See CA_42C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | | |
| CA_20A-32A | - | 20 | | | Yes | Yes | | | 30 | 0 |
| | | 32 | | | Yes | Yes | Yes | Yes | | |
| CA_23A-29A | - | 23 | | | Yes | Yes | Yes | Yes | 30 | 0 |
| | | 29 | | Yes | Yes | Yes | | | | |
| | | 23 | | | Yes | Yes | | | 20 | 1 |
| | | 29 | | Yes | Yes | Yes | | | | |
| CA_25A-41A[5] | - | 25 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 41 | | | Yes | Yes | Yes | Yes | | |
| CA_25A-41C[5] | - | 25 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | | | | | | |
| CA_26A-41A | - | 26 | | | Yes | Yes | Yes | | 35 | 0 |
| | | 41 | | | Yes | Yes | Yes | Yes | | |
| CA_26A-41C | - | 26 | | | Yes | Yes | Yes | | 55 | 0 |
| | | 41 | See CA_41C Bandwidth Combination Set 1 in Table 5.6.A.1-1 | | | | | | | |
| CA_29A-30A | - | 29 | | | Yes | Yes | | | 20 | 0 |
| | | 30 | | | Yes | Yes | | | | |
| CA_39A-41A | CA_39A-41A | 39 | | | | Yes | Yes | Yes | 40 | 0 |
| | | 41 | | | | | | Yes | | |
| CA_39A-41C | - | 39 | | | | Yes | Yes | Yes | 60 | 0 |
| | | 41 | | | | | | Yes | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 41 | | | | | | Yes | | |
| CA_39C-41A | - | 39 | See CA_39C Bandwidth Combination Set 0 in Table 5.6A.1-1 | | | | | | 55 | 0 |
| | | 41 | | | | | | Yes | | |
| CA_41A-42A | - | 41 | | | | Yes | Yes | Yes | 40 | 0 |
| | | 42 | | | | 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.1-2a: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (three bands)**

| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **E-UTRA CA Configuration** | **Uplink CA configurations (NOTE 5)** | **E-UTRA Bands** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Maximum aggregated bandwidth [MHz]** | **Bandwidth combination set** |
| CA_1A-3A-5A | - | 1 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 5 | | | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | | | 40 | 1 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 5 | | | Yes | Yes | | | | |
| CA_1A-3A-8A | - | 1 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 8 | | Yes | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | | | 40 | 1 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 8 | | Yes | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | Yes | | 40 | 2 |
| | | 3 | | | Yes | Yes | Yes | | | |
| | | 8 | | Yes | Yes | Yes | | | | |
| CA_1A-3A-19A | - | 1 | | | Yes | Yes | Yes | Yes | 55 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 19 | | | Yes | Yes | Yes | | | |
| CA_1A-3A-26A | - | 1 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 26 | | | Yes | Yes | | | | |
| CA_1A-3A-20A | - | 1 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 3 | | | Yes | Yes | Yes | Yes | | |
| | | 20 | | | Yes | Yes | Yes | Yes | | |
| CA_1A-5A-7A | - | 1 | | | Yes | Yes | | | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 7 | | | | Yes | Yes | Yes | | |
| | | 1 | | | Yes | Yes | Yes | Yes | 50 | 1 |
| | | 5 | | | Yes | Yes | | | | |
| | | 7 | | | | Yes | Yes | Yes | | |
| CA_1A-7A-20A | - | 1 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| | | 20 | | | Yes | Yes | | | | |
| CA_1A-18A-28A | - | 1 | | | Yes | Yes | Yes | Yes | 45 | 0 |
| | | 18 | | | Yes | Yes | Yes | | | |
| | | 28 | | | Yes | Yes | | | | |
| | | 1 | | | Yes | Yes | Yes | Yes | 40 | 1 |
| | | 18 | | | Yes | Yes | | | | |
| | | 28 | | | Yes | Yes | | | | |
| CA_1A-19A-21A | - | 1 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 19 | | | Yes | Yes | Yes | | | |
| | | 21 | | | Yes | Yes | Yes | | | |
| CA_2A-4A-5A | - | 2 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| | | 5 | | | Yes | Yes | | | | |
| CA_2A-4A-12A | - | 2 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| | | 12 | | | Yes | Yes | | | | |
| CA_2A-4A-13A | - | 2 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| | | 13 | | | | Yes | | | | |
| CA_2A-4A-29A | - | 2 | | | Yes | Yes | Yes | Yes | 50 | 0 |
| | | 4 | | | Yes | Yes | Yes | Yes | | |
| | | 29 | | | Yes | Yes | | | | |
| CA_2A-5A-12A | - | 2 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 12 | | | Yes | Yes | | | | |
| CA_2A-5A-13A | - | 2 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 13 | | | | Yes | | | | |
| CA_2A-5A-30A | - | 2 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_2A-12A-30A | - | 2 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_2A-29A-30A | - | 2 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 29 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_3A-7A-20A | - | 3 | | | Yes | Yes | Yes | Yes | 60 | 0 |
| | | 7 | | | | Yes | Yes | Yes | | |
| | | 20 | | | Yes | Yes | Yes | Yes | | |
| CA_4A-5A-12A | - | 4 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 12 | | | Yes | Yes | | | | |
| CA_4A-5A-13A | - | 4 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 13 | | | | Yes | | | | |
| CA_4A-5A-30A | - | 4 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 5 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_4A-7A-12A | - | 4 | | | Yes | Yes | | | 40 | 0 |
| | | 7 | | | Yes | Yes | Yes | Yes | | |
| | | 12[6] | | | Yes | Yes | | | | |
| CA_4A-12A-30A | - | 4 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 12 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_4A-29A-30A | - | 4 | | | Yes | Yes | Yes | Yes | 40 | 0 |
| | | 29 | | | Yes | Yes | | | | |
| | | 30 | | | Yes | Yes | | | | |
| CA_7A-8A-20A | - | 7 | | | | Yes | Yes | Yes | 40 | 0 |
| | | 8[6] | | Yes | Yes | Yes | | | | |
| | | 20 | | | Yes | Yes | | | | |

NOTE 1: The CA Configuration refers to a combination of an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.
NOTE 2: For each band combination, all combinations of indicated bandwidths belong to the set.
NOTE 3: For the supported CC bandwidth combinations, the CC downlink and uplink bandwidths are equal.
NOTE 4: A terminal which supports a DL CA configuration shall support all the lower order fallback DL CA combinations and it shall support at least one bandwidth combination set for each of the constituent lower order DL combinations containing all the bandwidths specified within each specific combination set of the upper order DL combination.
NOTE 5: Uplink CA configurations are the configurations supported by the present release of specifications.
NOTE 6: 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 (with two sub-blocks)**

| E-UTRA CA configuration / Bandwidth combination set | | | | | | |
|---|---|---|---|---|---|---|
| E-UTRACA 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] | Channel bandwidths for carrier [MHz] | | |
| CA_2A-2A | - | 5, 10, 15, 20 | 5, 10, 15, 20 | | 40 | 0 |
| CA_3A-3A | - | 5, 10, 15, 20 | 5, 10, 15, 20 | | 40 | 0 |
| CA_4A-4A | CA_4A-4A | 5, 10, 15, 20 | 5, 10, 15, 20 | | 40 | 0 |
| CA_7A-7A | - | 5 | 15 | | 40 | 0 |
| | | 10 | 10, 15 | | | |
| | | 15 | 15, 20 | | | |
| | | 20 | 20 | | | |
| CA_23A-23A | - | 5 | 10 | | 15 | 0 |
| CA_25A-25A | - | 5, 10 | 5, 10 | | 20 | 0 |
| | | 5, 10, 15, 20 | 5, 10, 15, 20 | | 40 | 1 |
| CA_41A-41A | - | 10, 15, 20 | 10, 15, 20 | | 40 | 0 |
| | | 5, 10, 15, 20 | 5, 10, 15, 20 | | 40 | 1 |
| CA_41A-41C | - | 5, 10, 15, 20 | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | 60 | 0 |
| | | See CA_41C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | 5, 10, 15, 20 | | |
| CA_42A-42A | - | 5, 10, 15, 20 | 5, 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

# 5.6C Channel bandwidth for Dual Connectivity

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

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

NOTE 2: For TDD inter-band dual connectivity configurations, requirements are applicable only for synchronous operation.5.6C.1 Void

# 5.6D Channel bandwidth for ProSe

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

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

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

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

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

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

# 5.7 Channel arrangement

## 5.7.1 Channel spacing

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

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

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

### 5.7.1A Channel spacing for CA

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

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

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 | | |
| 30 | 2350 | 9770 | 9770 – 9869 | 2305 | 27660 | 27660 – 27759 |
| 31 | 462.5 | 9870 | 9870 – 9919 | 452.5 | 27760 | 27760 – 27809 |
| …32[2] | 1452 | 9920 | 9920 – 10359 | N/A | | |
| 33 | 1900 | 36000 | 36000 – 36199 | 1900 | 36000 | 36000 – 36199 |
| 34 | 2010 | 36200 | 36200 – 36349 | 2010 | 36200 | 36200 – 36349 |
| 35 | 1850 | 36350 | 36350 – 36949 | 1850 | 36350 | 36350 – 36949 |
| 36 | 1930 | 36950 | 36950 – 37549 | 1930 | 36950 | 36950 – 37549 |
| 37 | 1910 | 37550 | 37550 – 37749 | 1910 | 37550 | 37550 – 37749 |
| 38 | 2570 | 37750 | 37750 – 38249 | 2570 | 37750 | 37750 – 38249 |
| 39 | 1880 | 38250 | 38250 – 38649 | 1880 | 38250 | 38250 – 38649 |
| 40 | 2300 | 38650 | 38650 – 39649 | 2300 | 38650 | 38650 – 39649 |
| 41 | 2496 | 39650 | 39650 –41589 | 2496 | 39650 | 39650 –41589 |
| 42 | 3400 | 41590 | 41590 – 43589 | 3400 | 41590 | 41590 – 43589 |
| 43 | 3600 | 43590 | 43590 – 45589 | 3600 | 43590 | 43590 – 45589 |
| 44 | 703 | 45590 | 45590 – 46589 | 703 | 45590 | 45590 – 46589 |

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

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

NOTE 3: For ProSe the corresponding UL channel number are also specified for the DL for the associated ProSe operating bands i.e. $ProSe\_F_{UL} = F_{UL}$ and $ProSe\_F_{DL} = F_{UL}$.

## 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 |
| 30 | 45 MHz |
| 31 | 10 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 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 | | |
| 30 | | | | | 23 | ±2 | | |
| 31 | | | | | 23 | ±2 | | |
| … | | | | | | | | |
| 33 | | | | | 23 | ±2 | | |
| 34 | | | | | 23 | ±2 | | |
| 35 | | | | | 23 | ±2 | | |
| 36 | | | | | 23 | ±2 | | |
| 37 | | | | | 23 | ±2 | | |
| 38 | | | | | 23 | ±2 | | |
| 39 | | | | | 23 | ±2 | | |
| 40 | | | | | 23 | ±2 | | |
| 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, UE maximum output power shall be measured over all component carriers from different bands. If each band has separate antenna connectors, maximum output power is measured as the sum of maximum output power at each UE antenna connector. The maximum output power is specified in Table 6.2.2A-0.

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

| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|
| CA_1A-3A | | | | | 23 | +2/-3[2] | | |
| CA_1A-5A | | | | | 23 | +2/-3 | | |
| CA_1A-7A | | | | | 23 | +2/-3[2] | | |
| CA_1A-8A | | | | | 23 | +2/-3[2] | | |
| CA_1A-19A | | | | | 23 | +2/-3 | | |
| CA_1A-21A | | | | | 23 | +2/-3 | | |
| CA_2A-4A | | | | | 23 | +2/-3[2] | | |
| CA_2A-13A | | | | | 23 | +2/-3[2] | | |
| CA_3A-5A | | | | | 23 | +2/-3[2] | | |
| CA_3A-7A | | | | | 23 | +2/-3[2] | | |
| CA_3A-8A | | | | | 23 | +2/-3[2] | | |
| CA_3A-19A | | | | | 23 | +2/-3[2] | | |
| CA_3A-20A | | | | | 23 | +2/-3[2] | | |
| CA_3A-26A | | | | | 23 | +2/-3[2] | | |
| CA_4A-7A | | | | | 23 | +2/-3[2] | | |
| CA_4A-12A | | | | | 23 | +2/-3[2] | | |
| CA_4A-13A | | | | | 23 | +2/-3 | | |
| CA_4A-17A | | | | | 23 | +2/-3 | | |
| CA_5A-7A | | | | | 23 | +2/-3[2] | | |
| CA_5A-12A | | | | | 23 | +2/-3[2] | | |
| CA_5A-17A | | | | | 23 | +2/-3 | | |
| CA_7A-20A | | | | | 23 | +2/-3[2] | | |
| CA_7A-28A | | | | | 23 | +2/-3[2] | | |
| CA_19A-21A | | | | | 23 | +2/-3 | | |
| CA 39A-41A | | | | | 23 | +2/-3[2] | | |

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: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance
NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).

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 for intraband contiguous CA**

| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|
| CA_1C | | | | | 23 | +2/-2 | | |
| CA_3C | | | | | 23 | +2/-2[2] | | |
| CA_7C | | | | | 23 | +2/-2[2] | | |
| CA_38C | | | | | 23 | +2/-2 | | |
| CA_39C | | | | | 23 | +2/-2 | | |
| CA_40C | | | | | 23 | +2/-2 | | |
| CA_41C | | | | | 23 | +2/-2[2] | | |
| CA_42C | | | | | 23 | +2/-3 | | |

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

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

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

| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|
| CA_4A-4A | | | | | 23 | +2/-2 | | |

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

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

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2.2B-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least 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] | | |
| 30 | | | | | 23 | +2/-3 | | |
| 31 | | | | | 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
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

**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

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

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

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-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) |
|---|---|---|---|---|---|---|
| | 25 RB + 100 RB | 50 RB + 100 RB | 75 RB + 75 RB | 75 RB + 100 RB | 100 RB + 100 RB | |
| QPSK | > 8 and ≤ 25 | > 12 and ≤ 50 | > 16 and ≤ 75 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 1 |
| QPSK | > 25 | > 50 | > 75 | > 75 | > 100 | ≤ 2 |
| 16 QAM | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 16 | ≤ 18 | ≤ 1 |
| 16 QAM | > 8 and ≤ 25 | > 12 and ≤ 50 | > 16 and ≤ 75 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 2 |
| 16 QAM | > 25 | > 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

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

Where $M_A$ is defined as follows

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

and $M_{IM5}$ is defined as follows

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

Where

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

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

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

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

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

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

where $M_N$ is defined as follows

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

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

For intra-band carrier aggregation, the MPR is evaluated per 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.

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

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

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

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

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

For UE Power Class 1 and 3, this subclause specifies the allowed Maximum Power Reduction (MPR) power for ProSe physical channels and signals due to higher order modulation and transmit bandwidth configuration (resource blocks).

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

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

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

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

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

## 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)**

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Channel bandwidth (MHz) | Resources Blocks ($N_{RB}$) | A-MPR (dB) |
|---|---|---|---|---|---|
| NS_01 | 6.6.2.1.1 | Table 5.5-1 | 1.4, 3, 5, 10, 15, 20 | Table 5.6-1 | N/A |
| NS_03 | 6.6.2.2.1 | 2, 4,10, 23, 25, 35, 36 | 3 | >5 | ≤ 1 |
| | | | 5 | >6 | ≤ 1 |
| | | | 10 | >6 | ≤ 1 |
| | | | 15 | >8 | ≤ 1 |
| | | | 20 | >10 | ≤ 1 |
| NS_04 | 6.6.2.2.2, 6.6.3.3.19 | 41 | 5, 10, 15, 20 | Table 6.2.4-4 | |
| NS_05 | 6.6.3.3.1 | 1 | 10,15,20 | ≥ 50 | ≤ 1 (NOTE1) |
| | | | 15, 20 | Table 6.2.4-18 (NOTE2) | |
| NS_06 | 6.6.2.2.3 | 12, 13, 14, 17 | 1.4, 3, 5, 10 | Table 5.6-1 | N/A |
| NS_07 | 6.6.2.2.3 6.6.3.3.2 | 13 | 10 | Table 6.2.4-2 | |
| NS_08 | 6.6.3.3.3 | 19 | 10, 15 | > 44 | ≤ 3 |
| NS_09 | 6.6.3.3.4 | 21 | 10, 15 | > 40 | ≤ 1 |
| | | | | > 55 | ≤ 2 |
| NS_10 | | 20 | 15, 20 | Table 6.2.4-3 | |
| NS_11 | 6.6.2.2.1 6.6.3.3.13 | 23 | 1.4, 3, 5, 10, 15, 20 | Table 6.2.4-5 | |
| NS_12 | 6.6.3.3.5 | 26 | 1.4, 3, 5, 10, 15 | Table 6.2.4-6 | |
| NS_13 | 6.6.3.3.6 | 26 | 5 | Table 6.2.4-7 | |
| NS_14 | 6.6.3.3.7 | 26 | 10, 15 | Table 6.2.4-8 | |
| NS_15 | 6.6.3.3.8 | 26 | 1.4, 3, 5, 10, 15 | Table 6.2.4-9 Table 6.2.4-10 | |
| NS_16 | 6.6.3.3.9 | 27 | 3, 5, 10 | Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13 | |
| NS_17 | 6.6.3.3.10 | 28 | 5, 10 | Table 5.6-1 | N/A |
| NS_18 | 6.6.3.3.11 | 28 | 5 | ≥ 2 | ≤ 1 |
| | | | 10, 15, 20 | ≥ 1 | ≤ 4 |
| NS_19 | 6.6.3.3.12 | 44 | 10, 15, 20 | Table 6.2.4-14 | |
| NS_20 | 6.2.2 6.6.2.2.1 6.6.3.3.14 | 23 | 5, 10, 15, 20 | Table 6.2.4-15 | |
| NS_21 | 6.6.2.2.1 6.6.3.3.15 | 30 | 5, 10 | Table 6.2.4-16 | |
| NS_22 | 6.6.3.3.16 | 42, 43 | 5, 10, 15, 20 | Table 6.2.4-17 | |
| NS_23 | 6.6.3.3.17 | 42, 43 | 5, 10, 15, 20 | N/A | |
| ... | | | | | |
| NS_32 | - | - | - | - | - |

NOTE 1 Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. A-MPR for operations below this frequency is not covered in this version of specifications except for the channel assignments in NOTE 2 as the emissions requirement in 6.6.3.3.1 may not be met. For 10MHz channel bandwidth whose carrier frequency is larger than or equal to 1945 MHz or 15 MHz channel bandwidth whose carrier frequency is larger than or equal to 1947.5 MHz, no A-MPR applies.

NOTE2 Applicable when carrier frequency is 1932.5 MHz for 15MHz channel bandwidth or 1930 MHz for 20MHz channel bandwidth case.

**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<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. | | | | | |

**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<br>NOTE 2: $L_{CRB}$ is the length of a contiguous resource block allocation<br>NOTE 3: For intra-subframe frequency hopping which intersects Region A, notes 1 and 2 apply on a per slot basis<br>NOTE 4: For intra-subframe frequency hopping which intersect Region A, the larger A-MPR value may be applied for both slots in the subframe | | |

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

<table>
<tr><th>Channel bandwidth [MHz]</th><th colspan="8">Parameters</th></tr>
<tr><td rowspan="4">5</td><td>Fc [MHz]</td><td colspan="6">≤ 2499.5</td><td>> 2499.5</td></tr>
<tr><td>$RB_{start}$</td><td colspan="4">0 - 8</td><td colspan="2">9 - 24</td><td>0 - 24</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="4">> 0</td><td colspan="2">> 0</td><td>> 0</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="4">≤ 2</td><td colspan="2">0</td><td>0</td></tr>
<tr><td rowspan="5">10</td><td>Fc [MHz]</td><td colspan="6">≤ 2504</td><td>> 2504</td></tr>
<tr><td>$RB_{start}$</td><td colspan="4">0 - 8</td><td>9 - 35</td><td>36 - 49</td><td>0 - 49</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td>≤ 15</td><td colspan="2">> 15 and < 25</td><td>≥ 25</td><td>N/A</td><td>> 0</td><td>> 0</td></tr>
<tr><td>$RB_{start}$ + $L_{CRB}$ [RBs]</td><td>N/A</td><td colspan="2">N/A</td><td>N/A</td><td>≥ 45</td><td>N/A</td><td>N/A</td></tr>
<tr><td>A-MPR [dB]</td><td>≤ 3</td><td colspan="2">≤ 1</td><td>≤ 2</td><td>≤ 1</td><td>0</td><td>0</td></tr>
<tr><td rowspan="5">15</td><td>Fc [MHz]</td><td colspan="6">≤ 2510.8</td><td>> 2510.8</td></tr>
<tr><td>$RB_{start}$</td><td colspan="4">0 - 13</td><td>14 – 59</td><td>60 – 74</td><td>0 - 74</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="2">≤ 18 or ≥ 36</td><td colspan="2">> 18 and < 36</td><td>N/A</td><td>> 0</td><td>> 0</td></tr>
<tr><td>$RB_{start}$ + $L_{CRB}$ [RBs]</td><td colspan="2">N/A</td><td colspan="2">N/A</td><td>≥ 62</td><td>N/A</td><td>N/A</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="2">≤ 3</td><td colspan="2">≤ 1</td><td>≤ 1</td><td>0</td><td>0</td></tr>
<tr><td rowspan="5">20</td><td>Fc [MHz]</td><td colspan="6">≤ 2517.5</td><td>> 2517.5</td></tr>
<tr><td>$RB_{start}$</td><td colspan="4">0 – 22</td><td>23 – 76</td><td>77 – 99</td><td>0 - 99</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td colspan="2">≤ 18 or ≥ 40</td><td colspan="2">> 18 and < 40</td><td>N/A</td><td>> 0</td><td>> 0</td></tr>
<tr><td>$RB_{start}$ + $L_{CRB}$ [RBs]</td><td colspan="2">N/A</td><td colspan="2">N/A</td><td>≥ 86</td><td>N/A</td><td>N/A</td></tr>
<tr><td>A-MPR [dB]</td><td colspan="2">≤ 3</td><td colspan="2">≤ 1</td><td>≤ 1</td><td>0</td><td>0</td></tr>
<tr><td colspan="9">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</td></tr>
</table>

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

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

**Table 6.2.4-6: A-MPR for "NS_12"**

| Channel bandwidth [MHz] | Parameters | Region A | | Region B |
|---|---|---|---|---|
| 1.4 | $RB_{start}$ | 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] | 1-15 | | ≥9 |
| | A-MPR [dB] | ≤4 | | ≤3 |
| 5 | $RB_{start}$ | 0-6 | | 0-9 |
| | $L_{CRB}$ [RBs] | ≤8 | | ≥9 |
| | A-MPR [dB] | ≤5 | | ≤3 |
| 10 | $RB_{start}$ | 0-15 | | 0-22 |
| | $L_{CRB}$ [RBs] | ≤18 | | ≥20 |
| | A-MPR [dB] | ≤4 | | ≤2 |
| 15 | $RB_{start}$ | 0-30 | | 0-30 |
| | $L_{CRB}$ [RBs] | ≤30 | | ≥32 |
| | A-MPR [dB] | ≤4 | | ≤3 |

**Table 6.2.4-7: A-MPR for "NS_13"**

| Channel bandwidth [MHz] | Parameters | Region A | |
|---|---|---|---|
| 5 | $RB_{start}$ | 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"**

| Channel Bandwidth [MHz] | Parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | Fc [MHz] | < 2007.5 | 2007.5 ≤ Fc < 2012.5 | | | 2012.5 ≤ Fc ≤ 2017.5 | |
| | $RB_{start}$ | ≤24 | 0-3 | | 4-6 | ≤24 | |
| | $L_{CRB}$ [RBs] | >0 | 15-19 | ≥20 | ≥18 | 1-25 | |
| | A-MPR [dB] | ≤17 | ≤1 | ≤4 | ≤2 | ≤ 0 | |
| 10 | Fc [MHz] | 2005 | | | | | |
| | $RB_{start}$ | 0-25 | 26-34 | | 35-49 | | |
| | $L_{CRB}$ [RBs] | >0 | 8-15 | >15 | >0 | | |
| | A-MPR [dB] | ≤16 | ≤2 | ≤5 | ≤ 6 | | |
| | Fc [MHz] | 2015 | | | | | |
| | $RB_{start}$ | 0-5 | 6-10 | | | | |
| | $L_{CRB}$ [RBs] | ≥32 | ≥40 | | | | |
| | A-MPR [dB] | ≤4 | ≤2 | | | | |
| 15 | Fc [MHz] | 2012.5 | | | | | |
| | $RB_{start}$ | 0-14 | | 15-24 | | 25-39 | 61-74 |
| | $L_{CRB}$ [RBs] | 1-9 & 40-75 | 10-39 | 24-29 | ≥30 | ≥36 | ≤6 |
| | A-MPR [dB] | ≤11 | ≤6 | ≤1 | ≤7 | ≤5 | ≤6 |
| 20 | Fc [MHz] | 2010 | | | | | | |
| | $RB_{start}$ | 0-21 | 22-31 | | 32-38 | 39-49 | 50-68 | 69-99 |
| | $L_{CRB}$ [RBs] | >0 | 1-9 & 31-75 | 10-30 | ≥15 | ≥24 | ≥25 | >0 |
| | A-MPR [dB] | ≤17 | ≤12 | ≤6 | ≤9 | ≤7 | ≤5 | ≤16 |

NOTE 1: When NS_20 is signaled the minimum requirements for the 10 MHz bandwidth are specified for E-UTRA UL carrier center frequencies of 2005 MHz or 2015 MHz.

NOTE 2: When NS_20 is signaled the minimum requirements for the 15 MHz channel bandwidth are specified for E-UTRA UL carrier center frequency of 2012.5 MHz.

**Table 6.2.4-16: A-MPR for "NS_21"**

| Channel Bandwidth [MHz] | Parameters | Region A | | Region B | |
|---|---|---|---|---|---|
| 10 | $RB_{start}$ | 0 – 6 | 0 – 6 | N/A | N/A |
| | $RB_{end}$ | N/A | N/A | 43 – 49 | 43 – 49 |
| | $L_{CRB}$ [RBs] | 1 – 2 | 3 – 12, 32 - 50 | 1 – 2 | 3 – 12, 32 - 50 |
| | A-MPR [dB] | ≤ 4 | ≤ 3 | ≤ 4 | ≤ 3 |

**Table 6.2.4-17: A-MPR for "NS_22"**

| Channel bandwidth [MHz] | Parameters | Region A | Region B | Region C | Region D |
|---|---|---|---|---|---|
| 5 | No A-MPR is needed for 5 MHz channel bandwidth | | | | |
| 10 | $RB_{start}$ | 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. | | | | | |

**Table 6.2.4-18: A-MPR for "NS_05"**

<table>
<tr><th>Channel Bandwidth [MHz]</th><th colspan="8">Parameters</th></tr>
<tr><td rowspan="4">15</td><td>Fc [MHz]</td><td colspan="7">1932.5</td></tr>
<tr><td>$RB_{start}$</td><td>0-7</td><td colspan="4">8 – 66</td><td colspan="2">67-74</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td>≥1</td><td>≤30</td><td colspan="2">31 – 54</td><td>> 54</td><td>≤6</td><td>>6</td></tr>
<tr><td>A-MPR [dB]</td><td>≤11</td><td>0</td><td colspan="2">≤3</td><td>≤5</td><td>≤5</td><td>≤1</td></tr>
<tr><td rowspan="4">20</td><td>Fc [MHz]</td><td colspan="7">1930</td></tr>
<tr><td>$RB_{start}$</td><td>0-23</td><td colspan="4">24-75</td><td colspan="2">76-99</td></tr>
<tr><td>$L_{CRB}$ [RBs]</td><td>≥1</td><td>≤24</td><td>25 – 40</td><td>41 – 50</td><td>> 50</td><td>≤6</td><td>>6</td></tr>
<tr><td>A-MPR [dB]</td><td>≤11</td><td>0</td><td>≤3</td><td>≤5</td><td>≤10</td><td>≤5</td><td>≤1</td></tr>
</table>

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 = 0dB, 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 | 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_07 | 6.6.3.3A.6 | CA_39C | 6.2.4A.7 |
| CA_NS_08 | 6.6.3.3A.7 | CA_42C | 6.2.4A.8 |
| … | | | |
| CA_NS_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*. | | | |

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

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

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

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

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

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

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

For intra-band carrier aggregation, the A-MPR 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
NOTE 2: $L_{\_CRB}$ is the length of a contiguous resource block allocation
NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis
NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe

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

$$M_A = \begin{cases} -22.5\,A + 17 & ; 0 \le A < 0.20 \\ -11.0\,A + 14.7 & ; 0.20 \le A < 0.70 \\ -1.7\,A + 8.2 & ; 0.70 \le A \le 1 \end{cases}$$

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

$$M_A = \begin{cases} -22.5\ A + 17 & ;\ 0 \le A < 0.20 \\ -11.0\ A + 14.7 & ;\ 0.20 \le A < 0.70 \\ -1.7\ A + 8.2 & ;\ 0.70 \le A \le 1 \end{cases}$$

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:

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

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: Contigous 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
NOTE 2: $L_{CRB}$ is the length of a contiguous resource block allocation
NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis
NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe

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

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

Where $M_A$ is defined as follows

$$\begin{aligned} M_A &= 10.5, && 0 \le A < 0.05 \\ &= -50.0A + 13.00, && 0.05 \le A < 0.15 \\ &= -4.0A + 6.10, && 0.15 \le A < 0.40 \\ &= -0.83A + 4.83, && 0.40 \le A \le 1 \end{aligned}$$

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

$$M_A = -14.17\ A + 16.50 \qquad ;\ 0 \le A < 0.60$$

$$-2.50\ A + 9.50 \qquad ;\ 0.60 \le A \le 1$$

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 |
| 50RB/100RB and 100RB/50RB | 0 – 10 | > 0 | ≤ 5 dB |
| | 11 – 75 | > max(0, RB_End – 25) | ≤ 2 dB |
| | 76 – 103 | > 50 | ≤ 3 dB |
| | 104 – 144 | > 25 | ≤ 6 dB |
| | 145 – 149 | > 0 | ≤ 10 dB |
| 75RB/100RB and 100RB/75RB | 0 – 15 | > 0 | ≤ 5 dB |
| | 16 – 75 | > max(0, RB_End – 15) | ≤ 2 dB |
| | 76 – 120 | > 50 | ≤ 3 dB |
| | 121 – 160 | > 50 | ≤ 6 dB |
| | 161 – 174 | > 0 | ≤ 10 dB |

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

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

Where $M_A$ is defined as follows

$$M_A = \begin{cases} -23.33A + 17.5 + 10A & ; 0 \le A < 0.15 \\ -7.65A + 15.15 + 1.18A + 1.32 & ; 0.15 \le A \le 1 \end{cases}$$

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

### 6.2.4A.7 A-MPR for CA_NS_07

If the UE is configured to CA_39C and it receives IE CA_NS_07 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.7-1.

**Table 6.2.4A.7-1: Contiguous Allocation A-MPR for CA_NS_07**

| CA_39C: CA_NS_07 | $RB_{Start}$ | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM[dB] |
|---|---|---|---|
| 75 RB / 100 RB and 100 RB / 75 RB | 0 – 13 | > 0 | ≤ 11 |
| | 14 – 50 | ≤ 60 | ≤ 3 |
| | 14 – 100 | > 60 | ≤ 7 |
| | 101 – 155 | > max(155 - RBstart , 0) | ≤ 2 |
| | 156 – 174 | > 0 | ≤ 5 |
| 50 RB / 100 RB and 100 RB / 50 RB | 0 – 5 | > 0 | ≤ 11 |
| | 6 – 42 | ≤ 25 | ≤ 3 |
| | | > 25 | ≤ 6 |
| | 43 – 80 | > 50 | ≤ 5 |
| | 81 – 138 | > 20 | ≤ 2 |
| | 139 – 149 | > 0 | ≤ 5 |
| 25 RB / 100 RB and 100 RB / 25 RB | 0 – 32 | ≥ 84 | ≤ 6 |
| | | < 84 | ≤ 4 |
| | 33 – 60 | > 50 | ≤ 3 |
| | 61 – 124 | > 20 | ≤ 3 |

If the UE is configured to CA_39C and it receives IE CA_NS_07 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

$$M_A = -16.25A + 21 \qquad ; 0 \le A < 0.80$$

$$-2.50\,A + 10.00 \qquad ; 0.80 \le A \le 1$$

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

## 6.2.4A.8 A-MPR for CA_NS_08

If the UE is configured to CA_42C and it receives IE CA_NS_08 the allowed maximum output power reduction applied to transmission on the PCC and the SCC for contiguously aggregated signals is specified in Table 6.2.4A.8-1.

**Table 6.2.4A.8-1: Contiguous Allocation A-MPR for CA_NS_08**

| CA_42C: CA_NS_08 | RBstart | Condition | RBend | $L_{CRB}$ [RBs] | A-MPR for QPSK and 16-QAM[dB] |
|---|---|---|---|---|---|
| 100RB / 100RB | ≤ 21 | Or | ≥ 178 | ≤ 25 | ≤ 12 |
| | | | | > 25 and ≤ 80 | ≤ 6 |
| | ≥ 0 | N/A | N/A | > 80 and ≤ 172 | ≤ 8 |
| | | | | > 172 | ≤ 9 |
| | > 21 and ≤ 58 | Or | ≥ 141 and < 178 | < 48 | ≤ 3 |
| | > 21 | And | < 178 | ≥ 48 and ≤ 80 | ≤ 4 |
| 100RB / 75RB And 75RB / 100RB | ≤ 12 | Or | ≥ 162 | ≤ 25 | ≤ 12 |
| | | | | > 25 and ≤ 75 | ≤ 6 |
| | ≥ 0 | N/A | N/A | > 75 and <172 | ≤ 8 |
| | | | | ≥172 | 9 |
| | > 12 and ≤ 49 | Or | ≥ 125 and < 162 | < 54 | ≤ 3 |
| | > 12 | And | < 162 | ≥ 54 and ≤75 | ≤ 5 |
| | > 49 | And | < 125 | ≥ 36 and < 54 | ≤ 2 |
| 75RB / 75RB and 100RB / 50RB And 50RB / 100RB | ≤ 5 | Or | ≤ 144 | ≤ 16 | ≤ 12 |
| | | | | > 16 and ≤ 61 | ≤ 6 |
| | ≥ 0 | N/A | N/A | > 61 | ≤ 8 |
| | > 5 | And | < 144 | ≥ 36 and ≤ 61 | ≤ 5 |
| | > 5 and ≤ 41 | Or | ≥ 108 and < 144 | < 36 | ≤ 3 |
| 100RB / 25RB And 25RB / 100RB | ≤ 31 | Or | ≥ 92 | ≤ 34 | ≤ 4 |
| | | | | > 34 and ≤ 44 | ≤ 5 |
| | ≥ 0 | N/A | N/A | > 44 | ≤ 8 |

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: $RB_{end}$ indicates the highest RB index of transmitted resource blocks

NOTE 4: If condition is "and" both $RB_{start}$ and $RB_{end}$ constraints need to be met. If condition is "or" either $RB_{start}$ or $RB_{end}$ constraints need to be met

NOTE 5: For intra-subframe frequency hopping which intersects regions, notes 1, 2, 3 and 4 apply on a per slot basis

NOTE 6: 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_42C and it receives IE CA_NS_08 the allowed maximum output power reduction applied to transmissions on the PCell and the SCell with non-contiguous resource allocation is defined as follows

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

Where MA is defined as follows

$$M_A = \begin{cases} 20 & 0 \le A < 0.025 \\ 23 - 120A & 0.025 \le A < 0.05 \\ 17.53 - 10.59A & 0.05 \le A \le 0.9 \\ 8 & 0.9 \le A \le 1 \end{cases}$$

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.

### 6.2.4D UE maximum output power with additional requirements for ProSe

The allowed A-MPR for the maximum output power for ProSe physical channels PSDCH, PSCCH, PSSCH, and PSBCH shall be as specified in subclause 6.2.4 for PUSCH for the corresponding modulation and transmission bandwidth.

The allowed A-MPR for the maximum output power for ProSe physical signal PSSS and SSSS shall be as be as specified in subclause 6.2.4 for PUSCH QPSK modulation for the corresponding transmission bandwidth.

### 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:

$P_{CMAX\_L,c} \leq P_{CMAX,c} \leq P_{CMAX\_H,c}$ with

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

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

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 $A\text{-}MPR_c$ for serving cell *c* are specified in subclause 6.2.3 and subclause 6.2.4, respectively;
- $\Delta T_{IB,c}$ is the additional tolerance for serving cell *c* as specified in Table 6.2.5-2; $\Delta T_{IB,c} = 0$ dB otherwise;
- $\Delta T_{C,c} = 1.5$ dB when Note 2 in Table 6.2.2-1 applies;
- $\Delta T_{C,c} = 0$ dB when Note 2 in Table 6.2.2-1 does not apply;
- $\Delta T_{ProSe} = 0.1$ dB when the UE supports ProSe Direct Discovery and/or ProSe Direct Communication on the corresponding E-UTRA ProSe band; $\Delta T_{ProSe} = 0$ dB otherwise.

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

NOTE 1: $P\text{-}MPR_c$ 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: $P\text{-}MPR_c$ 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:

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

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

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

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

For the UE which supports inter-band carrier aggregation configurations with the uplink assigned to one or two E-UTRA bands the $\Delta T_{IB,c}$ is defined for applicable bands in Table 6.2.5-2 and Table 6.2.5-3.

**Table 6.2.5-2: $\Delta T_{IB,c}$ (two bands)**

| Inter-band CA Configuration | E-UTRA Band | $\Delta T_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-3A | 1 | 0.3 |
| | 3 | 0.3 |
| CA_1A-5A | 1 | 0.3 |
| | 5 | 0.3 |
| CA_1A-7A | 1 | 0.5 |
| | 7 | 0.6 |
| CA_1A-8A | 1 | 0.3 |
| | 8 | 0.3 |
| CA_1A-11A | 1 | 0.3 |
| | 11 | 0.3 |
| CA_1A-18A | 1 | 0.3 |
| | 18 | 0.3 |
| CA_1A-19A | 1 | 0.3 |
| | 19 | 0.3 |
| CA_1A-20A | 1 | 0.3 |
| | 20 | 0.3 |
| CA_1A-21A | 1 | 0.3 |
| | 21 | 0.3 |
| CA_1A-26A | 1 | 0.3 |
| | 26 | 0.3 |
| CA_1A-28A | 1 | 0.3 |
| | 28 | 0.6 |
| CA_1A-41A[8] | 1 | 0.5 |
| | 41 | 0.5 |
| CA_1A-41C[8] | 1 | 0.5 |
| | 41 | 0.5 |
| CA_1A-42A | 1 | 0.3 |
| | 42 | 0.8 |
| CA_1A-42C | 1 | 0.3 |
| | 42 | 0.8 |
| CA_2A-4A | 2 | 0.5 |
| | 4 | 0.5 |
| CA_2A-4A-4A | 2 | 0.5 |
| | 4 | 0.5 |
| CA_2A-5A | 2 | 0.3 |
| | 5 | 0.3 |
| CA_2A-2A-5A | 2 | 0.3 |
| | 5 | 0.3 |
| CA_2A-12A | 2 | 0.3 |
| | 12 | 0.3 |
| CA_2A-12B | 2 | 0.3 |
| | 12 | 0.3 |
| CA_2A-13A | 2 | 0.3 |
| | 13 | 0.3 |
| CA_2A-2A-13A | 2 | 0.3 |
| | 13 | 0.3 |
| CA_2A-17A | 2 | 0.3 |
| | 17 | 0.8 |
| CA_2A-29A | 2 | 0.3 |
| CA_2C-29A | 2 | 0.3 |
| CA_2A-30A | 2 | 0.5 |
| | 30 | 0.3 |
| CA_3A-5A | 3 | 0.3 |
| | 5 | 0.3 |
| CA_3A-7A | 3 | 0.5 |
| | 7 | 0.5 |
| CA_3A-7C | 3 | 0.5 |
| | 7 | 0.5 |
| CA_3C-7A | 3 | 0.5 |
| | 7 | 0.5 |
| CA_3A-8A | 3 | 0.3 |

| | | |
|---|---|---|
| | 8 | 0.3 |
| CA_3A-19A | 3 | 0.3 |
| | 19 | 0.3 |
| CA_3A-20A | 3 | 0.3 |
| | 20 | 0.3 |
| CA_3A-26A | 3 | 0.3 |
| | 26 | 0.3 |
| CA_3A-27A | 3 | 0.3 |
| | 27 | 0.3 |
| CA_3A-28A | 3 | 0.3 |
| | 28 | 0.3 |
| CA_3A-42A | 3 | 0.6 |
| | 42 | 0.8 |
| CA_3A-42C | 3 | 0.6 |
| | 42 | 0.8 |
| CA_4A-5A | 4 | 0.3 |
| | 5 | 0.3 |
| CA_4A-4A-5A | 4 | 0.3 |
| | 5 | 0.3 |
| CA_4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-12A | 4 | 0.3 |
| | 12 | 0.8 |
| CA_4A-4A-12A | 4 | 0.3 |
| | 12 | 0.8 |
| CA_4A-12B | 4 | 0.3 |
| | 12 | 0.8 |
| CA_4A-13A | 4 | 0.3 |
| | 13 | 0.3 |
| CA_4A-4A-13A | 4 | 0.3 |
| | 13 | 0.3 |
| CA_4A-17A | 4 | 0.3 |
| | 17 | 0.8 |
| CA_4A-27A | 4 | 0.3 |
| | 27 | 0.3 |
| CA_4A-29A | 4 | 0.3 |
| CA_4A-30A | 4 | 0.5 |
| | 30 | 0.3 |
| CA_5A-7A | 5 | 0.3 |
| | 7 | 0.3 |
| CA_5A-12A | 5 | 0.8 |
| | 12 | 0.4 |
| CA_5A-13A | 5 | 0.5 |
| | 13 | 0.5 |
| CA_5A-17A | 5 | 0.8 |
| | 17 | 0.4 |
| CA_5A-25A | 5 | 0.3 |
| | 25 | 0.3 |
| CA_5A-30A | 5 | 0.3 |
| | 30 | 0.3 |
| CA_7A-8A | 7 | 0.3 |
| | 8 | 0.6 |
| CA_7A-12A | 7 | 0.3 |
| | 12 | 0.3 |
| CA_7A-20A | 7 | 0.3 |
| | 20 | 0.3 |
| CA_7A-28A | 7 | 0.3 |
| | 28 | 0.3 |
| CA_8A-11A | 8 | 0.3 |
| | 11 | 0.4 |
| CA_8A-20A | 8 | 0.4 |
| | 20 | 0.4 |
| CA_8A-40A | 8 | 0.3 |

| | | |
|---|---|---|
| | 40 | 0.3 |
| CA_11A-18A | 11 | 0.3 |
| | 18 | 0.3 |
| CA_12A-25A | 12 | 0.3 |
| | 25 | 0.3 |
| CA_12A-30A | 12 | 0.3 |
| | 30 | 0.3 |
| CA_18A-28A[9] | 18 | 0.5 |
| | 28 | 0.5 |
| CA_19A-21A | 19 | 0.3 |
| | 21 | 0.4 |
| CA_19A-42A | 19 | 0.3 |
| | 42 | 0.8 |
| CA_19A-42C | 19 | 0.3 |
| | 42 | 0.8 |
| CA_20A-32A | 20 | 0.3 |
| CA_23A-29A | 23 | 0.3 |
| CA_25A-41A[8] | 25 | 0.5 |
| | 41 | 0.5 |
| CA_25A-41C[8] | 25 | 0.5 |
| | 41 | 0.5 |
| CA_26A-41A | 26 | 0.3 |
| | 41 | 0.3 |
| CA_26A-41C | 26 | 0.3 |
| | 41 | 0.3 |
| CA_29A-30A | 30 | 0.3 |
| CA_39A-41A | 39 | 0[4] |
| | 41 | 0[4] |
| CA_39A-41A | 39 | 0.5[7] |
| | 41 | 0.5[7] |
| CA_39A-41C | 39 | 0[4] |
| | 41 | 0[4] |
| CA_39C-41A | 39 | 0[4] |
| | 41 | 0[4] |
| CA_41A-42A | 41 | 0[4] |
| | 42 | 0.5[4] |

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 2DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 2DL 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 2DL tolerances above, truncated to one decimal place for that operating band among the supported 2DL CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 2DL carrier aggregation configurations involving such band shall be applied

- When the E-UTRA operating band frequency range is >1GHz, the applicable additional 2DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 2DL CA configurations

NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx.

NOTE 5: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:

- When the E-UTRA operating band frequency range is ≤ 1GHz and the tolerances are the same, the value applies to the band. If the tolerances

| |
|---|
| are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied<br>- When the E-UTRA operating band frequency range is >1GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations<br>NOTE 6: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.<br>NOTE 7: Applicable for UE supporting inter-band carrier aggregation with two uplinks and without simultaneous Rx/Tx.<br>NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in the FDD band.<br>NOTE 9: For Band 28, the requirements only apply for the restricted frequency range specified for this CA configuration (Table 5.5A-2). |

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

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

**Table 6.2.5-3: $\Delta T_{IB,c}$ (three bands)**

| Inter-band CA Configuration | E-UTRA Band | $\Delta T_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-3A-8A | 1 | 0.3 |
| | 3 | 0.3 |
| | 8 | 0.3 |
| CA_1A-3A-5A | 1 | 0.3 |
| | 3 | 0.3 |
| | 5 | 0.3 |
| CA_1A-3A-19A | 1 | 0.3 |
| | 3 | 0.3 |
| | 19 | 0.3 |
| CA_1A-3A-20A | 1 | 0.3 |
| | 3 | 0.3 |
| | 20 | 0.3 |
| CA_1A-3A-26A | 1 | 0.3 |
| | 3 | 0.3 |
| | 26 | 0.3 |
| CA_1A-5A-7A | 1 | 0.5 |
| | 5 | 0.3 |
| | 7 | 0.6 |
| CA_1A-7A-20A | 1 | 0.5 |
| | 7 | 0.6 |
| | 20 | 0.3 |
| CA_1A-18A-28A | 1 | 0.3 |
| | 18 | 0.5 |
| | 28 | 0.5 |
| CA_1A-19A-21A | 1 | 0.3 |
| | 19 | 0.3 |
| | 21 | 0.4 |
| CA_2A-4A-5A | 2 | 0.5 |
| | 4 | 0.5 |
| | 5 | 0.3 |
| CA_2A-4A-12A | 2 | 0.5 |
| | 4 | 0.5 |
| | 12 | 0.8 |
| CA_2A-4A-13A | 2 | 0.5 |
| | 4 | 0.5 |
| | 13 | 0.3 |
| CA_2A-4A-29A | 2 | [0.5] |
| | 4 | 0.5 |
| CA_2A-5A-12A | 2 | 0.3 |
| | 5 | 0.8 |
| | 12 | 0.4 |
| CA_2A-5A-13A | 2 | 0.3 |
| | 5 | 0.5 |
| | 13 | 0.5 |
| CA_2A-5A-30A | 2 | 0.5 |
| | 5 | 0.3 |
| | 30 | 0.3 |
| CA_2A-12A-30A | 2 | 0.5 |
| | 12 | 0.3 |
| | 30 | 0.3 |
| CA_2A-29A-30A | 2 | 0.5 |
| | 30 | 0.3 |
| CA_3A-7A-20A | 3 | 0.5 |
| | 7 | 0.5 |
| | 20 | 0.3 |
| CA_4A-5A-12A | 4 | 0.3 |
| | 5 | 0.8 |
| | 12 | 0.8 |
| CA_4A-5A-13A | 4 | 0.3 |
| | 5 | 0.5 |
| | 13 | 0.5 |

| | | |
|---|---|---|
| CA_4A-5A-30A | 4 | 0.5 |
| | 5 | 0.3 |
| | 30 | 0.3 |
| CA_4A-7A-12A | 4 | 0.5 |
| | 7 | 0.5 |
| | 12 | 0.8 |
| CA_4A-12A-30A | 4 | 0.5 |
| | 12 | 0.8 |
| | 30 | 0.3 |
| CA_4A-29A-30A | 4 | 0.5 |
| | 30 | 0.3 |
| CA_7A-8A-20A | 7 | 0.3 |
| | 8 | 0.6 |
| | 20 | [0.6] |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations<br>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<br>NOTE 3: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:<br>- When the E-UTRA operating band frequency range is ≤ 1GHz and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied<br>- When the E-UTRA operating band frequency range is >1GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations<br>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration. | | |

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

## 6.2.5A Configured transmitted power for CA

For uplink carrier aggregation the UE is allowed to set its configured maximum output power $P_{CMAX,c}$ 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 inter-band carrier aggregation, $MPR_c$ and $A\text{-}MPR_c$ apply per serving cell *c* and are specified in subclause 6.2.3 and subclause 6.2.4, respectively. $P\text{-}MPR_c$ accounts for power management for serving cell *c*. $P_{CMAX,c}$ is calculated under the assumption that the transmit power is increased independently on all component carriers.

For uplink intra-band contiguous and non-contiguous carrier aggregation, $MPR_c$ = 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.

The total configured maximum output power $P_{CMAX}$ shall be set within the following bounds:

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

For uplink inter-band carrier aggregation with one serving cell c per operating band,

$$P_{CMAX\_L} = \text{MIN}\ \{10\log_{10}\sum \text{MIN}\ [\ p_{EMAX,c}/(\Delta t_{C,c}),\ \ p_{PowerClass}/(mpr_c \cdot a\text{-}mpr_c \cdot \Delta t_{C,c} \cdot \Delta t_{IB,c} \cdot \Delta t_{ProSe})\ ,\ p_{PowerClass}/pmpr_c],\ P_{PowerClass}\}$$

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

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; $p_{PowerClass}$ is the linear value of $P_{PowerClass}$;
- $mpr_c$ and $a\text{-}mpr_c$ are the linear values of $MPR_c$ and $A\text{-}MPR_c$ as specified in subclause 6.2.3 and subclause 6.2.4, respectively;
- $pmpr_c$ is the linear value of $P\text{-}MPR_c$;
- $\Delta t_{C,c}$ is the linear value of $\Delta T_{C,c}$. $\Delta t_{C,c} = 1.41$ when Note 2 in Table 6.2.2-1 applies for a serving cell *c*, otherwise $\Delta t_{C,c} = 1$;
- $\Delta t_{IB,c}$ is the linear value of the inter-band relaxation term $\Delta T_{IB,c}$ of the serving cell *c* as specified in Table 6.2.5-2; otherwise $\Delta t_{IB,c} = 1$;
- $\Delta t_{ProSe}$ is the linear value of $\Delta T_{ProSe}$ and applies as specified in subclause 6.2.5.

For uplink intra-band contiguous and non-contiguous carrier aggregation,

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

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

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*;*
- $\Delta T_{ProSe}$ applies as specified in subclause 6.2.5.

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.

If the UE is configured with multiple TAGs and transmissions of the UE on subframe *i* for any serving cell in one TAG overlap some portion of the first symbol of the transmission on subframe *i* +1 for a different serving cell in another TAG, the UE minimum of $P_{CMAX\_L}$ for subframes *i* and *i* + 1 applies for any overlapping portion of subframes *i* and *i* + 1. $P_{PowerClass}$ 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-1 and Table 6.2.5A-2 for inter-band carrier aggregation and intra-band carrier aggregation, respectively. The tolerance $T_L$ is the absolute value of the lower tolerance for applicable E-UTRA CA configuration as specified in Table 6.2.2A-0, Table 6.2.2A-1 and Table 6.2.2A-2 for inter-band carrier aggregation, intra-band contiguous carrier aggregation and intra-band non-contiguous carrier aggregation, respectively.

**Table 6.2.5A-1: $P_{CMAX}$ tolerance for uplink inter-band CA (two bands)**

| $P_{CMAX}$ (dBm) | Tolerance $T_{LOW}(P_{CMAX})$ (dB) | Tolerance $T_{HIGH}(P_{CMAX})$ (dB) |
|---|---|---|
| $P_{CMAX}$ = 23 | 3.0 | 2.0 |
| 22 ≤ $P_{CMAX}$ < 23 | 5.0 | 2.0 |
| 21 ≤ $P_{CMAX}$ < 22 | 5.0 | 3.0 |
| 20 ≤ $P_{CMAX}$ < 21 | 6.0 | 4.0 |
| 16 ≤ $P_{CMAX}$ < 20 | 5.0 | |
| 11 ≤ $P_{CMAc}$ < 16 | 6.0 | |
| -40 ≤ $P_{CMAX}$ < 11 | 7.0 | |

**Table 6.2.5A-2: $P_{CMAX}$ tolerance**

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

## 6.2.5B 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;
- $A\text{-}MPR_{,c}$ 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 ≤ $P_{CMAX,c}$ < 23 | 5.0 | 2.0 |
| 21 ≤ $P_{CMAX,c}$ < 22 | 5.0 | 3.0 |
| 20 ≤ $P_{CMAX,c}$ < 21 | 6.0 | 4.0 |
| 16 ≤ $P_{CMAX,c}$ < 20 | 5.0 | |
| 11 ≤ $P_{CMAX,c}$ < 16 | 6.0 | |
| -40 ≤ $P_{CMAX,c}$ < 11 | 7.0 | |

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

## 6.2.5C Configured transmitted power for Dual Connectivity

For inter-band dual connectivity with one uplink serving cell per CG, the UE is allowed to set its configured maximum output power $P_{CMAX,c(i),i}$ for serving cell $c(i)$ of CG $i$, $i = 1,2$, and its total configured maximum output power $P_{CMAX}$.

The configured maximum output power $P_{CMAX,c(i),i}$ ($p$) in subframe $p$ of serving cell $c(i)$ on CG $i$ shall be set within the following bounds:

$$P_{CMAX\_L,c(i),i}(p) \leq P_{CMAX,c(i),i}(p) \leq P_{CMAX\_H,c(i),i}(p)$$

where $P_{CMAX\_L,c(i),i}(p)$ and $P_{CMAX\_H,c(i),i}(p)$ are the limits for a serving cell $c(i)$ of CG $i$ as specified in subclause 6.2.5.

The total UE configured maximum output power $P_{CMAX}(p,q)$ in a subframe $p$ of CG 1 and a subframe $q$ of CG 2 that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

$$P_{CMAX\_L}(p,q) \leq P_{CMAX}(p,q) \leq P_{CMAX\_H}(p,q)$$

with

$$P_{CMAX\_L}(p,q) = \text{MIN}\{10\log_{10}[p_{CMAX\_L,c(1),1}(p) + p_{CMAX\_L,c(2),2}(q)], P_{PowerClass}\}$$

$$P_{CMAX\_H}(p,q) = \text{MIN}\{10\log_{10}[p_{CMAX\_H,c(1),1}(p) + p_{CMAX\_H,c(2),2}(q)], P_{PowerClass}\}$$

where $p_{CMAX\_L,c(i),i}$ is $p_{CMAX\_H,c(i),i}$ are the respective limits $P_{CMAX\_L,c(i),i}(p)$ and $P_{CMAX\_H,c(i),i}(p)$ expressed in linear scale.

If the UE is configured in Dual Connectivity and synchronous transmissions of the UE on subframe $p$ for a serving cell in one CG overlaps some portion of the first symbol of the transmission on subframe $q+1$ for a different serving cell in the other CG, the UE minimum of $P_{CMAX\_L}$ between subframes pairs $(p, q)$ and $(p+1, q+1)$ respectively applies for any overlapping portion of subframes $(p, q)$ and $(p+1, q+1)$. $P_{PowerClass}$ shall not be exceeded by the UE during any period of time.

The measured total maximum output power $P_{UMAX}$ over both CGs is

$$P_{UMAX} = 10\log_{10}[p_{UMAX,c(1),1} + p_{UMAX,c(2),2}],$$

where $p_{UMAX,c(i),i}$ denotes the measured output power of serving cell $c(i)$ of CG $i$ expressed in linear scale.

If the UE is configured in Dual Connectivity and synchronous transmissions

$$P_{CMAX\_L}(p,q) - T_{LOW}(P_{CMAX\_L}(p,q)) \leq P_{UMAX} \leq P_{CMAX\_H}(p,q) + T_{HIGH}(P_{CMAX\_H}(p,q))$$

where $P_{CMAX\_L}(p,q)$ and $P_{CMAX\_H}(p,q)$ are the limits for the pair $(p,q)$ and with the tolerances $T_{LOW}(P_{CMAX})$ and $T_{HIGH}(P_{CMAX})$ for applicable values of $P_{CMAX}$ specified in Table 6.2.5C-1. $P_{CMAX\_L}$ may be modified for any overlapping portion of subframes $(p, q)$ and $(p+1, q+1)$.

If the UE is configured in Dual Connectivity and asynchronous transmissions, the subframes of the leading CG are taken as reference subframes for the measurement of the total configured output power $P_{UMAX}$. If subframe $p$ of CG 1 and subframe $q$ of CG 2 overlap in time in their respective slot 0 and

1. if *p* leads in time over *q*, then *p* is the reference subframe and the (*p*,*q*) and (*p*,*q-1*) pairs are considered for determining the $P_{CMAX}$ tolerance
2. if *q* leads in time over *p*, then *q* is the reference subframe and the (*p-1*,*q*) and (*p*,*q*) pairs are considered for determining the $P_{CMAX}$ tolerance;

for the reference subframe *p* duration (when subframe *p* in CG 1 leads):

$$P'_{CMAX\_L} = MIN \{P_{CMAX\_L}(p,q), P_{CMAX\_L}(p,q-1)\}$$

$$P'_{CMAX\_H} = MAX \{P_{CMAX\_H}(p,q), P_{CMAX\_H}(p,q-1)\}$$

while for the reference subframe *q* duration (when subframe *q* in CG 2 leads):

$$P'_{CMAX\_L} = MIN \{P_{CMAX\_L}(p-1,q), P_{CMAX\_L}(p,q)\}$$

$$P'_{CMAX\_H} = MAX \{P_{CMAX\_H}(p-1,q), P_{CMAX\_H}(p,q)\}$$

where $P_{CMAX\_L}$ and $P_{CMAX\_H}$ are the applicable limits for each overlapping subframe pairs *(p,q)* , (*p, q-1*), *(p-1,q*). The measured total configured maximum output power $P_{UMAX}$ shall be within the following bounds:

$$P'_{CMAX\_L} - T_{LOW}(P'_{CMAX\_L}) \leq P_{UMAX} \leq P'_{CMAX\_H} + T_{HIGH}(P'_{CMAX\_H})$$

with the tolerances $T_{LOW}(P_{CMAX})$ and $T_{HIGH}(P_{CMAX})$ for applicable values of $P_{CMAX}$ specified in Table 6.2.5C-1.

**Table 6.2.5C-1: $P_{CMAX}$ tolerance for inter-band Dual Connectivity**

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

## 6.2.5D Configured transmitted power for ProSe

The configured maximum output power $P_{CMAX,c}$ and power boundary requirement specified in subclause 6.2.5 shall apply to UE supporting ProSe, where

- $MPR_c$ is specified in subclause 6.2.3D;
- $A\text{-}MPR_c$ is specified in subclause 6.2.4D;
- $\Delta T_{ProSe}$ = 0.1 dB.

For $P_{\text{CMAX},PSSCH}$ and $P_{\text{CMAX},PSCCH}$ , $P_{EMAX,c}$ is the value given by IE *P-Max* for serving cell c, defined by [7], when present. $P_{EMAX,c}$ is the value given by IE *maxTxPower*, defined by [7], when the UE is not associated with a serving cell on the ProSe carrier .

For $P_{\text{CMAX},PSDCH}$ , $P_{EMAX,c}$ is the value given by the IE discMaxTxPower in [7].

For $P_{\text{CMAX},PSBCH}$ , $P_{EMAX,c}$ is the value given by the IE *maxTxPower* in [7] when the ProSe UE is not associated with a serving cell on the ProSe carrier. When the UE is associated with a serving cell, then $P_{EMAX,c}$ is the value given by the IE *P-Max* when PSBCH/SLSS transmissions is triggered for ProSe Direct communication as specified in [7], and is the value given by the IE *discMaxTxPower* in [7] otherwise.

For $P_{\text{CMAX},SSSS}$ , the value is as calculated for $P_{\text{CMAX},PSBCH}$ and applying the MPR for SSSS as specified in Section 6.2.3D.

## 6.3 Output power dynamics

### 6.3.1 (Void)

### 6.3.2 Minimum output power

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

#### 6.3.2.1 Minimum requirement

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

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

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

### 6.3.2A UE Minimum output power for CA

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

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

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the minimum output power is defined per carrier and the requirement is specified in subclause 6.3.2.1.

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

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

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

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

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

#### 6.3.2B.1 Minimum requirement

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

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

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

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

### 6.3.3 Transmit OFF power

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

#### 6.3.3.1. Minimum requirement

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

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

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

### 6.3.3A UE Transmit OFF power for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands and intra-band contiguous and non-contiguous carrier aggregation, transmit OFF power is defined as the mean power per component carrier when the transmitter is OFF on all component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During measurements gaps, the UE is not considered to be OFF.

#### 6.3.3A.1 Minimum requirement for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, transmit OFF power requirement is defined per carrier and the requirement is specified in subclause 6.3.3.1.

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

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

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

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

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

### 6.3.3B.1 Minimum requirement

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

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

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

## 6.3.3D Transmit OFF power for ProSe

The Prose UE shall Transmit OFF power at all times when the UE is not associated with PCell on the ProSe carrier and does not have knowledge of its geographical area or is provisioned with pre-configured radio parameters that are not associated with any known Geographical Area.

The requirements specified in subclause 6.3.3D shall apply to UE supporting ProSe when

- the UE is associated with PCell on the ProSe carrier, or
- the UE is not associated with PCell on the ProSe carrier and is provisioned with the preconfigured radio parameters for ProSe Direct Communications that are associated with known Geographical Area.

## 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

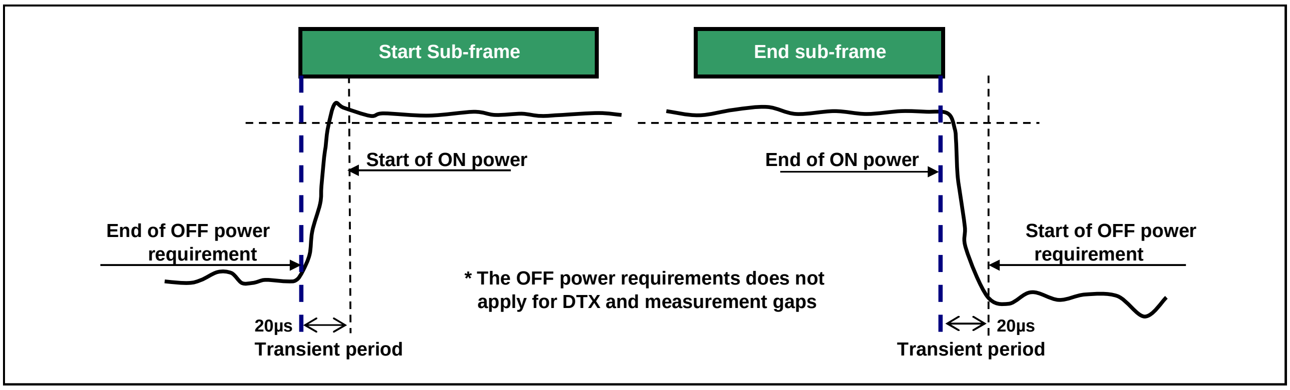


**Figure 6.3.4.1-1: General ON/OFF time mask**

## 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 |

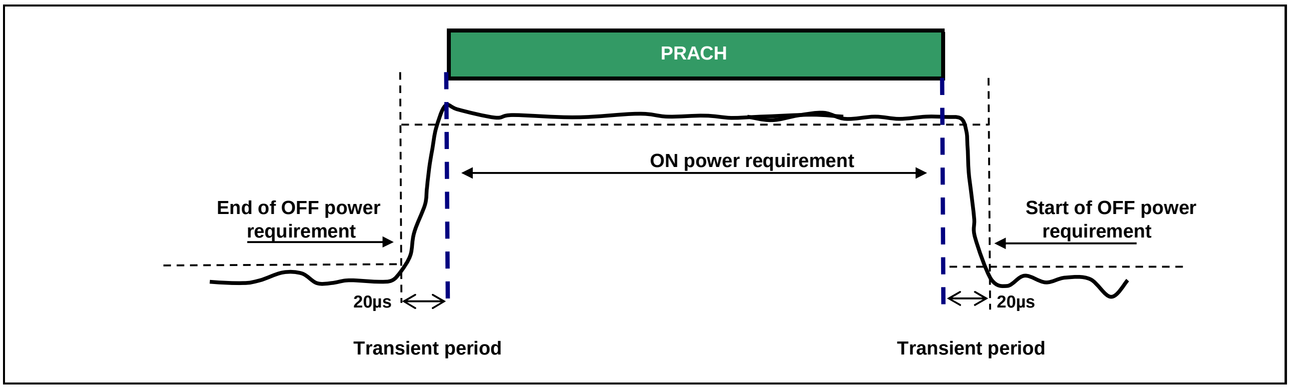


**Figure 6.3.4.2-1: PRACH ON/OFF time mask**

### 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

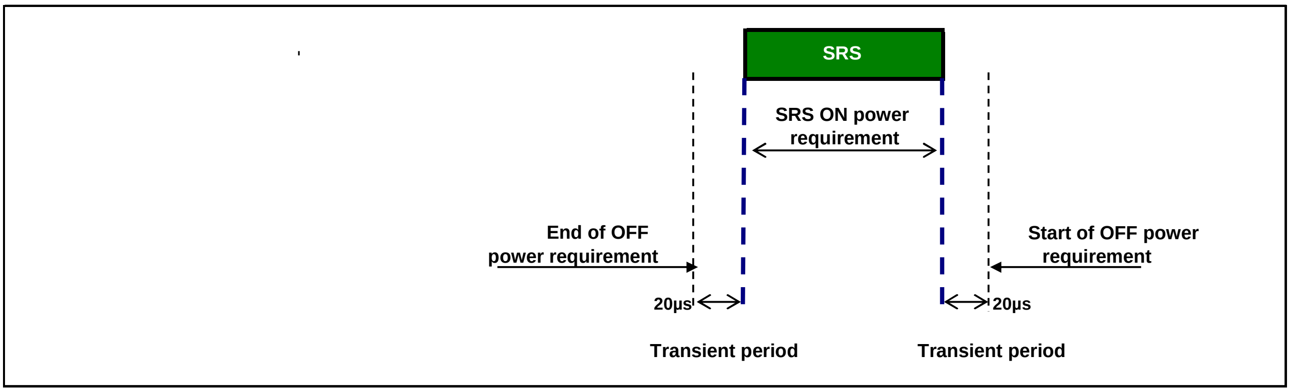


**Figure 6.3.4.2.2-1: Single SRS time mask**

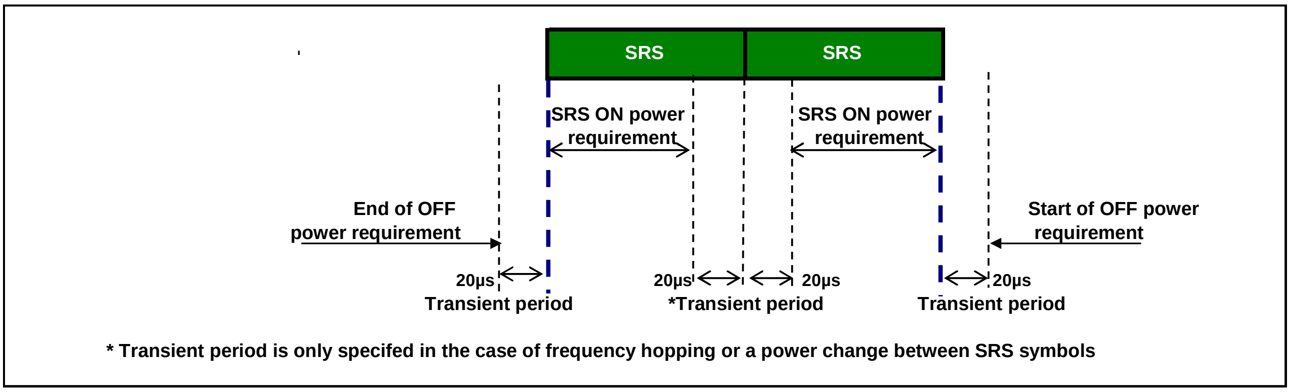


**Figure 6.3.4.2.2-2: Dual SRS time mask for the case of UpPTS transmissions**

### 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

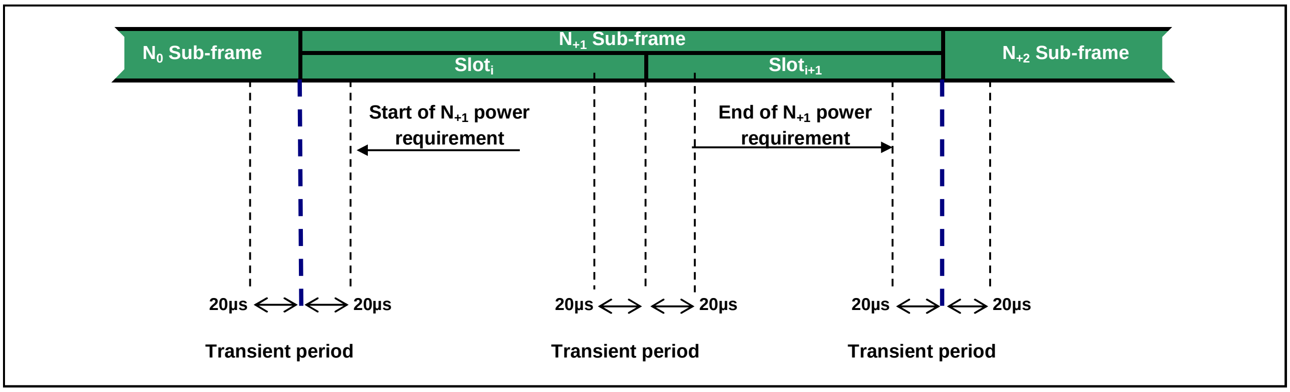


**Figure 6.3.4.3-1: Transmission power template**

## 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

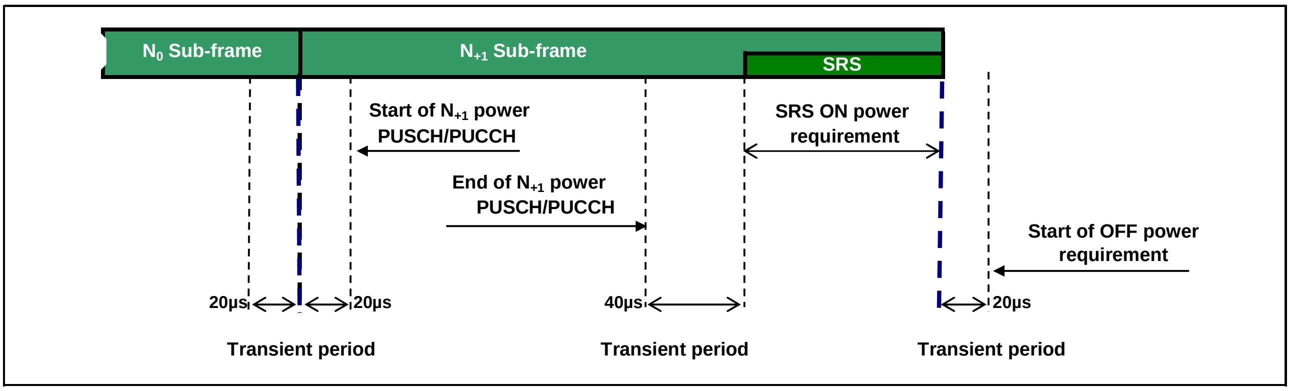


**Figure 6.3.4.4-1: PUCCH/PUSCH/SRS time mask when there is a transmission before SRS but not after**

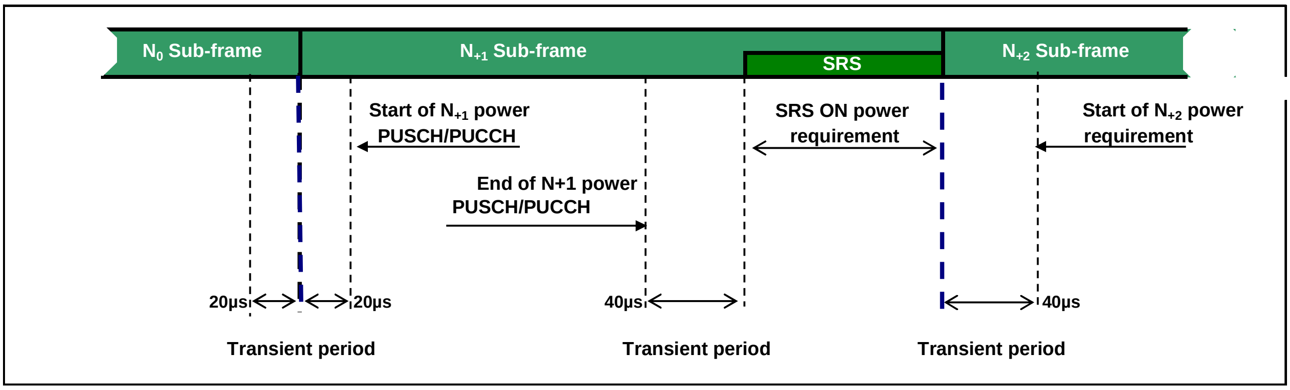


**Figure 6.3.4.4-2: PUCCH/PUSCH/SRS time mask when there is transmission before and after SRS**

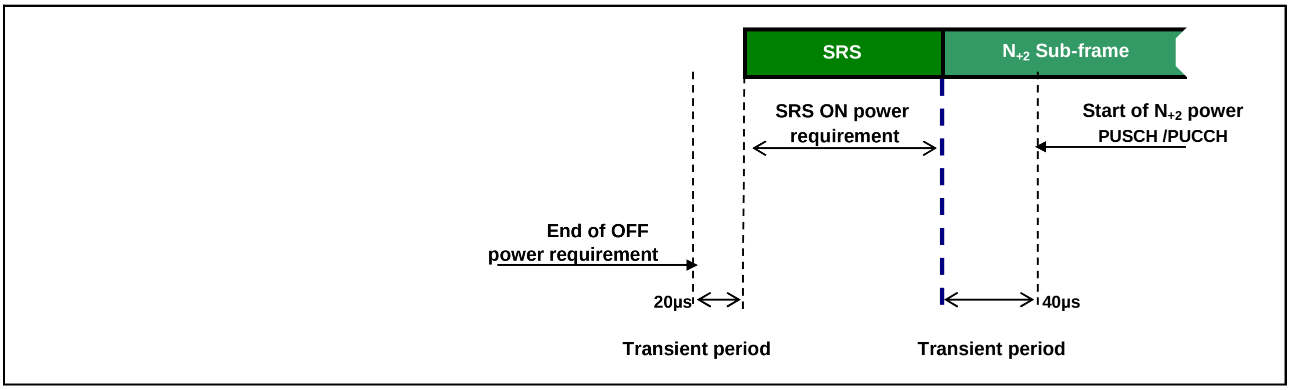


**Figure 6.3.4.4-3: PUCCH/PUSCH/SRS time mask when there is a transmission after SRS but not before**

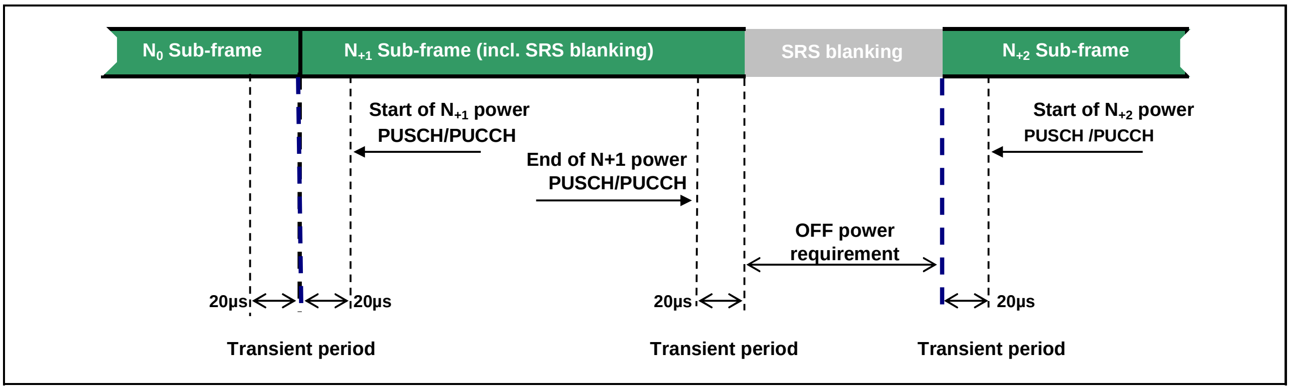


**Figure 6.3.4.4-4: SRS time mask when there is FDD SRS blanking**

## 6.3.4A ON/OFF time mask for CA

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

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

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

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

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

## 6.3.4D ON/OFF time mask for ProSe

For ProSe Direct Discovery and ProSe Direct Communications, additional requirements on ON/OFF time masks for ProSe physical channels and signals are specified in this clause.

### 6.3.4D.1 General time mask for ProSe

The General ON/OFF time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSDCH, PSCCH, and PSSCH transmissions in a subframe wherein the last symbol is punctured to create a guard period.

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

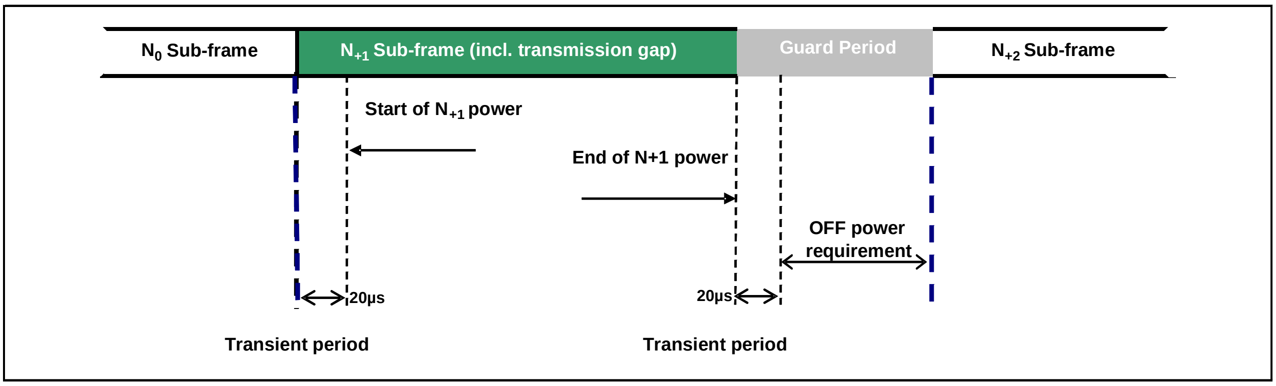


**Figure 6.3.4D.1-1: PSDCH/PSCCH/PSSCH time mask**

### 6.3.4D.2 PSSS/SSSS time mask

The PSSS time mask / SSSS time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSSS/SSSS transmissions in a subframe when not multiplexed with PSBCH in that subframe.

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

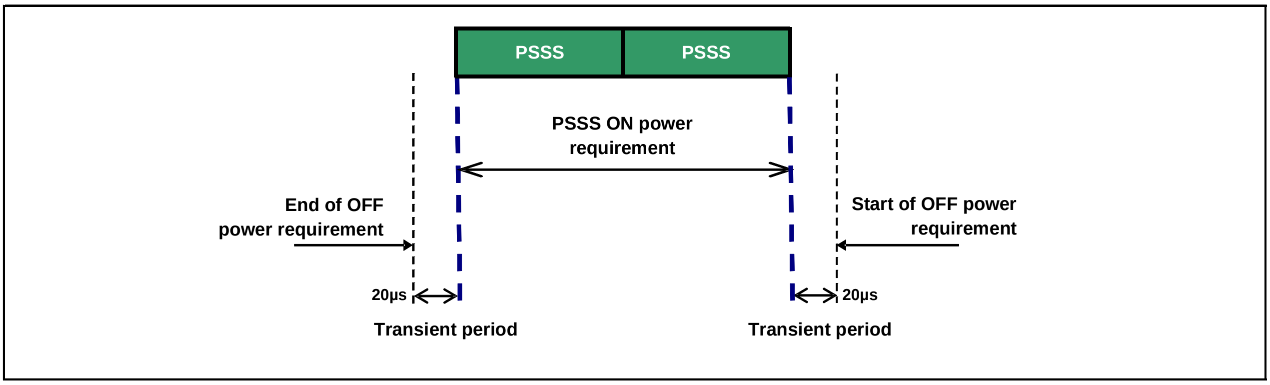


**Figure 6.3.4D.2-1: PSSS time mask for normal CP transmission (when not time-multiplexed with PSBCH)**

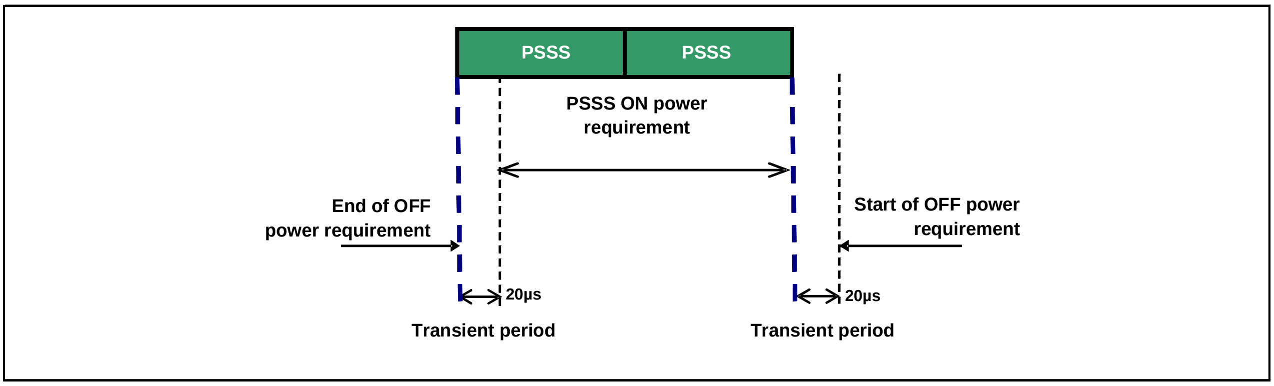


**Figure 6.3.4D.2-2: PSSS time mask for extended CP transmission (when not time-multiplexed with PSBCH)**

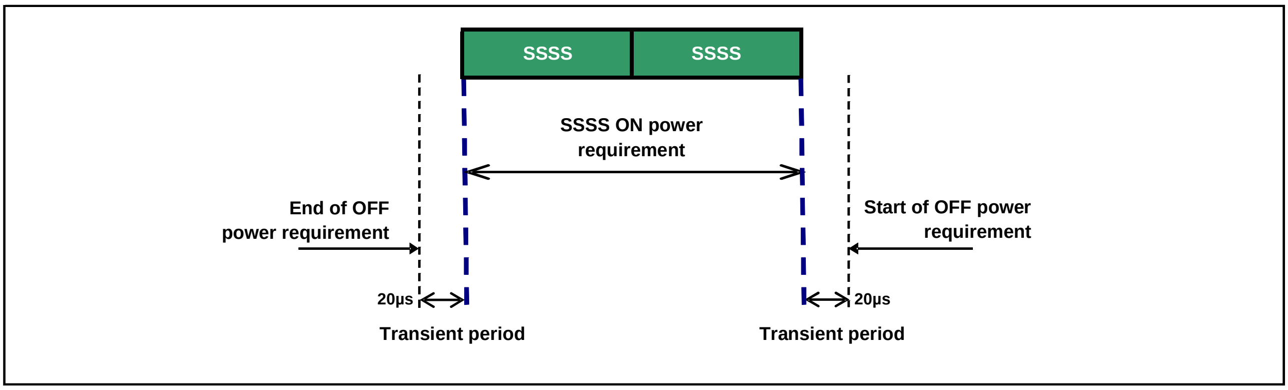


**Figure 6.3.4D.2-3: SSSS time mask (when not time-multiplexed with PSBCH)**

## 6.3.4D.3 PSSS / SSSS / PSBCH time mask

The PSSS/SSSS/PSBCH time mask defines the observation period between SSSS and adjacent PSSS/PSBCH symbols in a subframe, with last symbol punctured to create a guard period.

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

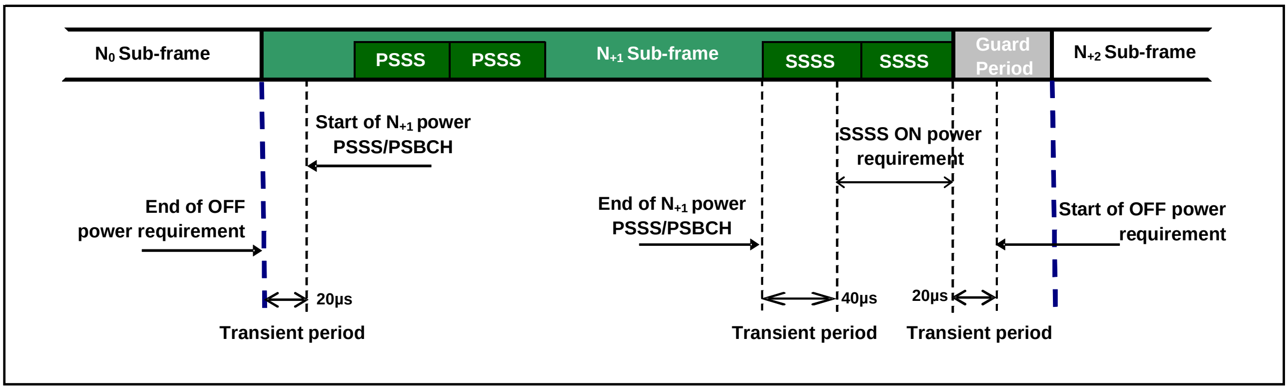


**Figure 6.3.4D.3-1: PSSS/SSSS/PBCH time mask for normal CP transmission**

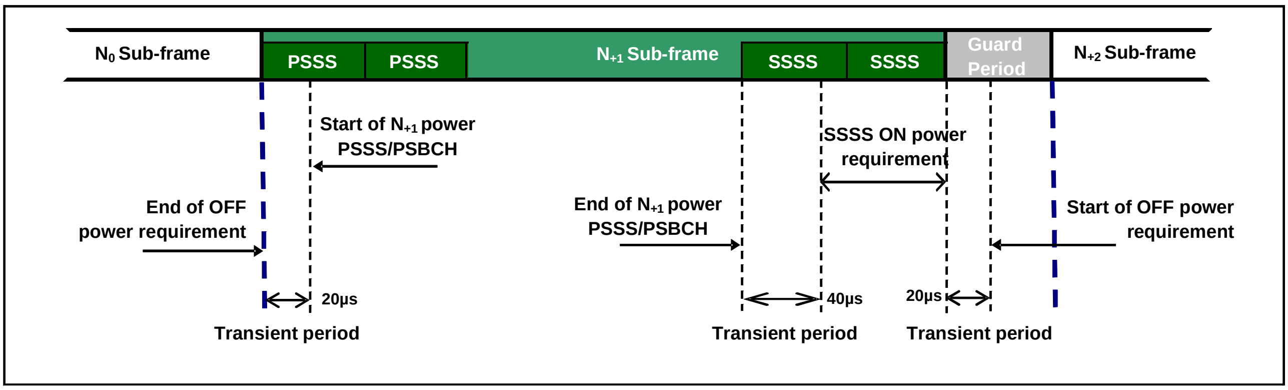


**Figure 6.3.4D.3-2: PSSS/SSSS/PBCH time mask for extended CP transmission**

#### 6.3.4D.4 PSSCH / SRS time mask

The PSSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) and an adjacent PSSCH symbol and subsequent sub-frame.

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

The PSSCH/SRS time mask shall follow the PUSCH/PUCCH/SRS time mask as specified in subclause 6.3.4.4.

### 6.3.5 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the absolute power control tolerance is specified on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by maximum output power as defined in subclause 6.2.2A. The requirements defined in Table 6.3.5.1.1-1 shall apply on each component carrier with both component carriers active. The requirements can be tested by time aligning any transmission gaps on both the component carriers.

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

### 6.3.5A.2 Relative power tolerance

#### 6.3.5A.2.1 Minimum requirements

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the relative power tolerance is specified when the power of the target and reference sub-frames on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by $P_{UMAX}$ as defined in subclause 6.2.5A. The requirements shall apply on each component carrier with both component carriers active. The UE transmitter shall have the capability of changing the output power independently on all component carriers in the uplink and:

a) the requirements for all combinations of PUSCH and PUCCH transitions per component carrier is given in Table 6.3.5.2.1-1.

b) for SRS the requirements for combinations of PUSCH/PUCCH and SRS transitions between subframes given in Table 6.3.5.2.1-1 apply per component carrier when the target and reference subframes are configured for either simultaneous SRS or simultaneous PUSCH.

c) for RACH the requirements apply for the primary cell and are given in Table 6.3.5.2.1-1.

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

The UE shall meet the following requirements for transmission on both assigned component carriers when the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame:

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

b) for SRS transitions on each component carrier, the requirements for combinations of PUSCH/PUCCH and SRS transitions given in Table 6.3.5.2.1-1 with simultaneous SRS of constant SRS bandwidth allocated in the target and reference 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the aggregate power tolerance is specified on each component carrier exceed the minimum output power as defined in subclause 6.3.2A and the total power is limited by maximum output power as defined in subclause 6.2.2A. The requirements defined in Table 6.3.5.3.1-1 shall apply on each component carrier with both component carriers active. The requirements can be tested by time aligning any transmission gaps on both the component carriers.

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

## 6.3.5B Power control for UL-MIMO

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

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

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

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

## 6.3.5D Power Control for ProSe

### 6.3.5D.1 Absolute power tolerance

For ProSe transmissions, the absolute power tolerance requirements specified in subclause 6.3.5.1 shall apply for each ProSe transmission.

## 6.4 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the frequency error requirements defined in subclause 6.5.1 shall apply on each component carrier with both component carriers active.

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.

For intra-band non-contiguous carrier aggregation the requirements in Section 6.5.1 applies per component carrier.

### 6.5.1B Frequency error for UL-MIMO

For UE(s) supporting UL-MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±0.1 PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the E-UTRA Node B.

### 6.5.1D Frequency error for ProSe

The UE modulated carrier frequency for ProSe sidelink transmissions shall be accurate to within ±0.1 PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the synchronization source. The synchronization source can be E-UTRA Node B or a ProSe UE transmitting sidelink synchronization signals.

### 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 | |

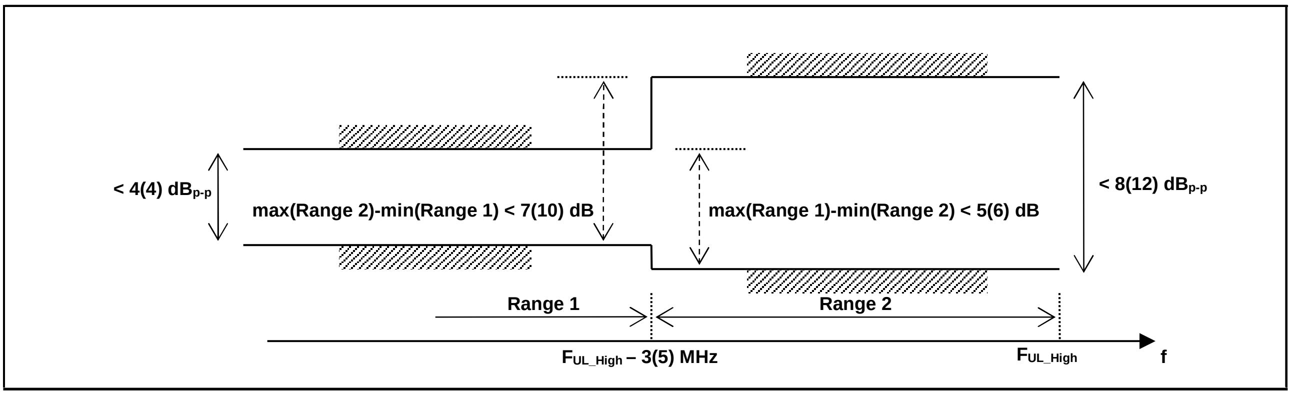


**Figure 6.5.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets).**

## 6.5.2A Transmit modulation quality for CA

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the requirements shall apply on each component carrier as defined in clause 6.5.2 with both component carriers active.

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

### 6.5.2A.1 Error Vector Magnitude

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

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

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

**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 aggrecated 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.

For intra-band non-contiguous carrier aggregation the requirements for in-band emissions should be defined for each component carrier. Requirements only apply with PRB allocation in one of the component carriers according to Table 6.5.2.3.1.

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

| Parameter | Unit | Limit | | Applicable Frequencies |
|---|---|---|---|---|
| General | dB | $\max\left\{ -25-10\cdot\log_{10}(N_{RB}/L_{CRB}),\ 20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},\ -57\,dBm/180\,kHz-P_{RB}\right\}$ | | Any non-allocated (Note 2) |
| IQ Image | dB | -25 | | Exception for IQ image (Note 3) |
| Carrier leakage | dBc | -25 | Output power > 0 dBm | Exception for Carrier frequency (Note 4) |
| | | -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 9. The limit is evaluated in each non-allocated RB.

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

NOTE 3: Exceptions to the general limit are allowed for up to $L_{CRBs}$ +1 RBs within a contiguous width of $L_{CRBs}$ +1 non-allocated RBs. The measurement bandwidth is 1 RB.

NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.

NOTE 5: $L_{CRB}$ is the Transmission Bandwidth (see Figure 5.6-1) not exceeding $\lfloor N_{RB}/2-1 \rfloor$

NOTE 6: $N_{RB}$ is the Transmission Bandwidth Configuration (see Figure 5.6-1) of the component carrier with RBs allocated.

NOTE 7: $EVM$ is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

NOTE 8: $\Delta_{RB}$ is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth).

NOTE 9: $P_{RB}$ is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

**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.<br>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.<br>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.<br>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.

## 6.5.2D Transmit modulation quality for ProSe

The requirements in this clause apply to ProSe sidelink transmissions.

### 6.5.2D.1 Error Vector Magnitude

For ProSe sidelink physical channels PSDCH, PSCCH, PSSCH, and PSBCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in subclause 6.5.2.1 for the corresponding modulation and transmission bandwidth. When ProSe transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

For PSBCH the duration over which EVM is averaged shall be 24 subframes.

This requirement is not applicable for ProSe physical signals PSSS and SSSS.

### 6.5.2D.2 Carrier leakage

The requirements of subcaluse 6.5.2.2 shall apply for ProSe transmissions.

### 6.5.2D.3 In-band emissions

For ProSe sidelink physical channels PSDCH, PSCCH, PSSCH, and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.5.2.3 for the corresponding modulation and transmission bandwidth. When ProSe transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

### 6.5.2D.4 EVM equalizer spectrum flatness for ProSe

The requirements of subcaluse 6.5.2.4 shall apply for ProSe transmissions.

## 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.

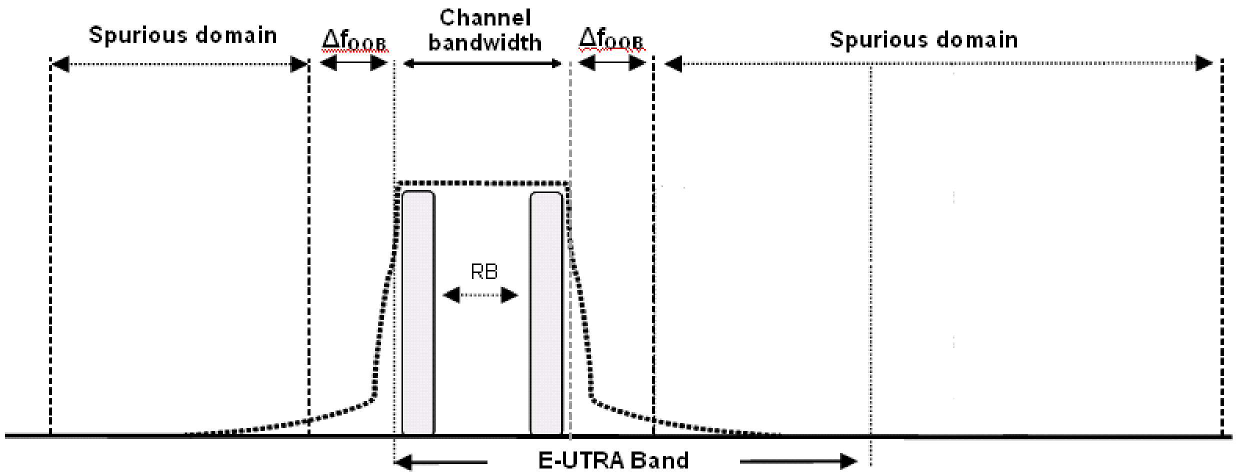


**Figure 6.6-1: Transmitter RF spectrum**

### 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands the occupied bandwidth is defined per component carrier. Occupied bandwidth is the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on assigned channel bandwidth on the component carrier. The occupied bandwidth shall be less than the channel bandwidth specified in Table 6.6.1-1.

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

For intra-band non-contiguous carrier aggregation sub-block occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the sub-block. In case the sub-block consist of one component carrier the occupied bandwidth of the sub-block shall be less than the channel bandwidth specified in Table 6.6.1-1.

### 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 | | | | | | | |
|---|---|---|---|---|---|---|---|
| $\Delta f_{OOB}$ (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 | -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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the spectrum emission mask of the UE is defined per component carrier while both component carriers are active and the requirements are specified in subclauses 6.6.2.1 and 6.6.2.2. If for some frequency spectrum emission masks of component carriers overlap then spectrum emission mask allowing higher power spectral density applies for that frequency. If for some frequency a component carrier spectrum emission mask overlaps with the channel bandwidth of another component carrier, then the emission mask does not apply for that frequency.

For intra-band contiguous carrier aggregation the spectrum emission mask of the UE applies to frequencies ($\Delta f_{OOB}$) 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]/$BW_{Channel\_CA}$ | | | | | | |
|---|---|---|---|---|---|---|
| **$\Delta f_{OOB}$ (MHz)** | **25RB+100RB (24.95MHz)** | **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 |

For intra-band non-contiguous carrier aggregation transmission the spectrum emission mask requirement is defined as a composite spectrum emissions mask. Composite spectrum emission mask applies to frequencies up to ± $\Delta f_{OOB}$ starting from the edges of the sub-blocks. Composite spectrum emission mask is defined as follows

a) Composite spectrum emission mask is a combination of individual sub-block spectrum emissions masks

b) In case the sub-block consist of one component carrier the sub-lock general spectrum emission mask is defined in subclause 6.6.2.1.1

c) If for some frequency sub-block spectrum emission masks overlap then spectrum emission mask allowing higher power spectral density applies for that frequency

d) If for some frequency a sub-block spectrum emission mask overlaps with the sub-block bandwidth of another sub-block, then the emission mask does not apply for that frequency.

### 6.6.2.2 Additional spectrum emission mask

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

#### 6.6.2.2.1 Minimum requirement (network signalled value "NS_03", “NS_11”, "NS_20", and “NS_21”)

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

When "NS_03", "NS_11", "NS_20" or "NS_21" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.1-1.

**Table 6.6.2.2.1-1: Additional requirements**

| | Spectrum emission limit (dBm)/ Channel bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|
| $\Delta f_{OOB}$ (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 | | | | |
|---|---|---|---|---|---|
| $\Delta f_{OOB}$ (MHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Measurement bandwidth |
| ± 0-1 | -15 | -18 | -20 | -21 | 30 kHz |
| ± 1-2.5 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 2.5-2.8 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 2.8-5 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 5-6 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 6-9 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 9-10 | -25 | -25 | -13 | -13 | 1 MHz |
| ± 10-13.5 | | -25 | -13 | -13 | 1 MHz |
| ± 13.5-15 | | -25 | -25 | -13 | 1 MHz |
| ± 15-18 | | | -25 | -13 | 1 MHz |
| ± 18-20 | | | -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+75B (30 MHz) | 75+100RB (34.85 MHz) | 100+100RB (39.8 MHz) | Measurement bandwidth |
| ± 0-1 | -22.5 | -22.5 | -23.5 | -24 | 30 kHz |
| ± 1-5.5 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 5.5-34.9 | -25 | -25 | -25 | -25 | 1 MHz |
| ± 34.9-35 | | -25 | -25 | -25 | 1 MHz |
| ± 35-39.85 | | | -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.

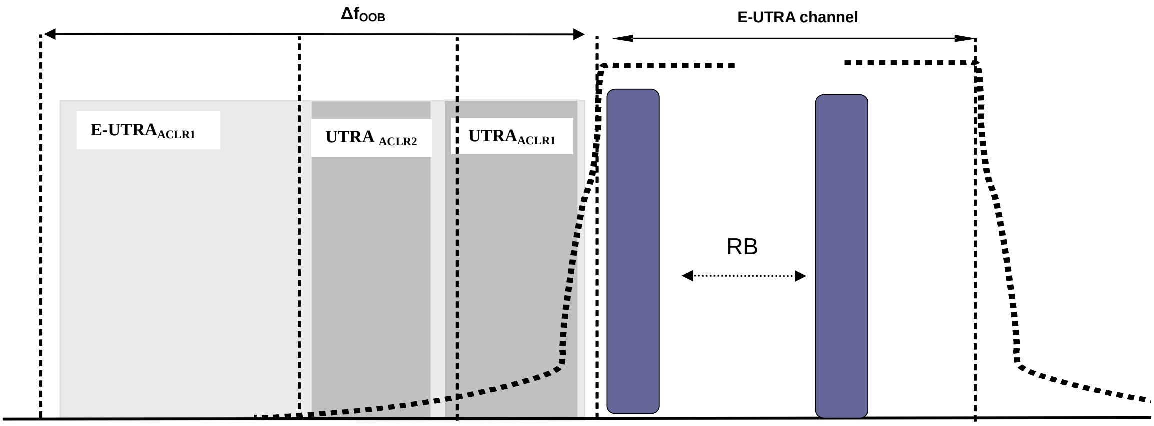


**Figure 6.6.2.3-1: Adjacent Channel Leakage requirements for one E-UTRA carrier**

### 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

#### 6.6.2.3.1Aa Void

#### 6.6.2.3.2 Minimum requirements UTRA

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

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel ($UTRA_{ACLR1}$) and the 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the UTRA Adjacent Channel Leakage power Ratio ($UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the assigned channel bandwidth on the component carrier to the filtered mean power centred on an adjacent channel frequency. The UTRA Adjacent Channel Leakage power Ratio is defined per carrier and the requirement is specified in subclause 6.6.2.3.2.

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

For intra-band non-contiguous carrier aggregation when all sub-blocks consist of one component carrier the UTRA Adjacent Channel Leakage power Ratio ($UTRA_{ACLR}$) is the ratio of the sum of the filtered mean powers centered on the assigned sub-block frequencies to the filtered mean power centred on an adjacent(s) UTRA channel frequency. $UTRA_{ACLR1/2}$ requirements are applicaple for all sub-blocks and are specified in Table 6.6.2.3.2A-2. $UTRA_{ACLR1}$ is required to be met in the sub-block gap when the gap bandwidth Wgap is 5MHz≤Wgap <15MHz. Both $UTRA_{ACLR1}$ and $UTRA_{ACLR2}$ are required to be met in the sub-block gap when the gap bandwidth Wgap is 15MHz≤Wgap.

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 for intraband contiguous carrier aggregation or 6.6.2.3.2A-2 for intraband non-contiguous carrier aggregation. If the measured UTRA channel power is greater than –50dBm then the $UTRA_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.2A-1 for intraband contiguous carrier aggregation or 6.6.2.3.2A-2 for intraband non-contiguous carrier aggregation.

**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<br>/<br>- $BW_{Channel\_CA}$ / 2 - $BW_{UTRA}$/2 |
| $UTRA_{ACLR2}$ | 36 dB |
| Adjacent channel centre frequency offset (in MHz) | + $BW_{Channel\_CA}$ /2 + 3*$BW_{UTRA}$/2<br>/<br>- $BW_{Channel\_CA}$ /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.<br>NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | |

**Table 6.6.2.3.2A-2: Requirements for intraband non-contiguous CA $UTRA_{ACLR1/2}$**

| | **$UTRA_{ACLR1/2}$ / measurement bandwidth** |
|---|---|
| **$UTRA_{ACLR1}$** | 33 dB |
| **Adjacent channel centre frequency offset (in MHz)** | + $F_{edge,block,high}$ + $BW_{UTRA}$/2<br>/<br>- $F_{edge,block,low}$ - $BW_{UTRA}$/2 |
| **$UTRA_{ACLR2}$** | 36 dB |
| **Adjacent channel centre frequency offset (in MHz)** | + $F_{edge,block,high}$ + 3*$BW_{UTRA}$/2<br>/<br>- $F_{edge,block,low}$ – 3*$BW_{UTRA}$/2 |
| **Sub-block measurement bandwidth** | $BW_{Channel,block}$ - 2* $BW_{GB}$ |
| **UTRA 5 MHz channel Measurement bandwidth (Note 1)** | 3.84 MHz |
| **UTRA 1.6 MHz channel measurement bandwidth (Note 2)** | 1.28 MHz |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.<br>NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | |

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

For intra-band contiguous carrier aggregation the carrier aggregation E-UTRA Adjacent Channel Leakage power Ratio (CA E-UTRA$_{ACLR}$) 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-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-UTRA$_{ACLR}$**

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

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands, E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned channel bandwidth on a component carrier to the filtered mean power centred on an adjacent channel frequency. The E-UTRA Adjacent Channel Leakage power Ratio is defined per carrier and the requirement is specified in subclause 6.6.2.3.1.

For intra-band non-contiguous carrier aggregation when all sub-blocks consist of one component carrier the E-UTRA Adjacent Channel Leakage power Ratio (E-UTRA$_{ACLR}$) is the ratio of the sum of the filtered mean powers centred on the assigned sub-block frequencies to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. In case the sub-block gap bandwidth Wgap is smaller than of the sub-block bandwidth then for that sub-block no E-UTRA$_{ACLR}$ requirement is set for the gap. In case the sub-block gab bandwidth Wgap is smaller than either of the sub-block bandwidths then no E- UTRA$_{ACLR}$ requirement is set for the gap.The assigned E-UTRA sub-block power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.3A-2. If the measured adjacent channel power is greater than –50dBm then the E-UTRA$_{ACLR}$ shall be higher than the value specified in Table 6.6.2.3.3A-2.

**Table 6.6.2.3.3A-2: General requirements for non-contiguous intraband CA E-UTRA$_{ACLR}$**

| | CC and adjacent channel bandwidth / E-UTRA$_{ACLR}$ / Measurement bandwidth | | | | | |
|---|---|---|---|---|---|---|
| | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| **E-UTRA$_{ACLR1}$** | 30 dB | 30 dB | 30 dB | 30 dB | 30 dB | 30 dB |
| **CC and adjacent channel measurement bandwidth [MHz]** | 1.08 | 2.7 | 4.5 | 9 | 13.5 | 18 |
| **Adjacent channel centre frequency offset [MHz]** | + 1.4 / - 1.4 | + 3 / - 3 | + 5 / - 5 | + 10 / - 10 | + 15 / - 15 | + 20 / - 20 |

### 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 < 5$^{th}$ 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the spurious emission requirement Table 6.6.3.1-2 apply for the frequency ranges that are more than $F_{OOB}$ as defined in Table 6.6.3.1-1 away from edges of the assigned channel bandwidth on a component carrier. If for some frequency a spurious emission requirement of individual component carrier overlaps with the spectrum emission mask or channel bandwidth of another component carrier then it does not apply.

NOTE: For inter-band carrier aggregation with uplink assigned to two E-UTRA bands the requirements in Table 6.6.3.1-2 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.6.3.1-2 would be considered to be verified by the measurements verifying the one uplink inter-band CA spurious emission requirement.

For intra-band contiguous carrier aggregation the spurious emission limits apply for the frequency ranges that are more than 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 |

For intra-band non-contiguous carrier aggregation transmission the spurious emission requirement is defined as a composite spurious emission requirement. Composite spurious emission requirement applies to frequency ranges that are more than $F_{OOB}$ away from the edges of the sub-blocks. Composite spurious emission requirement is defined as follows

a) Composite spurious emission requirement is a combination of individual sub-block spurious emission requirements

b) In case the sub-block consist of one component carrier the sub-lock spurious emission requirement and $F_{OOB}$ are defined in subclause 6.6.3.1

c) If for some frequency an individual sub-block spurious emission requirement overlaps with the general spectrum emission mask or the sub-block bandwidth of another sub-block then it does not apply

### 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, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 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 | | 1879.9 | -50 | 1 | 15 |
| | 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, 23, 24, 26, 27, 28, 29, 30, 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, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 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, 7, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 28, 29, 30, 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 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 23, 24, 25, 28, 29, 30, 31, 34, 38, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 26 | 859 | - | 869 | -27 | 1 | |
| | E-UTRA Band 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| 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, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 20, 22, 26, 27, 28, 29, 30, 31, 32, 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, 31, 32, 33, 34, 38, 39, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3, 7, 22, 41, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 8 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 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 | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| 10 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 28, 29, 30, 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 | 945 | - | 960 | -50 | 1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| 12 | E-UTRA Band 2, 5, 13, 14, 17, 23, 24, 25, 26, 27, 30, 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 | |
| | E-UTRA Band 14 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 15 |
| | E-UTRA Band 24, 30 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 15 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 15 |
| 14 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 29, 30, 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, 30, 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 | 758 | - | 799 | -50 | 1 | |
| | Frequency range | 799 | - | 803 | -40 | 1 | 15 |
| | Frequency range | 860 | - | 890 | -40 | 1 | |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| 19 | E-UTRA Band 1, 11, 21, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| 20 | E-UTRA Band 1, 3, 7, 8, 22, 31, 32, 33, 34, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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 | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| 22 | E-UTRA Band 1, 3, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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, 30, 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, 30, 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, 30, 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, 30, 31, 34, 39, 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 | 703 | - | 799 | -50 | 1 | |
| | Frequency range | 799 | - | 803 | -40 | 1 | 15 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| 27 | E-UTRA Band 1, 2, 3, 4, 5, 7, 10, 12, 13, 14, 17, 23, 25, 26, 27, 29, 30, 31, 38, 40, 41, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 28 | $F_{DL\_low}$ | - | 790 | -50 | 1 | |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | |
| 28 | E-UTRA Band 1, 4, 10, 22, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 1 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 19, 25 |
| | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 40, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 19, 24 |
| | Frequency range | 470 | - | 694 | -42 | 8 | 15, 35 |
| | Frequency range | 470 | - | 710 | -26.2 | 6 | 34 |
| | Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
| | Frequency range | 758 | - | 773 | -32 | 1 | 15 |
| | Frequency range | 773 | - | 803 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 19 |
| 30 | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 29, 30, 38, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| 31 | E-UTRA Band 1, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 33, 34, 38, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| … | | | | | | | |
| 33 | E-UTRA Band 1, 7, 8, 20, 22, 28, 31, 32, 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, 31, 32, 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, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 20, 22, 27, 28, 29, 30, 31, 32, 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 1, 8, 22, 26, 34, 40, 41, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 1805 | | 1855 | -40 | 1 | 33 |
| | Frequency range | 1855 | | 1880 | -15.5 | 5 | 15,26,33 |
| 40 | E-UTRA Band 1, 3, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 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, 30, 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 | 1884.5 | | 1915.7 | -41 | 0.3 | 8, 30 |
| 42 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 11, 18, 19, 20, 21, 25, 26, 27, 28, 31, 32, 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, 31,32, 33, 34, 38, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 22 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | [-50] | [1] | 3 |
| 44 | E-UTRA Band 1, 40, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 3, 5, 8, 34, 39, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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: 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.<br>NOTE 28: N/A<br>NOTE 29: N/A<br>NOTE 30: This requirement applies when the E-UTRA carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz<br>NOTE 31: N/A<br>NOTE 32: Void<br>NOTE 33: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.<br>NOTE 34: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.<br>NOTE 35: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. |

### 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.

For inter-band carrier aggregation with the uplink assigned to two E-UTRA bands, the requirements in Table 6.6.3.2A-0 apply on each component carrier with both component carriers are active.

NOTE: For inter-band carrier aggregation with uplink assigned to two E-UTRA bands the requirements in Table 6.6.3.2A-0 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.6.3.2A-0 would be considered to be verified by the measurements verifying the one uplink inter-band CA UE to UE co-existence requirements.

**Table 6.6.3.2A-0: Requirements for uplink inter-band carrier aggregation (two bands)**

| E-UTRA CA Configuration | Spurious emission | | | | | | |
|---|---|---|---|---|---|---|---|
| | Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
| CA_1A-3A | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 38, 40, 41, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 11,18,19, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 10 |
| | E-UTRA band 22, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 7, 10 |
| | Frequency range | 1880 | | 1895 | -40 | 1 | 3,12 |
| | Frequency range | 1895 | | 1915 | -15.5 | 5 | 3, 12, 13 |
| | Frequency range | 1915 | | 1920 | +1.6 | 5 | 3, 12, 13 |
| CA_1A-5A | E-UTRA Band 1, 5, 7, 8, 22, 28, 31, 38, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3,34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 26 | 859 | - | 869 | -27 | 1 | |
| | E-UTRA band 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| CA_1A-7A | E-UTRA Band 1, 5, 7, 8, 20, 22, 26, 27, 28, 31,32, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | Frequency range | 1880 | | 1895 | -40 | 1 | 3,12 |
| | Frequency range | 1895 | | 1915 | -15.5 | 5 | 3, 12, 13 |
| | Frequency range | 1915 | | 1920 | +1.6 | 5 | 3, 12, 13 |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_1A-8A | E-UTRA Band 1, 20, 26, 28, 31, 32, 38, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2,3 |
| | E-UTRA band 7, 22, 41, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 8, 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 11 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 3, 11 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 7, 11 |
| | Frequency range | 1880 | | 1895 | -40 | 1 | 3,12 |
| | Frequency range | 1895 | | 1915 | -15.5 | 5 | 3, 12, 13 |
| | Frequency range | 1915 | | 1920 | +1.6 | 5 | 3, 12, 13 |
| CA_1A-19A | E-UTRA Band 1, 11, 21, 28, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 3, 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 7 |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | 3 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| CA_1A-21A | E-UTRA Band 11 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -35 | 1 | 3, 16 |
| | E-UTRA Band 1, 18, 19, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 16 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 7 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| CA_2A-4A | E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 22, 23, 24, 26, 27, 28, 29, 30, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 2, 25 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| CA_2A-13A | E-UTRA Band 4, 5,10,12,13,17, 22, 23, 26, 27, 29, 41, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | E-UTRA Band 2,14, 25 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 24, 30, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 3 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 3, 9 |
| CA_3A-5A | E-UTRA Band 1, 5, 7, 8, 22, 28, 31, 38, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3,34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 26 | 859 | - | 869 | -27 | 1 | |
| CA_3A-7A | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 40, 43, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 22, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_3A-8A | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3, 8 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2, 3 |
| | E-UTRA band 11, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 10,11 |
| | E-UTRA band 7, 22, 41, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 4, 10, 11 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 3,11,17 |
| CA_3A-19A | E-UTRA Band 1, 11, 21, 28 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 34 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 3, 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 4 |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | 3 |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| CA_3A-20A | E-UTRA Band 1, 7, 8, 31, 32, 33, 34, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 3, 20 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 22, 38, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 758 | - | 788 | -50 | 1 | |
| CA_3A-26A | E-UTRA Band 1, 5, 7, 26, 34, 39, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 3 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA band 11, 18, 19, 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 10 |
| | E-UTRA band 22, 41, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 4, 10 |
| | Frequency range | 703 | - | 799 | -50 | 1 | |
| | | 799 | - | 803 | -40 | 1 | 3 |
| | Frequency range | 851 | - | 859 | -53 | 0.00625 | 15 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| CA_4A-7A | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 28, 29, 30, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_4A-12A | E-UTRA Band 2, 5, 7,13, 14, 17, 22, 23, 24, 25, 26, 27, 30, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 4, 10. 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| CA_4A-13A | E-UTRA Band 2,4, 5, 7, 10,12,13,17, 22, 23,25, 26, 27, 29, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 14 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 24, 30, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 769 | - | 775 | -35 | 0.00625 | 3 |
| | Frequency range | 799 | - | 805 | -35 | 0.00625 | 3, 9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CA_4A-17A | E-UTRA Band 2, 5, 7,13, 14, 17, 22, 23, 24, 25, 26, 27, 30, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 4, 10. 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| CA_5A-7A | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 22, 28, 29, 30, 31, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 26 | 859 | - | 869 | -27 | 1 | |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_5A-12A | E-UTRA Band 2, 5, 13, 14, 17, 22, 23, 24, 25, 30, 31, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 4, 10, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA band 26 | 859 | - | 869 | -27 | 1 | |
| | E-UTRA band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| CA_5A-17A | E-UTRA Band 2, 5, 13, 14, 17, 22, 23, 24, 25, 30, 31, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA band 4, 10, 41 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA band 26 | 859 | - | 869 | -27 | 1 | |
| | E-UTRA band 12 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| CA_7A-20A | E-UTRA Band 1,3, 7, 8, 22, 28, 31, 32, 33, 34, 40, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 20 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3 |
| | E-UTRA Band 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_7A-28A | E-UTRA Band 2, 3, 5, 7, 8, 20, 26, 27, 31, 34, 40 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 1, 4, 10, 22, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| | E-UTRA Band 1 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 5, 6 |
| | Frequency range | 758 | - | 773 | -32 | 1 | 3 |
| | Frequency range | 773 | - | 803 | -50 | 1 | |
| | Frequency range | 2570 | - | 2575 | +1.6 | 5 | 3, 13, 14 |
| | Frequency range | 2575 | - | 2595 | -15.5 | 5 | 3, 13, 14 |
| | Frequency range | 2595 | - | 2620 | -40 | 1 | 3, 14 |
| CA_19A-21A | E-UTRA Band 1, 18, 19, 28, 34, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 11 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 3, 16 |
| | E-UTRA Band 21 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 16 |
| | Frequency range | 860 | - | 890 | -40 | 1 | 3, 8 |
| | Frequency range | 945 | - | 960 | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 4 |
| | Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | |
| | Frequency range | 2545 | - | 2575 | -50 | 1 | |
| | Frequency range | 2595 | - | 2645 | -50 | 1 | |
| CA 39A-41A | E-UTRA Band 1, 8, 26, 34, 40, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 1805 | - | 1855 | -40 | 1 | 20 |
| | Frequency range | 1855 | - | 1880 | -15.5 | 5 | 3, 13, 20 |

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 In case the exceptions are allowed due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x $L_{CRB}$ x 180kHz), where N is 2, 3 or 4 for the 2nd, 3rd or 4th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: These requirements also apply for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

NOTE 4: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.

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

NOTE 6: 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 7: Applicable when NS_05 in section 6.6.3.3.1 is signalled by the network.

NOTE 8: Applicable when NS_08 in subclause 6.6.3.3.3 is signalled by the network

NOTE 9: Whether the applicable frequency range should be 793-805MHz instead of 799-805MHz is TBD.

NOTE10: This requirement applies for 5, 10, 15 and 20 MHz E-UTRA channel bandwidth allocated within 1744.9MHz and 1784.9MHz.

NOTE 11: 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 12: 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.

NOTE13: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.

NOTE 14: 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 15: Applicable when NS_15 in subclause 6.6.3.3.8 is signalled by the network.

NOTE 16: Applicable when NS_09 in subclause 6.6.3.3.4 is signalled by the network

NOTE 17: This requirement is applicable only when Band 3 transmission frequency is less than or equal to 1765 MHz.

NOTE 18: This requirement applies when the E-UTRA carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz

NOTE 19: Void

NOTE 20: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.

**Table 6.6.3.2A-1: Requirements for intraband carrier aggregation**

| E-UTRA CA Configuration | Spurious emission | | | | | | |
|---|---|---|---|---|---|---|---|
| | Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
| CA_1C | E-UTRA Band 1, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 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_3C | E-UTRA Band 1, 7, 8, 20, 26, 27, 28, 31, 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 | 10 |
| | E-UTRA Band 22, 42 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | 2 |
| CA_7C | E-UTRA Band 1, 3, 7, 8, 20, 22, 27, 28, 29, 30. 31, 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, 30, 31, 33, 34, 40, 42, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| CA_39C | E-UTRA Band 22, 34, 40, 41, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -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, 30, 34, 39, 40, 42, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| CA_42C | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 11, 18, 19, 20, 21, 25, 26, 27, 28, 31, 33, 34, 38, 40, 41, 44 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | |

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

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 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 13: N/A

NOTE 14: N/A

**Table 6.6.3.2A-2: Requirements for intraband non-contiguous CA**

| E-UTRA CA Configuration | Spurious emission | | | | | | |
|---|---|---|---|---|---|---|---|
| | Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
| CA_4A-4A | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 22, 23, 24, 25, 26, 27, 28, 29, 30, 41, 43 | $F_{DL\_low}$ | - | $F_{DL\_high}$ | -50 | 1 | |
| | E-UTRA Band 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<br>NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd or 3rd harmonic spurious emissions. 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 LCRB x 180kHz), where N is 2 or 3 for the 2nd or 3rd harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | |

### 6.6.3.3 Additional spurious emissions

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

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

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

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

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

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | | | | Measurement bandwidth | Note |
|---|---|---|---|---|---|---|
| | 5 MHz | 10 MHz | 15 MHz | 20 MHz | | |
| $1884.5 \leq f \leq 1915.7$ | -41 | -41 | -41 | -41 | 300 KHz | 1 |

#### 6.6.3.3.2 Minimum requirement (network signalled value “NS_07”)

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

**Table 6.6.3.3.2-1: Additional requirements**

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

#### 6.6.3.3.3 Minimum requirement (network signalled value “NS_08”)

When “NS 08” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.3-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (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, 10 MHz, 15 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 |
|---|---|---|
| | 1.4, 3, 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_21")

When "NS_21" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.15-1. These requirements also apply for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.15-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 5, 10 MHz | |
| 2200 ≤ f < 2288 | -40 | 1 MHz |
| 2288 ≤ f < 2292 | -37 | 1 MHz |
| 2292 ≤ f < 2296 | -31 | 1 MHz |
| 2296 ≤ f < 2300 | -25 | 1 MHz |
| 2320 ≤ f < 2324 | -25 | 1 MHz |
| 2324 ≤ f < 2328 | -31 | 1 MHz |
| 2328 ≤ f < 2332 | -37 | 1 MHz |
| 2332 ≤ f ≤ 2395 | -40 | 1 MHz |

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

When "NS 22" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.16-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.16-1: Additional requirement**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) 5, 10, 15, 20 MHz | MBW |
|---|---|---|
| 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 | | |

### 6.6.3.3.17 Minimum requirement (network signalled value "NS_23")

When "NS 23" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.17-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.17-1: Additional requirement**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) 5, 10, 15, 20 MHz | MBW |
|---|---|---|
| 3400 ≤ f ≤ 3800 | -23 (Note 1, Note 4) | 5 MHz |
| | -40 (Note 2) | 1 MHz |
| NOTE 1: This requirement applies within an offset between 5 MHz + $F_{offset\_NS\_23}$ 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 | | |

### 6.6.3.3.18 Void

**Table 6.6.3.3.18-1: Void**

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

When "NS 04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.19-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

**Table 6.6.3.3.19-1: Additional requirements**

| Frequency band (MHz) | Channel bandwidth / Spectrum emission limit (dBm) | Measurement bandwidth |
|---|---|---|
| | 5, 10, 15, 20 MHz | |
| 2490.5 ≤ f < 2496 | -13 | 1 MHz |
| 0 < f < 2490.5 | -25 | 1 MHz |

### 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)**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| E-UTRA band 34 | FDL_low | - | FDL_high | -50 | 1 | |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
| NOTE 1: Applicable when the aggregated channel bandwidth is confined within frequency range 1940 – 1980 MHz | | | | | | |

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

When "CA_NS_02" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.2-1. This requirement also applies for the frequency ranges that are less than 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 FOOB (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 FOOB (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 FOOB (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 FOOB (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.6 Minimum requirement for CA_39C (network signalled value "CA_NS_07")

When "CA_NS_07" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.6-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.6-1: Additional requirements**

| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
|---|---|---|---|---|---|---|
| Frequency range | 1805 | - | 1855 | -40 | 1 | 1 |
| Frequency range | 1855 | - | 1880 | -15.5 | 5 | 1, 2, 3 |
| NOTE 1: This requirement is applicable for carriers with aggregated channel bandwidths confined in 1885-1920 MHz.<br>NOTE 2: The requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.<br>NOTE 3: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | |

#### 6.6.3.3A.7 Minimum requirement for CA_42C (network signalled value "CA_NS_08")

When "CA_NS_08" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3A.7-1. This requirement also applies for the frequency ranges that are less than $F_{OOB}$ (MHz) in Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.

**Table 6.6.3.3A.7-1: Additional requirements**

| Frequency band (MHz) | Aggregated bandwidth / Spectrum emission limit (dBm) | MBW |
|---|---|---|
| | 25, 30, 35, 40 MHz (Note 1) | |
| 3400 ≤ f ≤ 3800 | -23 (Note 2, Note 4) | 5 MHz |
| | -40 (Note 3) | 1 MHz |
| NOTE 1: Possible aggregated bandwidth for CA_42C as specified in Table 5.6A.1-1.<br>NOTE 2: This requirement applies within an offset between 5 MHz and 25 MHz from the lower and from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.<br>NOTE 3: This requirement applies from 3400 MHz to 25 MHz below the lower E-UTRA channel edge and from 25 MHz above the upper E-UTRA channel edge to 3800 MHz.<br>NOTE 4: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band. | | |

## 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 inter-band carrier aggregation with uplink assigned to two E-UTRA bands, the requirement is specified in Table 6.7.1-1 which shall apply on each component carrier with both component carriers active.

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

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

| CA bandwidth class(UL) | 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 signal is 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:

$$Wgap \geq 2 \cdot |FInterferer\ (offset)_{,j}| - BWChannel(j)$$

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.

For a ProSe UE that supports both ProSe Direct Discovery and ProSe Direct Communication, the receiver characteristics specified in clause 7 for ProSe Direct Communication shall apply.

For ProSe Direct Discovery and ProSe Direct Communication on E-UTRA ProSe operating bands that correspond to TDD E-UTRA operating bands as specified in subclause 5.5D, the only additional requirement for ProSe specified in subcaluse 7.4.1D is applicable.

# 7.2 Diversity characteristics

The requirements in Section 7 assume that the receiver is equipped with two Rx port as a baseline. These requirements apply to all UE categories unless stated otherwise. 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.

For a category 0 UE the requirements in Section 7 assume that the receiver is equipped with single Rx port.

# 7.3 Reference sensitivity power level

The reference sensitivity power level REFSENS is the minimum mean power applied to both the UE antenna ports for all UE categories except category 0, or to the single antenna port for UE category 0, 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 |
| 30 | | | -99 | -96 | | | FDD |
| 31 | -99.0 | -95.7 | -93.5 | | | | FDD |
| … | | | | | | | |
| 33 | | | -100 | -97 | -95.2 | -94 | TDD |
| 34 | | | -100 | -97 | -95.2 | | TDD |
| 35 | -106.2 | -102.2 | -100 | -97 | -95.2 | -94 | TDD |
| 36 | -106.2 | -102.2 | -100 | -97 | -95.2 | -94 | TDD |
| 37 | | | -100 | -97 | -95.2 | -94 | TDD |
| 38 | | | -100 | -97 | -95.2 | -94 | TDD |
| 39 | | | -100 | -97 | -95.2 | -94 | TDD |
| 40 | | | -100 | -97 | -95.2 | -94 | TDD |
| 41 | | | -98 | -95 | -93.2 | -92 | TDD |
| 42 | | | -99 | -96 | -94.2 | -93 | TDD |
| 43 | | | -99 | -96 | -94.2 | -93 | TDD |
| 44 | | [-100.2] | [-98] | [-95] | [-93.2] | [-92] | TDD |

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 and Table 7.3.1-1B with the uplink in one or two E-UTRA bands, 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 Table 7.3.1-1A and Table 7.3.1-1B for the applicable E-UTRA bands.

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

| Inter-band CA Configuration | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-3A | 1 | 0 |
| | 3 | 0 |
| CA_1A-5A | 1 | 0 |
| | 5 | 0 |
| CA_1A-7A | 1 | 0 |
| | 7 | 0 |
| CA_1A-8A | 1 | 0 |
| | 8 | 0 |
| CA_1A-11A | 1 | 0 |
| | 11 | 0 |
| CA_1A-18A | 1 | 0 |
| | 18 | 0 |
| CA_1A-19A | 1 | 0 |
| | 19 | 0 |
| CA_1A-20A | 1 | 0 |
| | 20 | 0 |
| CA_1A-21A | 1 | 0 |
| | 21 | 0 |
| CA_1A-26A | 1 | 0 |
| | 26 | 0 |
| CA_1A-28A | 1 | 0 |
| | 28 | 0.2 |
| CA_1A-41A[8] | 1 | 0 |
| | 41 | 0 |
| CA_1A-41C[8] | 1 | 0 |
| | 41 | 0 |
| CA_1A-42A | 1 | 0 |
| | 42 | 0.5 |
| CA_1A-42C | 1 | 0 |
| | 42 | 0.5 |
| CA_2A-4A | 2 | 0.3 |
| | 4 | 0.3 |
| CA_2A-4A-4A | 2 | 0.3 |
| | 4 | 0.3 |
| CA_2A-5A | 2 | 0 |
| | 5 | 0 |
| CA_2A-2A-5A | 2 | 0 |
| | 5 | 0 |
| CA_2A-12A | 2 | 0 |
| | 12 | 0 |
| CA_2A-12B | 2 | 0 |
| | 12 | 0 |
| CA_2A-13A | 2 | 0 |
| | 13 | 0 |
| CA_2A-2A-13A | 2 | 0 |
| | 13 | 0 |
| CA_2A-17A | 2 | 0 |
| | 17 | 0.5 |
| CA_2A-29A | 2 | 0 |
| CA_2C-29A | 2 | 0 |
| CA_2A-30A | 2 | 0.4 |
| | 30 | 0.5 |
| CA_3A-5A | 3 | 0 |
| | 5 | 0 |
| CA_3A-7A | 3 | 0 |
| | 7 | 0 |
| CA_3A-7C | 3 | 0 |
| | 7 | 0 |
| CA_3C-7A | 3 | 0 |
| | 7 | 0 |
| CA_3A-8A | 3 | 0 |

| | | |
|---|---|---|
| | 8 | 0 |
| CA_3A-19A | 3 | 0 |
| | 19 | 0 |
| CA_3A-20A | 3 | 0 |
| | 20 | 0 |
| CA_3A-26A | 3 | 0 |
| | 26 | 0 |
| CA_3A-27A | 3 | 0 |
| | 27 | 0 |
| CA_3A-28A | 3 | 0 |
| | 28 | 0 |
| CA_3A-42A | 3 | 0.2 |
| | 42 | 0.5 |
| CA_3A-42C | 3 | 0.2 |
| | 42 | 0.5 |
| CA_4A-5A | 4 | 0 |
| | 5 | 0 |
| CA_4A-4A-5A | 4 | 0 |
| | 5 | 0 |
| CA_4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-4A-7A | 4 | 0.5 |
| | 7 | 0.5 |
| CA_4A-12A | 4 | 0 |
| | 12 | 0.5 |
| CA_4A-12B | 4 | 0 |
| | 12 | 0.5 |
| CA_4A-4A-12A | 4 | 0 |
| | 12 | 0.5 |
| CA_4A-13A | 4 | 0 |
| | 13 | 0 |
| CA_4A-4A-13A | 4 | 0 |
| | 13 | 0 |
| CA_4A-17A | 4 | 0 |
| | 17 | 0.5 |
| CA_4A-27A | 4 | 0 |
| | 27 | 0 |
| CA_4A-29A | 4 | 0 |
| CA_4A-30A | 4 | 0.4 |
| | 30 | 0.5 |
| CA_5A-7A | 5 | 0 |
| | 7 | 0 |
| CA_5A-12A | 5 | 0.5 |
| | 12 | 0.3 |
| CA_5A-13A | 5 | 0 |
| | 13 | 0 |
| CA_5A-17A | 5 | 0.5 |
| | 17 | 0.3 |
| CA_5A-25A | 5 | 0 |
| | 25 | 0 |
| CA_5A-30A | 5 | 0 |
| | 30 | 0 |
| CA_7A-8A | 7 | 0 |
| | 8 | 0.2 |
| CA_7A-12A | 7 | 0 |
| | 12 | 0 |
| CA_7A-20A | 7 | 0 |
| | 20 | 0 |
| CA_7A-28A | 7 | 0 |
| | 28 | 0 |
| CA_8A-11A | 8 | 0 |
| | 11 | 0 |
| CA_8A-20A | 8 | 0 |
| | 20 | 0 |
| CA_8A-40A | 8 | 0 |

| | | |
|---|---|---|
| | 40 | 0 |
| CA_11A-18A | 11 | 0 |
| | 18 | 0 |
| CA_12A-25A | 12 | 0 |
| | 25 | 0 |
| CA_12A-30A | 12 | 0 |
| | 30 | 0 |
| CA_18A-28A[9] | 18 | 0 |
| | 28 | 0 |
| CA_19A-21A | 19 | 0 |
| | 21 | 0 |
| CA_19A-42A | 19 | 0 |
| | 42 | 0.5 |
| CA_19A-42C | 19 | 0 |
| | 42 | 0.5 |
| CA_20A-32A | 20 | 0 |
| CA_23A-29A | 23 | 0 |
| CA_25A-41A[8] | 25 | 0 |
| | 41 | 0 |
| CA_25A-41C[8] | 25 | 0 |
| | 41 | 0 |
| CA_26A-41A | 26 | 0 |
| | 41 | 0 |
| CA_26A-41C | 26 | 0 |
| | 41 | 0 |
| CA_29A-30A | 30 | 0 |
| CA_39A-41A | 39 | 0.2[4] |
| | 41 | 0.2[4] |
| CA_39A-41A | 39 | 0.2[7] |
| | 41 | 0.2[7] |
| CA_39A-41C | 39 | 0.2[4] |
| | 41 | 0.2[4] |
| CA_39C-41A | 39 | 0.2[4] |
| | 41 | 0.2[4] |
| CA_41A-42A | 41 | 0.4[4] |
| | 42 | 0.5[4] |

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

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

NOTE 3: In case the UE supports more than one of the above 2DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 2DL inter-band carrier aggregation configurations then:

- When the E-UTRA operating band frequency range is ≤ 1GHz, the applicable additional tolerance shall be the average of the 2DL tolerances in Table 7.3.1-1A, truncated to one decimal place that would apply for that operating band among the supported 2DL CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 2DL carrier aggregation configurations involving such band shall be applied

- When the E-UTRA operating band frequency range is >1GHz, the applicable additional tolerance shall be the maximum 2DL tolerance in Table 7.3.1-1A that would apply for that operating band among the supported 2DL CA configurations

NOTE 4: Only applicable for UE supporting inter-band carrier aggregation with uplink in one E-UTRA band and without simultaneous Rx/Tx.

NOTE 5: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:

- When the E-UTRA operating band frequency range is ≤ 1GHz and the tolerances are the same, the value applies to the band. If the tolerances

| |
|---|
| are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied<br>- When the E-UTRA operating band frequency range is >1GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations<br>NOTE 6: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration.<br>NOTE 7: Applicable for UE supporting inter-band carrier aggregation with two uplinks and without simultaneous Rx/Tx.<br>NOTE 8: Only applicable for UE supporting inter-band carrier aggregation with the uplink active in the FDD band.<br>NOTE 9: For Band 28, the requirements only apply for the restricted frequency range specified for this CA configuration (Table 5.5A-2). |

**Table 7.3.1-1B: $\Delta R_{IB,c}$ (three bands)**

| Inter-band CA Configuration | E-UTRA Band | $\Delta R_{IB,c}$ [dB] |
|---|---|---|
| CA_1A-3A-5A | 1 | 0 |
| | 3 | 0 |
| | 5 | 0 |
| CA_1A-3A-8A | 1 | 0 |
| | 3 | 0 |
| | 8 | 0 |
| CA_1A-3A-19A | 1 | 0 |
| | 3 | 0 |
| | 19 | 0 |
| CA_1A-3A-20A | 1 | 0 |
| | 3 | 0 |
| | 20 | 0 |
| CA_1A-3A-26A | 1 | 0 |
| | 3 | 0 |
| | 26 | 0 |
| CA_1A-5A-7A | 1 | 0 |
| | 5 | 0 |
| | 7 | 0 |
| CA_1A-7A-20A | 1 | 0 |
| | 7 | 0 |
| | 20 | 0 |
| CA_1A-18A-28A | 1 | 0 |
| | 18 | 0 |
| | 28 | 0 |
| CA_1A-19A-21A | 1 | 0 |
| | 19 | 0 |
| | 21 | 0 |
| CA_2A-4A-5A | 2 | 0.3 |
| | 4 | 0.3 |
| | 5 | 0 |
| CA_2A-4A-12A | 2 | 0.3 |
| | 4 | 0.3 |
| | 12 | 0.5 |
| CA_2A-4A-13A | 2 | 0.3 |
| | 4 | 0.3 |
| | 13 | 0 |
| CA_2A-4A-29A | 2 | 0.3 |
| | 4 | 0.3 |
| CA_2A-5A-12A | 2 | 0 |
| | 5 | 0.5 |
| | 12 | 0.3 |
| CA_2A-5A-13A | 2 | 0 |
| | 5 | 0 |
| | 13 | 0 |
| CA_2A-5A-30A | 2 | 0.4 |
| | 5 | 0 |
| | 30 | 0.5 |
| CA_2A-12A-30A | 2 | 0.4 |
| | 12 | 0 |
| | 30 | 0.5 |
| CA_2A-29A-30A | 2 | 0.4 |
| | 30 | 0.5 |
| CA_3A-7A-20A | 3 | 0 |
| | 7 | 0 |
| | 20 | 0 |
| CA_4A-5A-12A | 4 | 0 |
| | 5 | 0.5 |
| | 12 | 0.5 |
| CA_4A-5A-13A | 4 | 0 |
| | 5 | 0 |
| | 13 | 0 |

| | | |
|---|---|---|
| CA_4A-5A-30A | 4 | 0.4 |
| | 5 | 0 |
| | 30 | 0.5 |
| CA_4A-7A-12A | 4 | 0.5 |
| | 7 | 0.5 |
| | 12 | 0.5 |
| CA_4A-12A-30A | 4 | 0.4 |
| | 12 | 0.5 |
| | 30 | 0.5 |
| CA_4A-29A-30A | 4 | 0.4 |
| | 30 | 0.5 |
| CA_7A-8A-20A | 7 | 0 |
| | 8 | 0.2 |
| | 20 | [0.2] |
| 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 and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations.<br>NOTE 3: Unless otherwise specified, in case the UE supports more than one of the above 3DL inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one 3DL inter-band carrier aggregation configurations then:<br>- When the E-UTRA operating band frequency range is ≤ 1GHz and the tolerances are the same, the value applies to the band. If the tolerances are different, the applicable additional 3DL tolerance is FFS. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported 3DL carrier aggregation configurations involving such band shall be applied<br>- When the E-UTRA operating band frequency range is >1GHz, the applicable additional 3DL tolerance shall be the maximum tolerance above that applies for that operating band among the supported 3DL CA configurations<br>NOTE 4: The above additional tolerances applicable for the E-UTRA operating bands that belong to the supported highest order inter-band carrier aggregation configuration, also applies to the same E-UTRA operating bands that belong to a supported lower order CA configuration. | | |

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

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

| E-UTRA Band / Channel bandwidth / $N_{RB}$ / 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 |
| 30 | | | 25 | 25[1] | | | FDD |
| 31 | 6 | 5[4] | 5[4] | | | | 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

NOTE 4: [4] refers to Band 31; in the case of 3 MHz channel bandwidth, the UL

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| resource blocks shall be located at $RB_{start}$ 9 and in the case of 5 MHz channel bandwidth, the UL resource blocks shall be located at $RB_{start}$ 10. |

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 |
| 30 | NS_21 |

## 7.3.1A Minimum requirements (QPSK) for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the throughput shall be ≥ 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 all downlink component carriers active and one of the uplink carriers active. The uplink resource blocks shall be located as close as possible to the primary downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). The primary downlink operating band is the downlink band of the active uplink operating band. The UE shall meet the requirements specified in subclause 7.3.1 with the following exceptions.

For the 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 is active in a lower-frequency band and is within a specified frequency range such that transmitter harmonics fall within the downlink transmission bandwidth assigned in a higher band 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 due to harmonic issue)**

| | | Channel bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_1A-3A-8A[4] | 1 | | | N/A | N/A | N/A | N/A | FDD |
| | 3 | | | N/A | N/A | N/A | N/A | |
| | 8 | | N/A | N/A | N/A | | | |
| CA_1A-18A-28A[12] | 1 | | | N/A | N/A | N/A | N/A | FDD |
| | 18 | | | N/A | N/A | N/A | | |
| | 28 | | | N/A | N/A | | | |
| CA_1A-28A[5,6] | 1 | | | -89.8 | -89.4 | -89 | -88.7 | FDD |
| | 28 | | | -98.3 | -95.3 | -93.5 | -90.8 | |
| CA_3A-8A[4] | 3 | | | N/A | N/A | N/A | N/A | FDD |
| | 8 | | N/A | N/A | N/A | | | |
| CA_3A-42A[9,10] | 3 | | | -96.8 | -93.8 | -92 | -90.8 | FDD |
| | 42 | | | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42A[11] | 3 | | | -96.8 | -93.8 | -92 | -90.8 | FDD |
| | 42 | | | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_4A-12A[5,6] | 4 | -89.2 | -89.2 | -90 | -89.5 | -89 | -88.5 | FDD |
| | 12 | | -98.2 | -96.5 | -93.5 | | | |
| CA_4A-17A[5,6] | 4 | | | -90 | -89.5 | | | FDD |
| | 17 | | | -96.5 | -93.5 | | | |
| CA_2A-4A-12A[5,6] | 2 | | | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
| | 4 | | | -90 | -89.5 | -89 | -88.5 | |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_4A-5A-12A[5,6] | 4 | | | -90 | -89.5 | -89 | -88.5 | FDD |
| | 5 | | | -97.5 | -94.5 | | | |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_4A-7A-12A[5,6] | 4 | | | [-90] | [-89.5] | [-89] | [-88.5] | FDD |
| | 7 | | | -97.5 | -94.5 | | | |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_26A-41A[8] | 26 | | | N/A | N/A | N/A | | FDD |
| | 41 | | | N/A | N/A | N/A | N/A | TDD |
| CA_7A-8A[5,6] | 7 | | | | -87.4 | -87 | -86.7 | FDD |
| | 8 | | -99 | -96.8 | -93.8 | | | |
| CA_7A-8A-20A[5,6] | 7 | | | | -87.4 | -87 | -86.7 | FDD |
| | 8 | | -99 | -96.8 | -93.8 | | | |
| | 20 | | | [-96.8] | [-93.8] | | | |

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 a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 6: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB}/0.3 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB}/2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB}/2$ with $f_{DL}^{HB}$ the carrier frequency of a high band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the low band.

NOTE 7: Void.

NOTE 8: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).

NOTE 9: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic

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| is within the downlink transmission bandwidth of a victim (higher) band and a range $\Delta F_{HD}$ above and below the edge of this downlink transmission bandwidth. The value $\Delta F_{HD}$ depends on the E-UTRA configuration: $\Delta F_{HD}$ = 10 MHz for CA_3A-42A.<br>NOTE 10: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB}/0.2 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB}/2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB}/2$ with $f_{DL}^{HB}$ carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.<br>NOTE 11: The requirements are only applicable to channel bandwidths with a carrier frequency at $\pm(20 + BW_{Channel}^{HB}/2)$ MHz offset from $2f_{UL}^{LB}$ in the victim (higher band) with $F_{UL\_low}^{LB} + BW_{Channel}^{LB}/2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB}/2$, where $BW_{Channel}^{LB}$ and $BW_{Channel}^{HB}$ are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.<br>NOTE 12: For the UE that supports CA_1A-18A-28A, no requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity should only be verified when this is not the case (the requirements specified in clause 7.3.1 apply). |

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

| E-UTRA Band / Channel bandwidth of the high band / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **UL band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex mode** |
| CA_1A-28A | 28 | | | 8 | 16 | 25 | 25 | FDD |
| CA_4A-12A | 12 | 2 | 5 | 8 | 16 | 20 | 20 | FDD |
| CA_4A-17A | 17 | | | 8 | 16 | | | FDD |
| CA_2A-4A-12A | 12 | | | 8 | 16 | 20 | 20 | FDD |
| CA_3A-42A | 3 | | | 12 | 25 | 36 | 50 | FDD |
| CA_4A-5A-12A | 12 | | | 8 | 16 | 20 | 20 | FDD |
| CA_4A-7A-12A | 12 | | | 8 | 16 | 20 | 20 | FDD |
| CA_7A-8A | 8 | | | | 16 | 25 | 25 | FDD |
| CA_7A-8A-20A | 8 | | | | 16 | 25 | 25 | 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 the UE that supports any of the E-UTRA CA configurations given in Table 7.3.1A-0bA, exceptions are allowed when the uplink is active within a specified frequency range as noted in Table 7.3.1A-0bA. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-0bA and Table 7.3.1A-0bB.

**Table 7.3.1A-0bA: Reference sensitivity for carrier aggregation QPSK $P_{REFSENS, CA}$ (exceptions for two bands due to close proximity of UL to DL channel)**

| Channel bandwidth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_1A-3A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| CA_1A-3A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| CA_18A-28A[6] | 18 | | | -100 | -97 | -95.2 | | FDD |
| | 28 | | | -94 | -92.5 | | | |

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: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.
NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz. For each channel bandwidth in Band 3, the requirement applies regardless of channel bandwidth in Band 1.
NOTE 6: These requirements apply when the uplink is active in Band 18 and the downlink channels in Band 28 are confined within the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 18.

**Table 7.3.1A-0bB: Uplink configuration for the uplink band (exceptions for two bands due to close proximity of UL to DL channel)**

| E-UTRA Band / Channel bandwidth of the affected DL band / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **UL band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex mode** |
| CA_1A-3A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_18A-28A[4] | 18 | | | 18 | 18 | | | FDD |

NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1.
NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz
NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.
NOTE 4: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 28 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1).

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

**Table 7.3.1A-0bC: Reference sensitivity for carrier aggregation QPSK $P_{REFSENS, CA}$ (exceptions for three bands due to close proximity of UL to DL channel)**

| Channel bandwidth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex mode** |
| CA_1A-3A-5A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| | 5 | | | -98 | -95 | | | |
| CA_1A-3A-5A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| | 5 | | | -98 | -95 | | | |
| CA_1A-3A-8A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| | 8 | | -99.2 | -97 | -94 | | | |
| CA_1A-3A-8A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| | 8 | | -99.2 | -97 | -94 | | | |
| CA_1A-3A-19A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| | 19 | | | -100 | -97 | -95.2 | | |
| CA_1A-3A-19A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| | 19 | | | -100 | -97 | -95.2 | | |
| CA_1A-3A-20A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| | 20 | | | -97 | -94 | -91.2 | -90 | |
| CA_1A-3A-20A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| | 20 | | | -97 | -94 | -91.2 | -90 | |
| CA_1A-3A-26A[4] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -94 | -91.5 | -90 | -89 | |
| | 26 | | | -97.5[7] | -94.5[7] | | | |
| CA_1A-3A-26A[5] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 3 | | | -97 | -94 | -92.2 | -91 | |
| | 26 | | | -97.5[7] | -94.5[7] | | | |
| CA_1A-18A-28A[6] | 1 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 18 | | | -100 | -97 | -95.2 | | |
| | 28 | | | -94 | -92.5 | | | |

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: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz. For each channel bandwidth in Band 3 and Band 5 or Band 8 or Band 19 or Band 20 or Band 26, the requirement applies regardless of channel bandwidth in Band 1.
NOTE 5: These requirements apply when the uplink is active in Band 1 and the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz. For each channel bandwidth in Band 3 and Band 5 or Band 8 or Band 19 or Band 20 or Band 26, the requirement applies regardless of channel bandwidth in Band 1.
NOTE 6: These requirements apply when the uplink is active in Band 18 and the downlink channels in Band 28 are confined within the restricted frequency range specified for this CA configuration (Table 5.5A-2). For each channel bandwidth in Band 28, the requirement applies regardless of channel bandwidth in Band 18.
NOTE 7: [7] indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.

**Table 7.3.1A-0bD: Uplink configuration for the uplink band (exceptions for three bands due to close proximity of UL to DL channel)**

| E-UTRA Band / Channel bandwidth of the affected DL band / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **UL band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex mode** |
| CA_1A-3A-5A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-5A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-8A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-8A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-19A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-19A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-20A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-20A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_1A-3A-26A[1, 2] | 1 | | | 25 | 25 | 25 | 25 | FDD |
| CA_1A-3A-26A[1, 3] | 1 | | | 25 | 45 | 45 | 45 | FDD |
| CA_1A-18A-28A[4] | 18 | | | 18 | 18 | | | FDD |
| NOTE 1: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 3 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1) in the uplink channel in Band 1.<br>NOTE 2: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is < 60 MHz<br>NOTE 3: UL allocation when the separation between the lower edge of the uplink channel in Band 1 and the upper edge of the downlink channel in Band 3 is ≥ 60 MHz.<br>NOTE 4: refers to the UL resource blocks shall be located as close as possible to the downlink channel in Band 28 but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.6-1). | | | | | | | | |

For 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 for any uplink band with uplink configuration specified in Table 7.3.1-2.

**Table 7.3.1A-0d: Reference sensitivity QPSK $P_{REFSENS}$ (CA with a SDL band)**

| 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 | -93.2 | -92 | FDD |
| | 29 | | -98.7 | -97 | -94 | | | |
| CA_2C-29A | 2 | | | -98 | -95 | -93.2 | -92 | FDD |
| | 29 | | | -97 | -94 | | | |
| CA_4A-29A | 4 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 29 | | -98.7 | -97 | -94 | | | |
| CA_20A-32A | 20 | | | -97 | -94 | | | FDD |
| | 32 | | | -100 | -97 | -95.2 | -94 | |
| CA_23A-29A | 23 | | | -100 | -97 | -95.2 | -94 | FDD |
| | 29 | | -98.7 | -97 | -94 | | | |
| CA_29A-30A | 29 | | | -97 | -94 | | | FDD |
| | 30 | | | -99 | -96 | | | |
| CA_2A-4A-29A | 2 | | | -97.7 | -94.7 | -92.9 | -91.7 | FDD |
| | 4 | | | -99.7 | -96.7 | -94.9 | -93.7 | |
| | 29 | | | -97 | -94 | | | |
| CA_2A-29A-30A | 2 | | | -97.6 | -94.6 | -92.8 | -91.6 | FDD |
| | 29 | | | -97 | -94 | | | |
| | 30 | | | -98.5 | -95.5 | | | |
| CA_4A-29A-30A | 4 | | | -99.6 | -96.6 | -94.8 | -93.6 | FDD |
| | 29 | | | -97 | -94 | | | |
| | 30 | | | -98.5 | -95.5 | | | |
| 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: Void**

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

For inter-band carrier aggregation with uplink assigned to two E-UTRA bands 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 all downlink component carriers active and both of the uplink carriers active.

For E-UTRA CA configurations with uplink and downlink assigned to two E-UTRA bands given in Table 7.3.1A-0f the reference sensitivity is defined only for the specific uplink and downlink test points which are specified in Table 7.3.1A-0f. For these test points the reference sensitivity requirement specified in Table 7.3.1-1 is relaxed by the amount of parameter MSD given in Table 7.3.1A-0f.

The allowed exceptions defined in Table 7.3.1A-0a and Table 7.3.1A-0b for inter-band carrier aggregation with a single active uplink are also applicable for dual uplink operation.

**Table 7.3.1A-0f: 2 UL and 2 DL interband reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations**

| E-UTRA Band / Channel bandwidth / $N_{RB}$ / Duplex mode | | | | | | | |
|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **EUTRA band** | **UL $F_c$ (MHz)** | **UL/DL BW (MHz)** | **UL $C_{LRB}$** | **DL $F_c$ (MHz)** | **MSD (dB)** | **Duplex mode** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CA_1A-3A | 1 | 1950 | 5 | 25 | 2140 | 23 | FDD |
| | 3 | 1760 | 5 | 25 | 1855 | N/A | |
| CA_1A-8A | 1 | 1965 | 5 | 25 | 2155 | 6 | FDD |
| | 8 | 887.5 | 5 | 25 | 932.5 | N/A | |
| CA_2A-4A | 2 | 1860 | 20 | 50[2] | 1940 | 5 | FDD |
| | 4 | 1752.5 | 5 | 25 | 2152.5 | N/A | |
| CA_2A-4A | 2 | 1868.3 | 5 | 25 | 1948.3 | N/A | FDD |
| | 4 | 1735 | 5 | 25 | 2135 | 5 | |
| CA_3A-5A | 3 | 1771 | 10 | 50 | 1866 | 4 | FDD |
| | 5 | 838 | 5 | 25 | 883 | N/A | |
| CA_3A-5A | 3 | 1721 | 10 | 50 | 1816 | N/A | FDD |
| | 5 | 838 | 5 | 25 | 883 | 24 | |
| CA_3A-7A | 3 | 1730 | 5 | 25 | 1825 | N/A | FDD |
| | 7 | 2535 | 10 | 50 | 2655 | 13 | |
| CA_3A-8A | 3 | 1755 | 10 | 50 | 1850 | N/A | FDD |
| | 8 | 900 | 5 | 25 | 945 | 8 | |
| CA_3A-8A | 3 | 1747.5 | 10 | 50 | 1842.5 | 6.4 | FDD |
| | 8 | 897.5 | 5 | 25 | 942.5 | N/A | |
| CA_3A-19A | 3 | 1771 | 5 | 25 | 1866 | 4 | FDD |
| | 19 | 838 | 5 | 25 | 883 | N/A | |
| CA_3A-19A | 3 | 1721 | 5 | 25 | 1816 | N/A | FDD |
| | 19 | 838 | 5 | 25 | 883 | 27 | |
| CA-3A-20A | 3 | 1775 | 5 | 25 | 1870 | 4 | FDD |
| | 20 | 840 | 5 | 25 | 799 | N/A | |
| CA-3A-20A | 3 | 1735 | 5 | 25 | 1830 | N/A | FDD |
| | 20 | 847 | 5 | 25 | 806 | 9 | |
| CA_3A-26A | 3 | 1771 | 5 | 25 | 1866 | 4 | FDD |
| | 26 | 838 | 5 | 25 | 883 | N/A | |
| CA_3A-26A | 3 | 1721 | 5 | 25 | 1816 | N/A | FDD |
| | 26 | 838 | 5 | 25 | 883 | 26 | |
| CA_4A-7A | 4 | 1730 | 5 | 25 | 1825 | N/A | FDD |
| | 7 | 2535 | 5 | 25 | 2655 | 15 | |
| CA_5A-7A | 5 | 834 | 5 | 25 | 879 | 12 | FDD |
| | 7 | 2547 | 10 | 50 | 2667 | N/A | |
| CA_7A-20A | 7 | 2512 | 10 | 50 | 2632 | N/A | FDD |
| | 20 | 851 | 5 | 25 | 810 | 12 | |
| NOTE 1: Both of the transmitters shall be set min(+20 dBm, $P_{CMAX\_L,c}$) as defined in subclause 6.2.5A<br>NOTE 2: $RB_{START}$ = 0 | | | | | | | |

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. The requirement is verified using an uplink CA configuration with the largest number of carriers supported by the UE. 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. In case downlink CA configuration has additional SCC(s) compared to uplink CA configuration those are configured furthers away from uplink band. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2 and the downlink PCC carrier center frequency shall be configured closer to uplink operating band than any of the downlink SCC center frequency. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

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

| CA configuration / CC combination / $N_{RB\_agg}$ / Duplex mode | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uplink CA configuration | 100RB+25RB | | 100RB+50RB | | 75RB+75RB | | 100RB+75RB | | 100RB+100RB | | Duplex Mode |
| | PCC | SCC | PCC | SCC | PCC | SCC | PCC | SCC | PCC | SCC | |
| CA_1C | N/A | N/A | N/A | N/A | 75 | 54 | N/A | N/A | 100 | 30 | FDD |
| CA_3C | 50 | 0 | 50 | 0 | N/A | N/A | 50 | 0 | 50 | 0 | FDD |
| CA_7C | N/A | N/A | 75 | 0 | 75 | 0 | 75 | 0 | 75 | 0 | FDD |
| CA_38C | N/A | N/A | N/A | N/A | 75 | 75 | N/A | N/A | 100 | 100 | TDD |
| CA_39C | 100 | 25 | 100 | 50 | N/A | N/A | 100 | 75 | N/A | N/A | TDD |
| CA_40C | N/A | N/A | 100 | 50 | 75 | 75 | 100 | 75 | 100 | 100 | TDD |
| CA_41C | N/A | N/A | 100 | 50 | 75 | 75 | 100 | 75 | 100 | 100 | TDD |
| CA_42C | 100 | 25 | 100 | 50 | N/A | N/A | 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.
NOTE 5: In case a CA configuration consists of CC channel bandwidths which are unequal in bandwidth the PCC channel bandwidth shall be the larger one for reference sensitivity test.
NOTE 6: Void.

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink sub-blocks, 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) 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 $\Delta R_{IBNC}$ given in Table 7.3.1A-3 for the SCC(s). The requirements apply with all downlink carriers active. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

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

| CA configuration | Aggregated channel bandwidth (PCC+SCC) | $W_{gap}$ / [MHz] | UL PCC allocation | $\Delta R_{IBNC}$ (dB) | Duplex mode |
|---|---|---|---|---|---|
| CA_2A-2A | 25RB+25RB | $30.0 < W_{gap} \leq 50.0$ | 12[1] | 5.3 | FDD |
| | | $0.0 < W_{gap} \leq 30.0$ | 25[1] | 0 | |
| | 25RB+50RB | $25.0 < W_{gap} \leq 45.0$ | 12[1] | 4.4 | |
| | | $0.0 < W_{gap} \leq 25.0$ | 25[1] | 0 | |
| | 25RB+75RB | $20.0 < W_{gap} \leq 40.0$ | 12[1] | 4.2 | |
| | | $0.0 < W_{gap} \leq 20.0$ | 25[1] | 0 | |
| | 25RB+100RB | $15.0 < W_{gap} \leq 35.0$ | 12[1] | 3.8 | |
| | | $0.0 < W_{gap} \leq 15.0$ | 25[1] | 0 | |
| | 50RB+25RB | $15.0 < W_{gap} \leq 45.0$ | 12[1] | 5.9 | |
| | | $0.0 < W_{gap} \leq 15.0$ | 32[1] | 0 | |
| | 50RB+50RB | $10.0 < W_{gap} \leq 40.0$ | 12[1] | 4.6 | |
| | | $0.0 < W_{gap} \leq 10.0$ | 32[1] | 0 | |
| | 50RB+75RB | $5.0 < W_{gap} \leq 35.0$ | 12[1] | 4.1 | |
| | | $0.0 < W_{gap} \leq 5.0$ | 32[1] | 0 | |
| | 50RB+100RB | $0.0 < W_{gap} \leq 30.0$ | 12[1] | 4.0 | |
| | 75RB+25RB | $10.0 < W_{gap} \leq 40.0$ | 12[12] | 6.7 | |
| | | $0.0 < W_{gap} \leq 10.0$ | 36[1] | 0 | |
| | 75RB+50RB | $5.0 < W_{gap} \leq 35.0$ | 12[12] | 5.4 | |
| | | $0.0 < W_{gap} \leq 5.0$ | 36[1] | 0 | |
| | 75RB+75RB | $0.0 < W_{gap} \leq 30.0$ | 12[12] | 4.6 | |
| | 75RB+100RB | $0.0 < W_{gap} \leq 25.0$ | 12[12] | 4.2 | |
| | 100RB+25RB | $0.0 < W_{gap} \leq 35.0$ | 16[13] | 7.2 | |
| | 100RB+50RB | $0.0 < W_{gap} \leq 30.0$ | 16[13] | 5.8 | |
| | 100RB+75RB | $0.0 < W_{gap} \leq 25.0$ | 16[13] | 5.0 | |
| | 100RB+100RB | $0.0 < W_{gap} \leq 20.0$ | 16[13] | 4.6 | |
| CA_3A-3A | 25RB+25RB | $45.0 < W_{gap} \leq 65.0$ | 12[1] | 4.7 | FDD |
| | | $0.0 < W_{gap} \leq 45.0$ | 25[1] | 0 | |
| | 25RB+50RB | $40.0 < W_{gap} \leq 60.0$ | 12[1] | 3.8 | |
| | | $0.0 < W_{gap} \leq 40.0$ | 25[1] | 0 | |
| | 25RB+75RB | $35.0 < W_{gap} \leq 55.0$ | 12[1] | 3.6 | |
| | | $0.0 < W_{gap} \leq 35.0$ | 25[1] | 0 | |
| | 25RB+100RB | $30.0 < W_{gap} \leq 50.0$ | 12[1] | 3.4 | |
| | | $0.0 < W_{gap} \leq 30.0$ | 25[1] | 0 | |
| | 50RB+25RB | $30.0 < W_{gap} \leq 60.0$ | 12[9] | 5.1 | |
| | | $0.0 < W_{gap} \leq 30.0$ | 32[1] | 0 | |
| | 50RB+50RB | $25.0 < W_{gap} \leq 55.0$ | 12[9] | 4.3 | |
| | | $0.0 < W_{gap} \leq 25.0$ | 32[1] | 0 | |
| | 50RB+75RB | $20.0 < W_{gap} \leq 50.0$ | 12[9] | 3.8 | |
| | | $0.0 < W_{gap} \leq 20.0$ | 32[1] | 0 | |
| | 50RB+100RB | $15.0 < W_{gap} \leq 45.0$ | 12[9] | 3.4 | |
| | | $0.0 < W_{gap} \leq 15.0$ | 32[1] | 0 | |
| | 75RB+25RB | $25.0 < W_{gap} \leq 55.0$ | 12[10] | 6.0 | |
| | | $0.0 < W_{gap} \leq 25.0$ | 32[1] | 0 | |
| | 75RB+50RB | $20.0 < W_{gap} \leq 50.0$ | 12[10] | 4.7 | |
| | | $0.0 < W_{gap} \leq 20.0$ | 32[1] | 0 | |
| | 75RB+75RB | $15.0 < W_{gap} \leq 45.0$ | 12[10] | 4.2 | |

| | | | | | |
|---|---|---|---|---|---|
| | | $0.0 < W_{gap} \le 15.0$ | 32[1] | 0 | |
| | 75RB+100RB | $10.0 < W_{gap} \le 40.0$ | 12[10] | 3.8 | |
| | | $0.0 < W_{gap} \le 10.0$ | 32[1] | 0 | |
| | 100RB+25RB | $15.0 < W_{gap} \le 50.0$ | 16[11] | 6.5 | |
| | | $0.0 < W_{gap} \le 15.0$ | 32[1] | 0 | |
| | 100RB+50RB | $10.0 < W_{gap} \le 45.0$ | 16[11] | 5.1 | |
| | | $0.0 < W_{gap} \le 10.0$ | 32[1] | 0 | |
| | 100RB+75RB | $5.0 < W_{gap} \le 40.0$ | 16[11] | 4.5 | |
| | | $0.0 < W_{gap} \le 5.0$ | 32[1] | 0 | |
| | 100RB+100RB | $0.0 < W_{gap} \le 35.0$ | 16[11] | 4.1 | |
| CA_4A-4A | NOTE 6 | NOTE 7 | NOTE 8 | 0.0 | FDD |
| CA_7A-7A | 50RB+50RB | $25.0 < W_{gap} \le 50.0$ | 32[1] | 0.0 | FDD |
| | | $0.0 < W_{gap} \le 25.0$ | 50[1] | 0.0 | |
| | 75RB+25RB | $20.0 < W_{gap} \le 50.0$ | 32[1] | 0.0 | |
| | | $0.0 < W_{gap} \le 20.0$ | 50[1] | 0.0 | |
| | 75RB+50RB | $20.0 < W_{gap} \le 45.0$ | 32[1] | 0.0 | |
| | | $0.0 < W_{gap} \le 20.0$ | 50[1] | 0.0 | |
| | 75RB+75RB | $15.0 < W_{gap} \le 40.0$ | 32[1] | 0.0 | |
| | | $0.0 < W_{gap} \le 15.0$ | 50[1] | 0.0 | |
| | 100RB+75RB | $15.0 < W_{gap} \le 35.0$ | 36[1] | 0.0 | |
| | | $0.0 < W_{gap} \le 15.0$ | 50[1] | 0.0 | |
| | 100RB+100RB | $15.0 < W_{gap} \le 30.0$ | 32[1] | 0.0 | |
| | | $0.0 < W_{gap} \le 15.0$ | 45[1] | 0.0 | |
| CA_23A-23A | NOTE 6 | NOTE 7 | NOTE 8 | 0.0 | FDD |
| CA_25A-25A | 25RB+25RB | $30.0 < W_{gap} \le 55.0$ | 10[1] | 5.0 | FDD |
| | | $0.0 < W_{gap} \le 30.0$ | 25[1] | 0.0 | |
| | 25RB+50RB | $25.0 < W_{gap} \le 50.0$ | 10[1] | 4.5 | |
| | | $0.0 < W_{gap} \le 25.0$ | 25[1] | 0.0 | |
| | 25RB+75RB | $20 < W_{gap} \le 45$ | 10[1] | 4.3 | |
| | | $0 < W_{gap} \le 20$ | 25[1] | 0 | |
| | 25RB+100RB | $15 < W_{gap} \le 40$ | 10[1] | 4.1 | |
| | | $0 < W_{gap} \le 15$ | 25[1] | 0 | |
| | 50RB+25RB | $15.0 < W_{gap} \le 50.0$ | 10[4] | 5.5 | |
| | | $0.0 < W_{gap} \le 15.0$ | 32[1] | 0.0 | |
| | 50RB+50RB | $10.0 < W_{gap} \le 45.0$ | 10[4] | 5.0 | |
| | | $0.0 < W_{gap} \le 10.0$ | 32[1] | 0.0 | |
| | 50RB+75RB | $5 < W_{gap} \le 40$ | 10[4] | 4.5 | |
| | | $0 < W_{gap} \le 5$ | 32[1] | 0 | |
| | 50RB+100RB | $0 < W_{gap} \le 35$ | 10[4] | 4.2 | |
| | 75RB+25RB | $10 < W_{gap} \le 45$ | 10[14] | 7.6 | |
| | | $0 < W_{gap} \le 10$ | 32[1] | 0 | |
| | 75RB+50RB | $5 < W_{gap} \le 40$ | 10[14] | 6.7 | |
| | | $0 < W_{gap} \le 5$ | 32[1] | 0 | |
| | 75RB+75RB | $0 < W_{gap} \le 35$ | 10[14] | 5.6 | |
| | 75RB+100RB | $0 < W_{gap} \le 30$ | 10[14] | 4.8 | |
| | 100RB+25RB | $0 < W_{gap} \le 40$ | 12[15] | 8 | |
| | 100RB+50RB | $0 < W_{gap} \le 35$ | 12[15] | 6.7 | |
| | 100RB+75RB | $0 < W_{gap} \le 30$ | 12[15] | 6.1 | |
| | 100RB+100RB | $0 < W_{gap} \le 25$ | 12[15] | 5.7 | |
| CA_41A-41A | NOTE 6 | NOTE 7 | NOTE 8 | 0.0 | TDD |
| CA_41A-41C | NOTE 6 | NOTE 7 | NOTE 8 | 0.0 | TDD |
| CA_42A-42A | 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.<br>NOTE 9: [9] refers to the UL resource blocks shall be located at $RB_{start}$=25.<br>NOTE 10: [10] refers to the UL resource blocks shall be located at $RB_{start}$=35.<br>NOTE 11: [11] refers to the UL resource blocks shall be located at $RB_{start}$=50.<br>NOTE 12: [12] refers to the UL resource blocks shall be located at $RB_{start}$=39.<br>NOTE 13: [13] refers to the UL resource blocks shall be located at $RB_{start}$=57.<br>NOTE 14: [14] refers to the UL resource blocks shall be located at $RB_{start}$=44.<br>NOTE 15: [15] refers to the UL resource blocks shall be located at $RB_{start}$=62. |

For intra-band non-contiguous carrier aggregation with two uplink and downlink carriers the reference sensitivity is defined to be met with both downlink and uplink carriers activated. The downlink PCC and SCC minimum requirements for reference sensitivity as specified in Table 7.3.1-1 are increased by amount of $\Delta R_{2UL\_PCC}$ and $\Delta R_{2UL\_SCC}$ which are defined in Table 7.3.1A-4 when uplink PCC and SCC allocations are according to the Table 7.3.1A-4.

**Table 7.3.1A-4: Intra-band non-contiguous CA with two uplinks configuration for reference sensitivity**

| CA configuration | Aggregated channel bandwidth (PCC+SCC) | $W_{gap}$ / [MHz] | UL PCC allocation | UL SCC allocation | $\Delta R_{2UL\_PCC}$ (dB) | $\Delta R_{2UL\_SCC}$ (dB) | Duplex mode |
|---|---|---|---|---|---|---|---|
| CA_4A-4A | NOTE 2 | NOTE 3 | NOTE 4 | NOTE 5 | 0.0 | 0.0 | FDD |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.<br>NOTE 2: All combinations of channel bandwidths defined in Table 5.6A.1-3.<br>NOTE 3: All applicable sub-block gap sizes.<br>NOTE 4: The PCC allocation is same as Transmission bandwidth configuration $N_{RB}$ as defined in Table 5.6-1.<br>NOTE 5: The SCC allocation is same as Transmission bandwidth configuration $N_{RB}$ as defined in Table 5.6-1. | | | | | | | |

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with an uplink configuration in accordance with Table 7.3.1-2 for each band capable of uplink operation. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For these uplink configurations, the UE shall meet the reference sensitivity requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the requirements specified in subclause 7.3.1. The three downlink carriers shall be active throughout the tests. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with an uplink configuration in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. The carrier center frequency of PCC in the UL operating band is configured closer to the DL operating band when the uplink is active in the band supporting non-contiguous aggregation of two component carriers. For these uplink configurations, the UE shall meet the reference sensitivity requirements for intra-band non-contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the requirements specified in subclause 7.3.1. For the two component carriers within the same band, $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3) when the uplink is active in the band supporting the single component carrier. The three downlink carriers shall be active throughout the tests. Unless given by Table 7.3.1-3, the reference sensitivity requirements shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

For the UE that supports any of combinations of intra-band and inter-band carrier aggregation given in Table 7.3.1A-5, exceptions to the aforementioned requirements are allowed when the uplink is active in a lower-frequency band and is within a specified frequency range such that transmitter harmonics fall within the downlink transmission bandwidth assigned in a higher band as noted in Table 7.3.1A-5. For these exceptions, the UE shall meet the requirements specified in Table 7.3.1A-5 and Table 7.3.1A-6.

**Table 7.3.1A-5: Reference sensitivity for carrier aggregation QPSK $P_{REFSENS, CA}$ (exceptions due to harmonic issues in the combinations of intra-band and inter-band CA)**

| 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-42C[7,8] | 3 | | | -96.8 | -93.8 | -92 | -90.8 | FDD |
| | 42 | | | -71.7 | -71.7 | -71.7 | -71.7 | TDD |
| CA_3A-42C[9] | 3 | | | -96.8 | -93.8 | -92 | -90.8 | FDD |
| | 42 | | | -97.1 | -94.7 | -93.2 | -92.5 | TDD |
| CA_4A-4A-12A[4,5] | 4 | | | -90 | -89.5 | -89 | -88.5 | FDD |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_4A-12B[4,5] | 4 | | | -90 | -89.5 | -89 | -88.5 | FDD |
| | 12 | | | -96.5 | -93.5 | | | |
| CA_26A-41C[6] | 26 | | | N/A | N/A | N/A | | FDD |
| | 41 | | | N/A | N/A | N/A | N/A | TDD |

NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5A.

NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1

NOTE 3: The signal power is specified per port

NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 5: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.3 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with $f_{DL}^{HB}$ the carrier frequency of a high band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the low band.

NOTE 6: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity is only verified when this is not the case (the requirements specified in clause 7.3.1 apply).

NOTE 7: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range $\Delta F_{HD}$ above and below the edge of this downlink transmission bandwidth. The value $\Delta F_{HD}$ depends on the E-UTRA configuration: $\Delta F_{HD}$ = 10 MHz for CA_3A-42C.

NOTE 8: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$ 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 $f_{DL}^{HB}$ carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

NOTE 9: The requirements are only applicable to channel bandwidths with a carrier frequency at $\pm(20 + BW_{Channel}^{HB} / 2)$ MHz offset from $2 f_{UL}^{LB}$ in the victim (higher band) with $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \le f_{UL}^{LB} \le F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$, where $BW_{Channel}^{LB}$ and $BW_{Channel}^{HB}$ are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

**Table 7.3.1A-6: Uplink configuration for the low band (exceptions due to harmonic issues in the combinations of intra-band and inter-band CA)**

| E-UTRA Band / Channel bandwidth of the high band / $N_{RB}$ / Duplex mode | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **EUTRA CA Configuration** | **UL band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex mode** |
| CA_3A-42C | 3 | | | 12 | 25 | 36 | 50 | FDD |
| CA_4A-4A-12A | 12 | | | 8 | 16 | 20 | 20 | FDD |
| CA_4A-12B | 12 | | | 8 | 16 | 20 | 20 | FDD |
| NOTE 1: refers to the UL resource blocks, which shall be centred within the transmission bandwidth configuration for the channel bandwidth.<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. | | | | | | | | |

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

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

## 7.3.1D Minimum requirements (QPSK) for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.6.2 with parameters specified in Table 7.3.1D-1 and Table 7.3.1D-2.

**Table 7.3.1D-1: Reference sensitivity for ProSe Direct Discovery QPSK $P_{REFSENS}$**

| Channel bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| **E-UTRA ProSe Band** | **1.4 MHz (dBm)** | **3 MHz (dBm)** | **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **Duplex Mode** |
| 2 | | | -104.1 | -104.1 | -104.1 | -104.1 | HD |
| 3 | | | -103.1 | -103.1 | -103.1 | -103.1 | HD |
| 4 | | | -106.1 | -106.1 | -106.1 | -106.1 | HD |
| 7 | | | -103.8 | -103.8 | -103.8 | -103.8 | HD |
| 14 | | | -103.1 | -103.1 | | | HD |
| 20 | | | -103.2 | -103.2 | -102.2 | -102.2 | HD |
| 26 | | | -103.5[5] | -103.5 [5] | -103.5 [5] | | HD |
| 28 | | | -104.4 | -104.4 | -104.4 | -102.9 | HD |
| 31 | | | -99.5 | | | | HD |
| NOTE 1: Reference measurement channel is A.6.2<br>NOTE 2: The signal power is specified per port<br>NOTE 3: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.<br>NOTE 4: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.<br>NOTE 5: [5] indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.<br>NOTE 6: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths. | | | | | | | |

**Table 7.3.1D-2: Reference sensitivity for ProSe Direct Communication QPSK $P_{REFSENS}$**

| Channel bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| E-UTRA ProSe Band | 1.4 MHz (dBm) | 3 MHz (dBm) | 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | Duplex Mode |
| 3 | | | | -97.6 | | | HD |
| 7 | | | | -98.3 | | | HD |
| 14 | | | | -97.6 | | | HD |
| 20 | | | | -97.7 | | | HD |
| 26 | | | | -98.0 [5] | | | HD |
| 28 | | | | -98.9 | | | HD |
| 31 | | | -96.7 | | | | HD |
| NOTE 1: Reference measurement channel is A.6.2<br>NOTE 2: The signal power is specified per port<br>NOTE 3: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.<br>NOTE 4: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.<br>NOTE 5: [5] indicates that the requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.<br>NOTE 6: For a UE that support both Band 18 and Band 26, the reference sensitivity level for Band 26 applies for the applicable channel bandwidths. | | | | | | | |

NOTE: Table 7.3.1D-1/ Table 7.3.1D-2 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of allocated resource blocks will be practically constrained by other factors.

For the UE which supports ProSe in an operating band as specified in Section 5.5D and is configured with (and can transmit on) only PCell, and the UE also supports a E-UTRA downlink inter-band carrier aggregation configuration in Table 7.3.1-1A or Table 7.3.1-1B, the minimum requirement for reference sensitivity in Table 7.3.1D-1 and Table 7.3.1D-2 shall be increased by the amount given in $\Delta R_{IB,c}$ in Table 7.3.1-1A and Table 7.3.1-1B for the corresponding E-UTRA ProSe band.

## 7.3.1E Minimum requirements (QPSK) for UE category 0

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 7.3.1E-1A/Table 7.3.1E-1B and Table 7.3.1E-2.

**Table 7.3.1E-1A: Reference sensitivity for FDD and TDD UE category 0 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 |
| 2 | -100.2 | -97.2 | -95.5 | -92.5 | -90.7 | -89.5 | FDD |
| 3 | -99.2 | -96.2 | -94.5 | -91.5 | -89.7 | -88.5 | FDD |
| 4 | -102.2 | -99.2 | -97.5 | -94.5 | -92.7 | -91.5 | FDD |
| 5 | -100.7 | -97.7 | -95.5 | -92.5 | | | FDD |
| 8 | -99.7 | -96.7 | -94.5 | -91.5 | | | FDD |
| 13 | | | -94 | -91 | | | FDD |
| 20 | | | -94.5 | -91.5 | -88.2 | -87 | FDD |
| 39 | | | -97.5 | -94.5 | -92.7 | -91.5 | TDD |
| 41 | | | -95.5 | -92.5 | -90.7 | -89.5 | TDD |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5<br>NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 | | | | | | | |

**Table 7.3.1E-1B: Reference sensitivity for HD-FDD UE category 0 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** |
| 2 | -101 | -98 | -96.3 | -93.3 | -91.5 | -90.3 | HD-FDD |
| 3 | -100 | -97 | -95.3 | -92.3 | -90.5 | -89.3 | HD-FDD |
| 4 | -103 | -100 | -98.3 | -95.3 | -93.5 | -92.3 | HD-FDD |
| 5 | -101.5 | -98.5 | -96.3 | -93.3 | | | HD-FDD |
| 8 | -100.5 | -97.5 | -95.3 | -92.3 | | | HD-FDD |
| 13 | | | -95.3 | -92.3 | | | HD-FDD |
| 20 | | | -95.3 | -92.3 | -89.5 | -88.3 | HD-FDD |
| NOTE 1: The transmitter shall be set to $P_{UMAX}$ as defined in subclause 6.2.5<br>NOTE 2: Reference measurement channel is A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 | | | | | | | |

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

NOTE: Table 7.3.1E-2 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex X (informative).

**Table 7.3.1E-2: FDD and TDD UE category 0 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** |
| 2 | 6 | 15 | 25 | $36^1$ | $36^1$ | $36^1$ | FDD and HD-FDD |
| 3 | 6 | 15 | 25 | $36^1$ | $36^1$ | $36^1$ | FDD and HD-FDD |
| 4 | 6 | 15 | 25 | $36^1$ | $36^1$ | $36^1$ | FDD and HD-FDD |
| 5 | 6 | 15 | 25 | $25^1$ | | | FDD and HD-FDD |
| 8 | 6 | 15 | 25 | $25^1$ | | | FDD and HD-FDD |
| 13 | | | $20^1$ | $20^1$ | | | FDD and HD-FDD |
| 20 | | | 25 | $20^1$ | $20^2$ | $20^2$ | FDD and HD-FDD |
| 39 | | | 25 | $36^1$ | $36^1$ | $36^1$ | TDD |
| 41 | | | 25 | $36^1$ | $36^1$ | $36^1$ | 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).<br>NOTE 2: $^2$ 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. | | | | | | | |

### 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[2] | | | | | |
| | | -27[3] | | | | | |
| 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.<br>NOTE 3: Reference measurement channel is Annex A.3.2: 256QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | |

## 7.4.1A Minimum requirements for CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one E-UTRA band the maximum input level is defined with the uplink active on the band(s) other than the band whose downlink is being tested. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. The UE shall meet the requirements specified in subclause 7.4.1 for each component carrier while all downlink carriers are active.

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

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

The throughput shall be ≥ 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 one uplink carrier and two downlink sub-blocks, each larger than or equal to 5 MHz, the maximum input level requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in Table 7.4.1-1 and Table 7.4.1A-1 for one component carrier and two component carriers per sub-block, respectively. The throughput of each downlink component carrier shall be ≥ 95% of the maximum throughput of the specified reference measurement channel as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1). The requirements apply with all downlink carriers active.

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

| Rx Parameter | Units | CA Bandwidth Class | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F |
| Power in largest Transmission Bandwidth Configuration CC | dBm | | -28[2] | -25[2] | -25[2] | | |
| | | | -30[3] | -27[3] | -27[3] | | |
| Power in each other CC | dBm | | $-28 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [2] | $-25 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [2] | $-25 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [2] | | |
| | | | $-30 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [3] | $-27 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [3] | $-27 + 10\log(N_{RB,c}/N_{RB,largest\ BW})$ [3] | | |

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 Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.
NOTE 3: Reference measurement channel is Annex A.3.2: 256QAM, R=4/5 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the maximum input-level requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the the requirements specified in subclause 7.4.1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the maximum input-level requirements for intra-band non-contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the the requirements specified in subclause 7.4.1. The three downlink carriers shall be active throughout the tests.

## 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.

## 7.4.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.6.2.

**Table 7.4.1D-1: Maximum input level for ProSe**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | -22 | | | | | |
| NOTE 1: Reference measurement channel is Annex A.6.2 | | | | | | | |

# 7.4A 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.<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 7.5.1-3: 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 one component carrier per operating band and the uplink assigned to one E-UTRA band, the adjacent channel requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.5.1 for each component carrier while all downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the adjacent channel requirements of subclause 7.5.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.5.1A-2 and Table 7.5.1A-3 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement specified in Table 7.5.1A-1 for an adjacent channel interferer on either side of the aggregated downlink signal at a specified frequency offset and for an interferer power up to -25 dBm. The throughput of each carrier shall be ≥ 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 sub-blocks, each larger than or equal to 5 MHz, the adjacent channel selectivity requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.5.1 and 7.5.1A for one component carrier and two component carriers per sub-block, respectively. The UE shall fulfil the minimum requirements all values of a single adjacent channel interferer in-gap and out-of-gap up to a –25 dBm interferer power while all downlink carriers are active. For the lower range of test parameters (Case 1), the interferer power $P_{interferer}$ shall be set to the maximum of the levels given by the carriers of the respective sub-blocks as specified in Table 7.5.1-2 and Table 7.5.1A-2 for one component carrier and two component carriers per sub-block, respectively. The wanted signal power levels for the carriers of each sub-block shall then be adjusted relative to $P_{interferer}$ in accordance with the ACS requirement for each sub-block (Table 7.5.1-1 and Table 7.5.1A-1). For the upper range of test parameters (Case 2) for which the interferer power $P_{interferer}$ is -25 dBm (Table 7.5.1-3 and Table 7.5.1A-3) the wanted signal power levels for the carriers of each sub-block shall be adjusted relative to $P_{interferer}$ like for Case 1.

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

| | | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| Rx Parameter | Units | B | C | D | E | F |
| ACS | dB | 27 | 24 | 22.2 | | |

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

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | | REFSENS + 14 dB | REFSENS + 14 dB | REFSENS + 14 dB | | |
| $P_{Interferer}$ | dBm | Aggregated power + 25.5 dB | Aggregated power + 22.5 dB | Aggregated power + 20.7 dB | | |
| $BW_{Interferer}$ | MHz | 5 | 5 | 5 | | |
| $F_{Interferer}$ (offset) | MHz | 2.5 + $F_{offset}$ / -2.5 - $F_{offset}$ | 2.5 + $F_{offset}$ / -2.5 - $F_{offset}$ | 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.
NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1
NOTE 3: The $F_{Interferer}$ (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 | -50.5 +10log10($N_{RB,c}$/ $N_{RB\ agg}$) | -47.5 +10log10($N_{RB,c}$/$N_{RB\ agg}$) | -45.7 +10log10($N_{RB,c}$/$N_{RB\ agg}$) | | |
| $P_{Interferer}$ | dBm | -25 | | | | |
| $BW_{Interferer}$ | MHz | 5 | 5 | 5 | | |
| $F_{Interferer}$ (offset) | MHz | 2.5+ $F_{offset}$ / -2.5- $F_{offset}$ | 2.5+ $F_{offset}$ / -2.5- $F_{offset}$ | 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.
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
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.

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the adjacent channel selectivity requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the the requirements specified in subclause 7.5.1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the adjacent channel selectivity requirements for intra-band non-contiguous carrier aggregation of two downlink carriers with $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3) and for the remaining component carrier the the requirements specified in subclause 7.5.1. The three downlink carriers shall be active throughout the tests.

## 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.

## 7.5.1D Minimum requirements for ProSe

The UE shall fulfil the minimum requirement specified in Table 7.5.1D-1 for all values of an adjacent channel interferer up to –25 dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1D-2 and Table 7.5.1D-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2.

**Table 7.5.1D-1: Adjacent channel selectivity for ProSe**

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

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

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + 14 dB | | | | | |
| $P_{Interferer}$ | dBm | | | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +42.5dB | REFSENS +39.5dB |
| $BW_{Interferer}$ | MHz | | | 5 | 5 | 5 | 5 |
| $F_{Interferer}$ (offset) | MHz | | | 5+0.0025 / -5-0.0025 | 7.5+0.0075 / -7.5-0.0075 | 10+0.0125 / -10-0.0125 | 12.5+0.0025 / -12.5-0.0025 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211. | | | | | | | |

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

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | | | -56.5 | -56.5 | -53.5 | -50.5 |
| $P_{Interferer}$ | dBm | -25 | | | | | |
| $BW_{Interferer}$ | MHz | | | 5 | 5 | 5 | 5 |
| $F_{Interferer}$ (offset) | MHz | | | 5+0.0025 / -5-0.0025 | 7.5+0.0075 / -7.5-0.0075 | 10+0.0125 / -10-0.0125 | 12.5+0.0025 / -12.5-0.0025 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211. | | | | | | | |

# 7.6 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 | $=-BW/2 - F_{Ioffset,case\ 1}$ & $=+BW/2 + F_{Ioffset,case\ 1}$ | $\leq -BW/2 - F_{Ioffset,case\ 2}$ & $\geq +BW/2 + F_{Ioffset,case\ 2}$ | | | $-BW/2 - 11$ |
| 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) | $F_{DL\_low} - 15$ to $F_{DL\_high} + 15$ | Void | Void | |
| 30 | $F_{Interferer}$ | MHz | (Note 2) | $F_{DL\_low} - 15$ to $F_{DL\_high} + 15$ | | | $F_{DL\_low} - 11$ |

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

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 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 one component carrier per operating band and the uplink assigned to one E-UTRA band the in-band blocking requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.1.1 for each component carrier while all downlink carriers are active. For the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{Interferer}$ 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 all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. The requirements for the component carrier configured in the operating band without uplink 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, 32 | $F_{Interferer}$ | 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(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.6.1.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.1.1A-1 and Tables 7.6.1.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.1.1A-1 and 7.6.1.1A-2.

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

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

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | 9 | 12 | 13.8 | | |
| $BW_{Interferer}$ | MHz | 5 | 5 | 5 | | |
| $F_{Ioffset, case 1}$ | MHz | 7.5 | 7.5 | 7.5 | | |
| $F_{Ioffset, case 2}$ | MHz | 12.5 | 12.5 | 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<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 7.6.1.1A-2: In-band blocking**

| CA configuration | Parameter | Unit | Case 1 | Case 2 |
|---|---|---|---|---|
| | $P_{Interferer}$ | dBm | -56 | -44 |
| | $F_{Interferer}$ (offset) | MHz | =-$F_{offset}$– $F_{Ioffset,case 1}$<br>&<br>=+$F_{offset}$ + $F_{Ioffset,case 1}$ | ≤-$F_{offset}$– $F_{Ioffset,case 2}$<br>&<br>≥+$F_{offset}$ + $F_{Ioffset,case 2}$ |
| CA_1C, CA_2C, CA_3C, CA_7C, CA_12B, CA_23B, CA_27B, CA_38C, CA_39C, CA_40C, CA_41C, CA_40D, CA_41D, CA_42C | $F_{Interferer}$ (Range) | MHz | (Note 2) | $F_{DL\_low}$ – 15<br>to<br>$F_{DL\_high}$ + 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<br>NOTE 2: For each carrier frequency the requirement is valid for two frequencies:<br>a. the carrier frequency -$F_{offset}$ - $F_{Ioffset, case 1}$ and<br>b. the carrier frequency +$F_{offset}$ + $F_{Ioffset, case 1}$<br>NOTE 3: $F_{offset}$ is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.<br>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 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. | | | | |

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the in-band blocking requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the requirements specified in subclause 7.6.1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the in-band blocking requirements for intra-band non-contiguous carrier aggregation of two downlink carriers with $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3) and for the remaining component carrier the requirements specified in subclause 7.6.1. The three downlink carriers shall be active throughout the tests.

### 7.6.1.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2.

**Table 7.6.1.1D-1: In band blocking parameters for ProSe Direct Discovery**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below + $P_{offset}$ | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| $BW_{Interferer}$ | MHz | | | 5 | 5 | 5 | 5 |
| $F_{Ioffset, case 1}$ | MHz | | | 7.5+0.0125 | 7.5+0.0025 | 7.5+0.0075 | 7.5+0.0125 |
| $F_{Ioffset, case 2}$ | MHz | | | 12.5+0.0075 | 12.5+0.0125 | 12.5+0.0025 | 12.5+0.0075 |
| $P_{offset}$ | dB | | | 10.9 | 13.9 | 15.7 | 16.9 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 | | | | | | | |

**Table 7.6.1.1D-2: In band blocking parameters for ProSe Direct Communication**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| $BW_{Interferer}$ | MHz | | | 5 | 5 | 5 | 5 |
| $F_{Ioffset, case 1}$ | MHz | | | 7.5+0.0125 | 7.5+0.0025 | 7.5+0.0075 | 7.5+0.0125 |
| $F_{Ioffset, case 2}$ | MHz | | | 12.5+0.0075 | 12.5+0.0125 | 12.5+0.0025 | 12.5+0.0075 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 | | | | | | | |

**Table 7.6.1.1D-3: In-band blocking for ProSe**

| E-UTRA ProSe band | Parameter | Unit | Case 1 | Case 2 |
|---|---|---|---|---|
| | $P_{Interferer}$ | dBm | -56 | -44 |
| | $F_{Interferer}$ (offset) | MHz | =-BW/2 – $F_{Ioffset,case 1}$ & =+BW/2 + $F_{Ioffset,case 1}$ | ≤-BW/2 – $F_{Ioffset,case 2}$ & ≥+BW/2 + $F_{Ioffset,case 2}$ |
| 2,3,4,7,14, 20,26,28,31 | $F_{Interferer}$ | 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 the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{Interferer}$ power defined in Table 7.6.1.1D-3 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

## 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 $\max(24,\ 6\cdot\lceil N_{RB}/6\rceil)$ exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where $N_{RB}$ is the number of resource blocks in the downlink transmission bandwidth configuration (see Figure 5.6-1). For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to $\max(8,\ \lceil (N_{RB}+2\cdot L_{CRBs})/8\rceil)$ exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where $N_{RB}$ is the number of resource blocks in the downlink transmission bandwidth configurations (see Figure 5.6-1) and $L_{CRBs}$ is the number of resource blocks allocated in the uplink. For these exceptions the requirements of clause 7.7 spurious response are applicable.

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

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

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

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

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

| E-UTRA band | Parameter | Units | Frequency | | | |
|---|---|---|---|---|---|---|
| | | | Range 1 | Range 2 | Range 3 | Range 4 |
| | $P_{Interferer}$ | dBm | -44 | -30 | -15 | -15 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42 (NOTE 2), 43 (NOTE 2), 44 | $F_{Interferer}$ (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 one component carrier per operating band and the uplink assigned to one E-UTRA band, the out-of-band blocking requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The throughput in the downlink measured shall be ≥ 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 all downlink carriers are active.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the out-of-band blocking requirements specified above shall be met with the transmitter power for the uplink set to 7 dB below $P_{CMAX\_L,c}$ for each serving cell *c*.

For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the out-of-band blocking requirements of subclause 7.6.2.1A do not apply.

**Table 7.6.2.1A-0: out-of-band blocking for inter-band carrier aggregation**

| Parameter | Unit | Range 1 | Range 2 | Range 3 |
|---|---|---|---|---|
| $P_w$ | dBm | Table 7.6.2.1-1 for all component carriers | | |
| $P_{interferer}$ | dBm | -44 + $\Delta R_{IB,c}$ | -30 + $\Delta R_{IB,c}$ | -15 + $\Delta R_{IB,c}$ |
| $F_{interferer}$ (CW) | MHz | -60 < f – $F_{DL\_Low(j)}$ < -15<br>or<br>15 < f – $F_{DL\_High(j)}$ < 60 | -85 < f – $F_{DL\_Low(j)}$ ≤ -60<br>or<br>60 ≤ f – $F_{DL\_High(j)}$ < 85 | 1 ≤ f ≤ $F_{DL\_Low(1)}$ – 85<br>or<br>$F_{DL\_High(j)}$ + 85 ≤ f ≤ $F_{DL\_Low(j+1)}$ – 85 with $j$ < X<br>or<br>$F_{DL\_High(X)}$ + 85 ≤ f ≤ 12750 |
| NOTE 1: $F_{DL\_Low(j)}$ and $F_{DL\_High(j)}$ denote the respective lower and upper frequency limits of the operating band containing carrier *j*, *j* = 1,…,X, with carriers numbered in increasing order of carrier frequency and X the number of component carriers in the band combination (X = 2 or X = 3 for the present version of this specification).<br>NOTE 2: For $F_{DL\_Low(j+1)}$ – $F_{DL\_High(j)}$ < 145 MHz and $F_{Interferer}$ in $F_{DL\_High(j)}$ < f < $F_{DL\_Low(j+1)}$ with *j* < X, $F_{Interferer}$ can be in both Range 1 and Range 2. Then the lower of the $P_{Interferer}$ applies.<br>NOTE 3: For $F_{DL\_Low(j)}$ – 15 MHz ≤ f ≤ $F_{DL\_High(j)}$ + 15 MHz the appropriate adjacent channel selectivity and in-band blocking requirments in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied for carrier *j*.<br>NOTE 4: $\Delta R_{IB,c}$ according to Table 7.3.1-1A applies when serving cell *c* is measured.<br>NOTE 5: For inter-band CA combinations containing Bands 42 or 43, the interferer with respect to Band 42 or Band 43 shall have power level ($P_{Interferer}$) for Range 3 modified to -20 + $\Delta R_{IB,c}$ dBm for $F_{Interferer}$ > 2800 MHz and $F_{Interferer}$ < 4400 MHz. | | | | |

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

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

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

The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Tables 7.6.2.1A-1 and Tables 7.6.2.1A-2 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 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 | 9 | 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_2C, CA_3C, CA_7C , CA_12B, CA_23B, CA_27B, CA_38C, CA_40C, CA_41C, CA_40D, CA_42C (NOTE 1) | $F_{Interferer}$ (CW) | MHz | $F_{DL\_low}$ - 15 to $F_{DL\_low}$ - 60 | $F_{DL\_low}$ - 60 to $F_{DL\_low}$ - 85 | $F_{DL\_low}$ - 85 to 1 MHz |
| | | | $F_{DL\_high}$ +15 to $F_{DL\_high}$ + 60 | $F_{DL\_high}$ +60 to $F_{DL\_high}$ +85 | $F_{DL\_high}$ +85 to +12750 MHz |
| NOTE 1: For CA_42C, 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. | | | | | |

For intra-band non-contiguous carrier aggregation with one uplink carrier and two downlink sub-blocks, the out-of-band blocking requirements are defined with the uplink configuration in accordance with table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.6.2.1 and 7.6.2.1A for one component carrier and two component carriers per sub-block, respectely. The requirements apply with all downlink carriers active.

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

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

For intra-band non-contiguous carrier aggregation with two uplink carriers and two downlink carriers, the out-of-band blocking requirements are defined with the uplink configuration of the PCC and SCC being in accordance with Table 7.3.1A-4 and powers of both carriers set to $P_{CMAX\_L,c}$ – 7 dBm. The UE shall meet the requirements specified in subclause 7.6.2.1 for each component carrier while both downlink carriers are active.

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

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

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and the uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For each downlink the UE shall meet the out-of-band blocking requirements applicable for inter-band carrier aggregation with one component carrier per operating band but with a sub-block of up to two component carriers assigned to the same operating band. For the sub-block of two component carriers the out-of-band blocking parameters in Table 7.6.2.1-1 are replaced by those specified in Table 7.6.2.1A-1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and the uplink assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For the two component carriers within the same band, $P_{wanted}$ in Table 7.6.2.1A-0 is set using $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3). For each downlink the UE shall meet the out-of-band blocking requirements applicable for inter-band carrier aggregation with one component carrier per operating band but with up to two component carriers assigned to the same band. The three downlink carriers shall be active throughout the tests.

### 7.6.2.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Tables 7.6.2.1D-1, 7.6.2.1D-2 and 7.6.2.1D-3.

For Table 7.6.2.1D-3 in frequency range 1, 2 and 3, up to $\max(24,\ 6\cdot\lceil N_{RB}/6\rceil)$ exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where $N_{RB}$ is the number of resource blocks in the downlink transmission bandwidth configuration (see Figure 5.6-1). For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

**Table 7.6.2.1D-1: Out-of-band blocking parameters for ProSe Direct Discovery**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below + $P_{offset}$ | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| $P_{offset}$ | dB | | | 10.9 | 13.9 | 15.7 | 16.9 |
| NOTE 2: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

**Table 7.6.2.1D-2: Out-of-band blocking parameters for ProSe Direct Communication**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

**Table 7.6.2.1D-3: Out of band blocking for ProSe**

| E-UTRA ProSe band | Parameter | Units | Frequency | | |
|---|---|---|---|---|---|
| | | | Range 1 | Range 2 | Range 3 |
| | $P_{Interferer}$ | dBm | -44 | -30 | -15 |
| 2,3,4,7,14, 20,26,28,31 | $F_{Interferer}$ (CW) | MHz | $F_{DL\_low}$ -15 to $F_{DL\_low}$ -60 | $F_{DL\_low}$ -60 to $F_{DL\_low}$ -85 | $F_{DL\_low}$ -85 to 1 MHz |
| | | | $F_{DL\_high}$ +15 to $F_{DL\_high}$ + 60 | $F_{DL\_high}$ +60 to $F_{DL\_high}$ +85 | $F_{DL\_high}$ +85 to +12750 MHz |
| NOTE 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS. | | | | | |

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

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.6.3.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.6.3.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 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 sub-blocks, the narrow band blocking requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.6.3.1 and 7.6.3.1A for one component carrier and two component carriers per sub-block, respectively. The requirements apply for in-gap and out-of-gap interferers while all downlink carriers are active.

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

| Parameter | Unit | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| $P_w$ in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | 16 | 16[4] | 16 | | |
| $P_{uw}$ (CW) | dBm | -55 | -55 | -55 | | |
| $F_{uw}$ (offset for $\Delta f$ = 15 kHz) | MHz | - $F_{offset}$ – 0.2 / + $F_{offset}$ + 0.2 | - $F_{offset}$ – 0.2 / + $F_{offset}$ + 0.2 | - $F_{offset}$ – 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.<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 $F_{uw}$ (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to $\lfloor F_{interferer} / 0.015 + 0.5 \rfloor 0.015 + 0.0075$ MHz to be offset from the sub-carrier raster.<br>NOTE 4: The requirement is applied for the band combinations whose component carriers' BW≥5 MHz. | | | | | | |

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the narrow-band blocking requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the requirements specified in subclause 7.6.3. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink active in each band capable of UL operation. For these uplink configurations, the UE shall meet the narrow-band blocking requirements for intra-band non-contiguous carrier aggregation of two downlink carriers with $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3) and for the remaining component carrier the requirements specified in subclause 7.6.3. The three downlink carriers shall be active throughout the tests.

## 7.6.3.1D Minimum requirements for ProSe

The relative throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Table 7.6.3.1D-1 and Table 7.6.3.1D-2.

**Table 7.6.3.1D-1: Narrow-band blocking for ProSe Direct Discovery**

| Parameter | Unit | Channel Bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| $P_w$ | dBm | $P_{REFSENS\_ProSe}$ + channel-bandwidth specific value below + $P_{offset}$ | | | | | |
| | | | | 16 | 13 | 14 | 16 |
| $P_{uw}$ (CW) | dBm | | | -55 | -55 | -55 | -55 |
| $P_{offset}$ | dB | | | 10.9 | 13.9 | 15.7 | 16.9 |
| $F_{uw}$ (offset for $\Delta f$ = 15 kHz) | MHz | | | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| $F_{uw}$ (offset for $\Delta f$ = 7.5 kHz) | MHz | | | | | | |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

**Table 7.6.3.1D-2: Narrow-band blocking for ProSe Direct Communication**

| Parameter | Unit | Channel Bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| $P_w$ | dBm | $P_{REFSENS\_ProSe}$ + channel-bandwidth specific value below | | | | | |
| | | | | 16 | 13 | 14 | 16 |
| $P_{uw}$ (CW) | dBm | | | -55 | -55 | -55 | -55 |
| $F_{uw}$ (offset for $\Delta f$ = 15 kHz) | MHz | | | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| $F_{uw}$ (offset for $\Delta f$ = 7.5 kHz) | MHz | | | | | | |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A, $P_{UW}$ power defined in Table 7.6.3.1D-1 and Table 7.6.3.1D-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

# 7.6A Void

<Reserved for future use>

# 7.6B Blocking characteristics for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.6 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter $P_{CMAX\_L}$ 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.<br>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 one component carrier per operating band and the uplink assigned to one E-UTRA band the spurious response requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The throughput measured in each downlink with $F_{interferer}$ 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 all downlink carriers are active.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the spurious response requirements applicable specified above shall be met with the transmitter power for the uplink set to 7 dB below $P_{CMAX\_L,c}$ for each serving cell *c*.

For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the spurious response requirements of subclause 7.7.1A do not apply.

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.7.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The throughput of each carrier shall be ≥ 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 sub-blocks, the spurious response requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.7.1 and 7.7.1A for one component carrier and two component carriers per sub-block, respectively. The requirements apply with all downlink carriers active.

For intra-band non-contiguous carrier aggregation with two uplink carriers and two downlink carriers, the spurious response requirements applicable specified above shall be met with the transmitter powers for the uplinks set to $P_{CMAX\_L,c}$ – 7 dBm.

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

| Rx Parameter | Units | CA Bandwidth Class | | | | |
|---|---|---|---|---|---|---|
| | | B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | 9 | 9 | 9 | | |
| 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 |

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For each downlink the UE shall meet the spurious-response requirements applicable for inter-band carrier aggregation with one component carrier per operating band but with a sub-block of up to two component carriers assigned to the same operating band. For the sub-block of two component carriers the spurious response parameters in Table 7.7.1-1 are replaced by those specified in Table 7.7.1A-1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For the two component carriers within the same band, $P_{wanted}$ in Table 7.6.2.1A-0 is set using $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3). For each downlink the UE shall meet the spurious-response requirements applicable for inter-band carrier aggregation with one component carrier per operating band but with up to two component carriers assigned to the same band. The three downlink carriers shall be active throughout the tests.

## 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.

## 7.7.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Tables 7.7.1D-1, 7.7.1D-2, and 7.7.1D-3.

**Table 7.7.1D-1: Spurious response parameters for ProSe Direct Discovery**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below+ $P_{offset}$ | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| $P_{offset}$ | dB | | | 10.9 | 13.9 | 15.7 | 16.9 |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

**Table 7.7.1D-2: Spurious response parameters for ProSe Direct Communication**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below | | | | | |
| | | | | 6 | 6 | 7 | 9 |
| NOTE 1: Reference measurement channel is specified in Annex A.6.2. | | | | | | | |

**Table 7.7.1D-3: Spurious response for ProSe**

| Parameter | Unit | Level |
|---|---|---|
| $P_{Interferer}$ (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 7.7.1D-3 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

# 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.
NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 with set-up according to Annex C.3.1The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥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 one component carrier per operating band and the uplink assigned to one E-UTRA band the wide band intermodulation requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.8.1.1 for each component carrier while all downlink carriers are active. For E-UTRA CA configurations including an operating band without uplink band (as noted in Table 5.5-1), the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For E-UTRA CA configurations listed in Table 7.3.1A-0a under conditions for which reference sensitivity for the operating band being tested is N/A, the wideband intermodulation requirements of subclause 7.8.1A do not apply.

For intra-band contiguous carrier aggegation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC, For FDD, the PCC shall be configured closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.8.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier 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 |
| $P_w$ in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
| | | 9 | 12 | 13.8 | | |
| $P_{Interferer\ 1}$ (CW) | dBm | -46 | | | | |
| $P_{Interferer\ 2}$ (Modulated) | dBm | -46 | | | | |
| $BW_{Interferer\ 2}$ | MHz | 5 | 5 | 5 | | |
| $F_{Interferer\ 1}$ (Offset) | MHz | $-F_{offset}$-7.5 / + $F_{offset}$+7.5 | $-F_{offset}$-7.5 / + $F_{offset}$+7.5 | $-F_{offset}$-7.5 / + $F_{offset}$+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.
NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 with set-up according to Annex C.3.1.
NOTE 4: The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥5MHz;
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 sub-blocks, the wide band intermodulation requirements are defined with the uplink configuration in accordance with Table 7.3.1A-3. For this uplink configuration, the UE shall meet the requirements for each sub-block as specified in subclauses 7.8.1.1 and in this subclause for one component carrier and two component carriers per sub-block, respectively. The requirements apply for out-of-gap interferers while all downlink carriers are active.

For combinations of intra-band contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test and a configuration in accordance with Table 7.3.1-2. The downlink PCC carrier center frequency shall be configured closer to the uplink operating band than the downlink SCC center frequency when the uplink is active in the band supporting two component carriers. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the wide-band intermodulation requirements for intra-band contiguous carrier aggregation of two downlink carriers and for the remaining component carrier the requirements specified in subclause 7.8.1. The three downlink carriers shall be active throughout the tests.

For combinations of intra-band non-contiguous and inter-band carrier aggregation with three downlink carriers and one uplink carrier assigned to one E-UTRA band, the requirement is defined with the uplink active in the band other than that supporting the downlink(s) under test. The uplink configuration shall be in accordance with Table 7.3.1A-3 when the uplink is active in the band supporting two component carriers and in accordance with Table 7.3.1-2 when the uplink is active in the other band. For E-UTRA CA configurations including an operating band without uplink band, the requirements for all downlinks shall be met with the single uplink carrier active in each band capable of UL operation. For these uplink configurations, the UE shall meet the wide-band intermodulation requirements for intra-band non-contiguous carrier aggregation of two downlink carriers with $\Delta R_{IBNC}$ = 0 dB for all sub-block gaps (Table 7.3.1A-3) and for the remaining component carrier the requirements specified in subclause 7.8.1. The three downlink carriers shall be active throughout the tests.

## 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.

## 7.8.1D Minimum requirements for ProSe

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.6.2 with parameters specified in Table 7.8.1D-1, Table 7.8.1D-2, and Table 7.8.1D-3 for the specified wanted signal mean power in the presence of two interfering signals

**Table 7.8.1D-1: Wide band intermodulation parameters for ProSe Direct Discovery**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| $P_{offset}$ | dB | | | 10.9 | 13.9 | 15.7 | 16.9 |

**Table 7.8.1D-2: Wide band intermodulation for ProSe Direct Communication**

| Rx parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| $P_{offset}$ | dB | | | 0 | 0 | 0 | 0 |

**Table 7.8.1D-3: Wide band intermodulation for ProSe**

| Rx Parameter | Units | Channel bandwidth | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | $P_{REFSENS\_ProSe}$ + channel bandwidth specific value below+ $P_{offset}$ | | | | | |
| | | 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: Reference measurement channel is specified in Annex A.6.2<br>NOTE 2: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211 | | | | | | | |

For the UE which supports inter band CA configuration in Table 7.3.1-1A, $P_{interferer1}$ and $P_{interferer2}$ powers defined in Table 7.8.1D-3 are increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.1-1A.

### 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 | 25 | 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 Receiver antenna capability

The performance requirements are based on UE(s) that utilize one or more antenna receivers.

For all test cases, the SNR is defined as

$$SNR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

where $N_{RX}$ denotes the number of receiver antenna connectors and the superscript receiver antenna connector $j$. The above SNR definition assumes that the REs are not precoded. The SNR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in Table C.3.2-1. The SNR requirement applies for the UE categories and CA capabilities given for each test.

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

$$SINR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)'}}$$

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

For the performance requirements specified in this clause, it is assumed that $N_{RX}$=2 unless otherwise stated.

**Table 8.1.1-1: Void**

#### 8.1.1.1 Simultaneous unicast and MBMS operations

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

### 8.1.2 Applicability of requirements

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

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

Test cases defined for 5MHz channel bandwidth that reference this clause are applicable to UEs that support only Band 31.

#### 8.1.2.2 Definition of CA capability

The definition with respect to CA capabilities for 2CCs is given as in Table 8.1.2.2-1. The definition with respect to CA capabilities for 3CCs is given in Table 8.1.2.2-3.

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

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

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

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

| CA Capability | Bandwidth combination for FDD CA | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA |
|---|---|---|---|
| CA2_C | 5+5MHz, 5+10MHz, 10+10MHz, 20+20MHz | 20+20MHz, 15+20MHz | NA |
| CA2_A2 | 10+10MHz, 10+15MHz, 10+20MHz, 15+20MHz, 20+20MHz | 20+20MHz | 10(FDD)+20(TDD)MHz, 15(FDD)+20(TDD)MHz, 20(FDD)+20(TDD)MHz |
| CA2_N2 | 5+10MHz, 10+10MHz, 20+20MHz | 20+20MHz | NA |
| Note 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2. | | | |

**Table 8.1.2.2-3: Definition of CA capability with 3 DL CCs**

| CA Capability | CA Capability Description |
|---|---|
| CA3_C | Intra-band contiguous CA |
| CA3_A2 | Inter-band CA (two bands) |
| CA3_A3 | Inter-band CA (three bands) |
| CA3_N2 | Intra-band non-contiguous CA (with two sub-blocks) |
| Note 1: CA3_C corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-1 for 3 DL CCs. CA3_A2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-2 for 3 DL CCs. CA3_A3 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in and Table 5.6A.1-2a for 3 DL CCs. CA3_N2 corresponds to E-UTRA CA configurations and bandwidth combination sets defined in Table 5.6A.1-3 for 3 DL CCs. | |

The supported testable largest aggregated CA bandwidth combinations for 3CCs for each CA capability are listed in Table 8.1.2.2-4.

**Table 8.1.2.2-4: Supported largest aggregated CA bandwidth combinations for different CA capability with 3 CCs**

| CA capability | Bandwidth combination for FDD CA | Bandwidth combination for TDD CA | Bandwidth combination for TDD-FDD CA |
|---|---|---|---|
| CA3_C | NA | 20+20+20MHz | NA |
| CA3_A2 | 5+10+20MHz,<br>10+10+20MHz,<br>10+20+20MHz,<br>20+20+20MHz | 15+20+20MHz,<br>20+20+20MHz | 15(FDD)+20(TDD)+20(TDD)MHz,<br>20(FDD)+20(TDD)+20(TDD)MHz |
| CA3_A3 | 10+10+20MHz,<br>10+15+15MHz,<br>10+15+20MHz,<br>10+20+20MHz,<br>15+15+20MHz,<br>15+20+20MHz,<br>20+20+20MHz | NA | NA |
| CA3_N2 | NA | 20+20+20MHz | NA |
| Note 1: This table is only for information and applicability and test rules of CA performance requirements are specified in 8.1.2.3 and 9.1.1.2. | | | |

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

## 8.1.2.2A Definition of dual connectivity capability

The definition with respect to dual connectivity capabilities for configurations with 2CCs is given as in Table 8.1.2.2A-1.

**Table 8.1.2.2A-1: Definition of dual connectivity capability with 2DL CCs**

| Dual connectivity Capability | Dual connectivity capability Description |
|---|---|
| DC_A_2 | Inter-band dual connecitivty (two bands) |
| Note 1: DC_A_2 corresponds to E-UTRA dual connectivity configurations and bandwidth combination sets defined for inter-band dual connecitivty (two bands) as specified in 5.6C. | |

The supported testable dual connectivity bandwidth combinations for 2CCs for each dual connectivity capability are listed in Table 8.1.2.2A-2.

**Table 8.1.2.2A-2: Supported testable dual connectivity bandwidth combinations for different dual connectivitys capability with 2DL CCs**

| Dual connectivity capability | Bandwidth combination for FDD dual connectivity | Bandwidth combination for TDD dual connectivity |
|---|---|---|
| DC_A_2 | 10+10MHz, 10+20MHz, 15+15MHz, 15+20MHz, 20+20MHz | 20+20MHz |
| Note 1: This table is only for information and applicability and test rules of dual connectivity performance requirements are specified in 8.1.2.3A | | |

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

The performance requirement for CA UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.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 and 3DL CCs in Table 8.2.2.3-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

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

| Tests | CA capability where the tests apply | CA configuration from the selected CA 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, 5+5 MHz, and 10MHz+5MHz. |
| CA tests with 2CCs in Clause 8.2.1.3.1 | Each supported CA capability | Any one of the supported FDD CA configurations in each CA capability | 10+10 MHz, 20+20 MHz, 5+5 MHz, and 10MHz+5MHz. |
| 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 | CA_C | Supported FDD intra-band contiguous CA configurations covering the lowest and highest operating bands | Largest aggregated CA bandwidth combinations |
| CA tests with 2CCs in Clause 8.2.2.1.1, 8.2.2.4.3 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.2.3.1 | Each supported CA capability | Any one of the supported TDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.2.3.1A, 8.7.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in 8.2.2.7.1 | CA_C | Supported TDD intra-band contiguous CA configurations covering the lowest and highest operating bands | Largest aggregated CA bandwidth combinations |
| CA tests with 2CCs in Clause 8.2.1.8.1 | CA_N | CA_3A-3A defined in Table 5.6A.1-3 | 10+10 MHz |
| CA tests with 2CCs in Clause 8.2.2.8.1 | CA2_C | CA_41C defined in Table 5.6A.1-1 | 20+20 MHz |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

**Table 8.1.2.3-2: Applicability and test rules for CA UE demodulation tests with 3 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 3CCs in Clause 8.2.1.1.1, 8.2.1.4.3, 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 3CCs in Clause 8.2.1.3.1 | Each supported CA capability | Any one of the supported FDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.2.1.1, 8.2.2.4.3, 8.7.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.2.3.1 | Each supported CA capability | Any one of the supported TDD CA configurations in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.2.8.1 | CA3_C | CA_41D defined in Table 5.6A.1-1 | 20+20+20 MHz |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

## 8.1.2.3A Applicability and test rules for different dual connectivity configuration and bandwidth combination set

The performance requirement for dual connectivity UE demodulation tests in Clause 8 are defined independent of dual connectivity configurations and bandwidth combination sets specified in Clause 5.6C.1. For UEs supporting difrerent dual connectivity configurations and bandwidth combination stes, the applicability and test rules are defined for the tests for the configurations with 2CCs in Table 8.1.2.3A-1. For simplicity, dual connectivity configurationbelow refers to combination of dual connectivity configuration and bandwidth set.

Both CA performance requirements and dual connectivity performance requirements are applied for dual connectivity capable UE.

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

| Tests | Dual connectivity capability where the tests apply | Dual connectivity configuration from the selected CA capbility where the tests apply | Dual connectivity Bandwidth combination to be tested in priority order |
|---|---|---|---|
| Dual connectivity test in Clause 8.2.1.4.3A, 8.7.6 | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported FDD dual connectvity configurations with the largest aggregated dual connectivity bandwidth combimation | Largest dual connectivity aggregated bandwidth combination |
| Dual connectivity test in Clause 8.2.2.4.3A, 8.7.7 | Any one of the supported dual connectivity capabilities with largest aggregated dual connectivity bandwidth combination | Any one of the supported TDD dual connectvity configurations with the largest aggregated dual connectivity bandwidth combination | Largest dual connectivity aggregated bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected DC or CA configuration is 1. | | | |

## 8.1.2.3B Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets

The performance requirement for TDD-FDD CA UE demodulation tests in Clause 8 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL TDD-FDD CA in Table 8.1.2.3B-1 and in Table 8.1.2.3B-2 for 3 DL TDD-FDD CA. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

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

| Tests | CA capability where the tests apply | CA configuration from the selected CA capbility where the tests apply | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 2CCs in Clause 8.2.3.1.1, 8.2.3.2.1A, 8.2.3.3.1, 8.7.5.1 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.3.2.1 | Each supported CA capability | Any one of the supported TDD-FDD CA configurations with FDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.3.1.2, 8.2.3.2.2A, 8.2.3.3.2, 8.7.5.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 8.2.3.2.2 | Each supported CA capability | Any one of the supported TDD-FDD CA configurations with TDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

**Table 8.1.2.3B-2: Applicability and test rules for CA UE demodulation tests for TDD-FDD CA with 3 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 3CCs in Clause 8.2.3.1.1, 8.2.3.2.1A, 8.2.3.3.1, 8.7.5.1 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.3.2.1 | Each supported CA capability | Any one of the supported TDD-FDD CA configurations with FDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.3.1.2, 8.2.3.2.2A, 8.2.3.3.2, 8.7.5.2 | Any one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 8.2.3.2.2 | Each supported CA capability | Any one of the supported TDD-FDD CA configurations with TDD PCell in each CA capability with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

### 8.1.2.4 Test coverage for different number of component carriers

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

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

For TDD FDD tests specified in 8.2.3.1, 8.2.3.2, 8.2.3.3, and 8.7.5, if corresponding TDD FDD CA tests are tested, the test coverage can be considered fulfilled without executing both FDD and TDD single carrier tests.

For FDD CA tests specified in 8.2.1.1.1, 8.2.1.4.3, and 8.7.1, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For FDD CA tests specified in 8.2.1.3.1, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 8.2.2.1.1, 8.2.2.4.3, and 8.7.2, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 8.2.2.3.1, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 8.2.3.1, 8.2.3.3, and 8.7.5, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 8.2.3.2, for each supported CA capability, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

For FDD CA power imbalance tests specified in 8.2.1.7.1, if they are are tested with FDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD intra-band contiguous CA configurations with 3 DL CCs supported by the UE.

For TDD CA power imbalance tests specified in 8.2.2.7.1, if they are are tested with TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with TDD intra-band contiguous CA configurations with 3 DL CCs supported by the UE.

#### 8.1.2.5 Applicability of performance requirements for Type B receiver

For TM10 capable UE, if corresponding tests specified in 8.3.1.1F, 8.3.2.1G, 9.3.8.3 are tested, the test coverage can be considered fulfilled without executing the tests specified in 8.3.1.1C, 8.3.2.1D, 9.3.8.2. For a UE which does not have TM10 capability, the tests specified in sections 8.3.1.1C, 8.3.2.1D, 9.3.8.2 should be used.

### 8.1.3 UE category and UE DL category

UE category and UE DL category refer to *ue-Category* and *ue-CategoryDL* define in 4.1 and 4.1A from [12]. A UE that belongs to either a UE category or a UE DL category indicated in UE performance requirements in subclause 8, 9, 10 shall fulfil the corresponding requirements.

A UE indicating DL category 13 may indicate category 9 or 10 and shall thereby fulfil all requirements in subclause 8, 9, 10 that are indicated for either cat 9 or DL Cat 13 UEs. For SDR tests in section 8.7 both cat 9 and cat 13 test shall be used for this UE while for the other test only Cat 13 tests needs to be done.

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

### 8.2.1 FDD (Fixed Reference Channel)

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

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

| Parameter | Unit | Value |
|---|---|---|
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cyclic Prefix | | Normal |
| Cell_ID | | 0 |
| Cross carrier scheduling | | Not configured |

#### 8.2.1.1 Single-antenna port performance

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

#### 8.2.1.1.1 Minimum Requirement

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

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

For CA with 3 DL CCs, the requirements are speicifed in Table 8.2.1.1.1-6, based on single carrier requirement speicified in Table 8.2.1.1.1-5, with the addition of the parameters in Table 8.2.1.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

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

**Table 8.2.1.1.1-1: Test Parameters**

| Parameter | | Unit | Test 1- 5 | Test 6- 8 | Test 9- 15 | Test 16- 18 | Test 19 |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 | 0 | 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 | | UE cate gory |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 | ≥1 |
| 2 | 10 MHz | R.2 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | -0.4 | ≥1 |
| 3 | 10 MHz | R.2 FDD | OP.1 FDD | ETU300 | 1x2 Low | 70 | 0.0 | ≥1 |
| 4 | 10 MHz | R.2 FDD | OP.1 FDD | HST | 1x2 | 70 | -2.4 | ≥1 |
| 5 | 1.4 MHz | R.4 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 0.0 | ≥1 |
| 6 | 10 MHz | R.3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | 1 |
| | 5 MHz (Note 4) | R.3-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 6.7 | ≥2 |
| 7 | 10 MHz | R.3 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | 1 |
| | 5 MHz (Note 4) | R.3-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.4 | ≥2 |
| 8 | 10 MHz | R.3 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | ≥2 |
| | 5 MHz | R.3-1 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | 1 |
| | 5 MHz (Note 4) | R.3-1 FDD | OP.1 FDD | ETU300 | 1x2 High | 70 | 9.4 | ≥2 |
| 9 | 3 MHz | R.5 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥1 |
| 10 | 5 MHz | R.6 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.4 | ≥2 |
| | 5 MHz | R.6-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.5 | 1 |
| 11 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 12 | 10 MHz | R.7 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 19.0 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 70 | 18.1 | 1 |
| 13 | 10 MHz | R.7 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 19.1 | ≥2 |
| | 10 MHz | R.7-1 FDD | OP.1 FDD | EVA5 | 1x2 High | 70 | 17.8 | 1 |
| 14 | 15 MHz | R.8 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.7 | ≥2 |
| | 15 MHz | R.8-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.8 | 1 |
| 15 | 20 MHz | R.9 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.6 | ≥3 |
| | 20 MHz | R.9-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 17.3 | 2 |
| | 20 MHz | R.9-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | 16.7 | 1 |
| 16 | 3 MHz | R.0 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 17 | 10 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 18 | 20 MHz | R.1 FDD | OP.1 FDD | ETU70 | 1x2 Low | 30 | 1.9 | ≥1 |
| 19 | 10 MHz | R.41 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -5.4 | ≥1 |

Note 1: Void.
Note 2: Void.
Note 3: Void.
Note 4: Test case applicability is defined in 8.1.2.1.

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

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | 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: $P_B = 0$.
Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
Note 3: PUCCH format 1b with channel selection is used to feedback ACK/NACK for Tests in Table 8.2.1.1.1-4, PUCCH format 3 is used to feedback ACK/NACK for Tests in Table 8.2.1.1.1-6.
Note 4: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.1.1.1-4: Minimum performance (FRC) for CA with 2DL CCs**

| Test num. | 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 |
| 3 | 2x5 MHz | R.42-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 | ≥2 |
| | | | OP.1 FDD | | | 70 | -1.0 | |
| 4 | 10MHz +5MHz | R.2 FDD for 10MHz CC | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 | ≥3 |
| | | R.42-2 FDD for 5MHz CC | OP.1 FDD | | | 70 | -1.0 | |

Note 1: The OCNG pattern applies for each CC.
Note 2: 30usec timing difference between two CCs is applied in inter-band CA case.
Note 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.1.1.1-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.4 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.3 |
| 3MHz | R.42-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.1 |
| 5MHz | R.42-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 |
| 10MHz | R.2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |
| 15MHz | R.42-3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 20MHz | R.42 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |

**Table 8.2.1.1.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 3 | 20MHz+20MHz+10MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 4 | 20MHz+15MHz+15MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 5 | 20MHz+15MHz+10MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 6 | 20MHz+10MHz+10MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 7 | 15MHz+15MHz+10MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| 8 | 20MHz+10MHz+5MHz | As specified in Table 8.2.1.1.1-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3<br>Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. | | | |

## 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 |
| | 5 MHz (Note 1) | R.11-2 FDD | OP.1 FDD | EVA5 | 2x2 Medium | 70 | 5.9 | ≥2 |
| 2 | 10 MHz | R.10 FDD | OP.1 FDD | HST | 2x2 | 70 | -2.3 | ≥1 |
| Note 1: Test case applicability is defined in 8.1.2.1. | | | | | | | | |

#### 8.2.1.2.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.2.2-2, with the addition of the parameters in Table 8.2.1.2.2-1 and the downlink physical channel setup according Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC-FSTD) with 4 transmitter antennas.

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

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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 Port (demodulation subframe overlaps with aggressor cell ABS)

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

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

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 |
| | 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 8.2.1.2.3-2 | 6 |
| $BW_{Channel}$ | | 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 5) | | | N/A | 11000100<br>11000000<br>11000000<br>11000000<br>11000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 10000000<br>10000000<br>10000000<br>10000000<br>10000000 | N/A |
| CSI Subframe Sets (Note7) | $C_{CSI,0}$ | | 11000100<br>11000000<br>11000000<br>11000000<br>11000000 | N/A |
| | $C_{CSI,1}$ | | 00111011<br>00111111<br>00111111<br>00111111<br>00111111 | N/A |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | 2 | N/A |
| Cyclic prefix | | | Normal | Normal |

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 8.2.1.2.3-2: 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 $\hat{E}_s / N_{oc2}$ 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 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)**

| 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 Table8.2.1.2.3 A-2 | 12 | 10 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | 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 | | | 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 8.2.1.2.3A-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.

#### 8.2.1.2.5 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model

The requirements are specified in Table 8.2.1.2.5-2, with the addition of parameters in Table 8.2.1.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 2 interference model defined in clause B.6.1. In Table 8.2.1.2.5-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.5-1: Test Parameters for Transmit Diversity Performance (FRC) with TM2 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (NOTE 1) | -3 | -3 |
| | 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 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 6 | 1 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | 3 | 3 |
| PDSCH transmission mode | | | 2 | 2 | 2 |
| Interference model | | | N/A | As specified in clause B.6.1 | As specified in clause B.6.1 |
| MBSFN | | | Not configured | Not configured | Not configured |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| NeighCellsInfo-r12 (NOTE 3) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.2.1.2.5-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM2 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-10 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 15.5 | ≥1 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

#### 8.2.1.2.6 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model

The requirements are specified in Table 8.2.1.2.6-2, with the addition of parameters in Table 8.2.1.2.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In Table 8.2.1.2.6-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.2.6-1: Test Parameters for Transmit Diversity Performance (FRC) with TM9 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | 0 | 0 |
| | $\rho_B$ | dB | -3 (NOTE 1) | 0 | 0 |
| | σ | dB | 0 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 3.28 | 0.74 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | Random from set {1,2,3} | Random from set {1,2,3} |
| PDSCH transmission mode | | | 2 | 9 | 9 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals | | | N/A | Antenna ports 15,16 | Antenna ports 15,16 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | N/A | 10 / 1 | 10 / 1 |
| CSI reference signal configuration | | | N/A | 6 | 7 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | N/A | 6 / 0100000000000000 | 6 / 0010000000000000 |
| Time offset to cell 1 | | us | N/A | 5 | -5 |
| Frequency offset to cell 1 | | Hz | N/A | 600 | -600 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |

NOTE 1: $P_B = 1$

NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.

NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.

NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 8.2.1.2.6-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-9 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 8.4 | ≥1 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.1.3 Open-loop spatial multiplexing performance

#### 8.2.1.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.1.3.1-2, with the addition of the parameters in Table 8.2.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CC, the requirements are specified in Table 8.2.1.3.1-4, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.3.1-6, based on single carrier requirement specified in Table 8.2.1.3.1-5, with the addition of the parameters in Table 8.2.1.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

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

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

| Parameter | | Unit | Test 1-4 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 3 |

Note 1: $P_B = 1$.
Note 2: Void.
Note 3: Void.

**Table 8.2.1.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test num | Bandwidth | Reference channel | OCNG pattern | 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 (Note 3) | 5 MHz | R.11-2 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.7 | ≥2 |
| 3 | 10 MHz | R.35 FDD | OP.1 FDD | EVA200 | 2x2 Low | 70 | 20.2 | ≥2 |
| 4 | 10 MHz | R.35-4 FDD | OP.1 FDD | ETU600 | 2x2 Low | 70 | 20.8 | ≥2 |

Note 1: Void.
Note 2: Test 1 may not be executed for UE-s for which Test 1 or 2 in Table 8.2.1.3.1-4 is applicable.
Note 3: Test case applicability is defined in 8.1.2.1.

**Table 8.2.1.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 3 |

Note 1: $P_B = 1$.
Note 2: PUCCH format 1b with channel selection is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-4, PUCCH format 3 is used to feedback ACK/NACK for Tests in Table 8.2.1.3.1-6.
Note 3: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.1.3.1-4: Minimum performance Large Delay CDD (FRC) for CA with 2DL CCs**

| Test num | Bandwidth | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of maximum Throughput (%) | SNR (dB) | |
| 1 (Note 2) | 2x10 MHz | R.11 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.7 | ≥3 |
| 2 (Note 2) | 2x20 MHz | R.30 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.2 | ≥5 |
| 3 | 2x5 MHz | R.11-2 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.7 | ≥2 |
| 4 | 10MHz+5 MHz | R.11 FDD for 10MHz CC, | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.0 | ≥3 |
| | | R.11-2 FDD for 5MHz CC | OP.1 FDD (Note 1) | | | 70 | 12.7 | |

Note 1: The OCNG pattern applies for each CC.
Note 2: Void
Note 3: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.1.3.1-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condition | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.11-5 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 13.6 |
| 3MHz | R.11-6 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 5MHz | R.11-2 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 10 MHz | R.11 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 15MHz | R.11-7 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 20MHz | R.30 FDD | OP. 1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |

**Table 8.2.1.3.1-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 3 | 20MHz+20MHz+10MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 4 | 20MHz+15MHz+15MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 5 | 20MHz+15MHz+10MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 6 | 20MHz+10MHz+10MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 7 | 15MHz+15MHz+10MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| 8 | 20MHz+10MHz+5MHz | As specified in Table 8.2.1.3.1-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 | | | |

### 8.2.1.3.1A Soft buffer management test

For CA, the requirements are specified in Table 8.2.1.3.1A-2, with the addition of the parameters in Table 8.2.1.3.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified 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 condition | 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. | | | | |

### 8.2.1.3.1B Enhanced Performance Requirement Type C –2Tx Antenna Ports

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$. | | | |

**Table 8.2.1.3.1B-2: Enhanced Performance Requirement Type C for Large Delay CDD (FRC)**

| Test num | Bandwidth | Reference channel | OCNG pattern | Propa-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 Medium | 70 | 17.8 | ≥2 |

### 8.2.1.3.1C Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference

The requirements are specified in Table 8.2.1.3.1C-2, with the addition of parameters in Table 8.2.1.3.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performence with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell with transmission mode 1. In Table 8.2.1.3.1C-1, Cell 1 is the serving cell, and Cell 2 is interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.

**Table 8.2.1.3.1C-1 Test parameters for Larger Delay CDD (FRC) with TM1 interference**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | |
| Downlink power allocation | $\rho_A$ | dB | -3 | 0 |
| | $\rho_B$ | | -3 (Note 1) | 0 |
| | σ | | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna port 0 |
| Cyclic Prefix | | | Normal | Normal |
| Cell ID | | | 0 | 1 |
| Transmission mode | | | 3 | Note 2 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A |
| $\hat{E}_s/N_{oc}$ (Note 3) | | dB | Reference Value in Table 8.2.1.3.1C-2 | 12.95 |
| Correlation and antenna configuration | | | Medium (2x2) | Medium(1x2) |
| Number of OFDM symbols for PDCCH | | | 2 | N/A |
| Max number of HARQ transmissions | | | 4 | N/A |
| Redundancy version coding sequence | | | {0,1,2,3} | N/A |
| Note 1: $P_B = 1$<br>Note 2: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.2 applying OCNG pattern OP.5 FDD as defined in Annex A.5.1.5.<br>Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.<br>Note 4: All cells are time-synchronous.<br>Note 5: SIB-1 will not be transmitted in Cell2 in this test. | | | | |

**Table 8.2.1.3.1C-2 Enhanced Performance Requirement Type C, Larger Delay CDD (FRC) with TM1 interference**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) | |
| 1 | R.11-8 FDD | OP.1 FDD | OP.5 FDD | EVA70 | EVA70 | 70 | 19.9 | ≥2 |
| Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.<br>Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1. | | | | | | | | |

### 8.2.1.3.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.3.2-2, with the addition of the parameters in Table 8.2.1.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 4 transmitter antennas.

**Table 8.2.1.3.2-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -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**

| 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 8.2.1.3.3-4 | 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 | 0001000000<br>0100000010<br>0000001000<br>0000000000 |
| RLM/RRM Measurement Subframe Pattern (Note 6) | | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A |
| CSI Subframe Sets (Note 7) | $C_{CSI,0}$ | | 0001000000<br>0100000010<br>0000001000<br>0000000000 | N/A |
| | $C_{CSI,1}$ | | 1110111111<br>1011111101<br>1111110111<br>1111111111 | N/A |
| MBSFN Subframe Allocation (Note 10) | | | N/A | 001000<br>100001<br>000100<br>000000 |
| Number of control OFDM symbols | | | 2 | 2 |
| PDSCH transmission mode | | | 3 | N/A |
| Cyclic prefix | | | Normal | Normal |

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 $4^{th}$, $12^{th}$, $19^{th}$ and $27^{th}$ 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], four frames with 24 bits is chosen for MBSFN subframe allocation.
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.

**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**

| 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 8.2.1.3.4-2 | Reference Value in Table 8.2.1.3.4-2 | Reference Value in Table 8.2.1.3.4-2 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | µs | N/A | 3 | -1 |
| Frequency shift between Cells | | Hz | N/A | 300 | -100 |
| Cell Id | | | 0 | 1 | 126 |
| ABS pattern (Note 5) | | | N/A | 11000000 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 | | | 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 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 8.2.1.3.4-2: 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.
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 Closed-loop spatial multiplexing performance

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

The requirements are specified in Table 8.2.1.4.1-2, with the addition of the parameters in Table 8.2.1.4.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.1.4.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 | Test 1A | Test 2 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 |
| Precoding granularity | | PRB | 6 | 4 | 50 |
| PMI delay (Note 2) | | ms | 8 | 8 | 8 |
| Reporting interval | | ms | 1 | 1 | 1 |
| Reporting mode | | | PUSCH 1-2 | PUSCH 1-2 | PUSCH 3-1 |
| CodeBookSubsetRestriction bitmap | | | 001111 | 001111 | 001111 |
| PDSCH transmission mode | | | 4 | 4 | 4 |

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at 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 |
| 1A (Note 1) | 5 MHz | R.10-2 FDD | OP.1 FDD | EVA5 | 2x2 Low | 70 | -2.9 | ≥1 |
| 2 | 10 MHz | R.10 FDD | OP.1 FDD | EPA5 | 2x2 High | 70 | -2.3 | ≥1 |
| Note 1: Test case applicability is defined in 8.1.2.1. | | | | | | | | |

#### 8.2.1.4.1A Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port

The requirements are specified in Table 8.2.1.4.1A-2, with the addition of the parameters in Table 8.2.1.4.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband and frequency selective precoding.

**Table 8.2.1.4.1A-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | $\sigma$ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 1 |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 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**

<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 8.2.1.4.1C-2</td><td>12</td><td>10</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>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>6</td><td>Note 9</td><td>Note 9</td></tr>
<tr><td colspan="2">Precoding granularity</td><td>PRB</td><td>50</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">PMI delay (Note 10)</td><td>ms</td><td>8</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Reporting interval</td><td>ms</td><td>1</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Peporting mode</td><td></td><td>PUSCH 3-1</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">CodeBookSubsetRestriction bitmap</td><td></td><td>1111</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td><td>Normal</td></tr>
</table>

| | |
|---|---|
| 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.

### 8.2.1.4.1D Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.1.4.1D-2, with the addition of the parameters in Table 8.2.1.4.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 4 interference model defined in clause B.6.3. In Table 8.2.1.4.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.1.4.1D-1: Test Parameters for Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | | Cell 3 | |
|---|---|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | | -3 | |
| | $\rho_B$ | dB | -3 (NOTE 1) | -3 | | -3 | |
| | 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/15 kHz | -98 | | | | |
| Test number (NOTE 4) | | | | Test 1 | Test 2 | Test 1 | Test 2 |
| $\widehat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.28 | 3.34 | 0.74 |
| Cell Id | | | | 6 | 1 | 1 | 6 |
| CFI indicated in PCFICH | | | | 3 | Random from set {1,2,3} | 3 | Random from set {1,2,3} |
| $BW_{Channel}$ | | MHz | 10 | 10 | | 10 | |
| Cyclic Prefix | | | Normal | Normal | | Normal | |
| Number of control OFDM symbols | | | 3 | 3 | | 3 | |
| PDSCH transmission mode | | | 4 | 4 | | 4 | |
| Interference model | | | N/A | As specified in clause B.6.3 | | As specified in clause B.6.3 | |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.3 | | As specified in clause B.6.3 | |
| Time offset to cell 1 | | us | N/A | 2 | | 3 | |
| Frequency offset to cell 1 | | Hz | N/A | 200 | | 300 | |
| MBSFN | | | Not configured | Not configured | | Not configured | |
| NeighCellsInfo-r12 (NOTE 3) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | | {dB-6, dB-3, dB0} | |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | | {2,3,4,8,9} | |

NOTE 1: $P_B = 1$
NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.
NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].
NOTE 4: Test 1 and Test 2 are defined in Table 8.2.1.4.1D-2.

**Table 8.2.1.4.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Num | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-10 FDD | OP.1 FDD | N/A | N/A | EVA 5 | EVA 5 | EVA 5 | 2x2 Low | 85 | 17.0 | ≥1 |
| 2 | R.11-9 FDD | OP.1 FDD | N/A | N/A | EPA 5 | EPA 5 | EPA 5 | 2x2 Low | 85 | 10.1 | ≥1 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.1.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.1.4.2-2,with the addition of the parameters in Table 8.2.1.4.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.1.4.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1-2 | Test 2A | Test 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 |
| Precoding granularity | | PRB | 50 | 25 | 6 |
| PMI delay (Note 2) | | ms | 8 | 8 | 8 |
| Reporting interval | | ms | 1 | 1 | 1 |
| Reporting mode | | | PUSCH 3-1 | PUSCH 3-1 | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 110000 | 110000 | 110000 |
| PDSCH transmission mode | | | 4 | 4 | 4 |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbol | 2 | 3 | 1 |
| Note 1: $P_B = 1$.<br>Note 2: If the UE reports in an available uplink reporting instance at 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 | UE DL category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | | |
| 1 | 10 MHz | R.35 FDD | OP.1 FDD | EPA5 | 2x2 Low | 70 | 18.9 | ≥2 | ≥6 |
| 2 | 10 MHz | R.11 FDD | OP.1 FDD | ETU70 | 2x2 Low | 70 | 14.3 | ≥2 | ≥6 |
| 2A (Note 1) | 5 MHz | R.11-2 FDD | OP.1 FDD | ETU70 | 2x2 Low | 70 | 14.0 | ≥2 | ≥6 |
| 3 | 10MHz 256QAM | R. 65 FDD | OP.1 FDD | EVA5 | 2x2 Low | 70 | 25.3 | 11-12 | ≥11 |
| Note 1: Test case applicability is defined in 8.1.2.1. | | | | | | | | | |

### 8.2.1.4.2A Enhanced Performance Requirement Type C – Multi-layer Spatial Multiplexing 2Tx Antenna Ports

The requirements are specified in Table 8.2.1.4.2A-2,with the addition of the parameters in Table 8.2.1.4.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

**Table 8.2.1.4.2A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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 8.2.1.4.2A-2: Enhanced Performance Requirement Type C for Multi-Layer Spatial Multiplexing with TM4 (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.11 FDD | OP.1 FDD | ETU70 | 2x2 Medium | 70 | 18.3 | ≥2 |

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

For single carrier, the requirements are specified in Table 8.2.1.4.3-2, with the addition of the parameters in Table 8.2.1.4.3-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.1.4.3-4, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.1.4.3-6, based on single carrier requirement specified in Table 8.2.1.4.3-5, with the addition of the parameters in Table 8.2.1.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

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 | | | 000000000000000000000000000<br>000011111111111111111100000000<br>00000000 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$.<br>Note 2: If the UE reports in an available uplink reporting instance at 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 | 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 | 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 | Value |
|---|---|---|---|
| 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 | 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 1 |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 000000000000000000000000000000 001111111111111111000000000000 0000 |
| CSI request field (Note 3) | | | ‘10’ |
| PDSCH transmission mode | | | 4 |

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at 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: Multiple CC-s under test are configured as the 1$^{st}$ set of serving cells by higher layers.
Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 1b with channel selection configured for Tests in Table 8.2.1.4.3-4, and with PUCCH format 3 for Tests in Table 8.2.1.4.3-6.
Note 5: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.1.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA with 2DL CCs**

| Test num. | 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.14 FDD | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.8 | ≥3 |
| 2 | 2x20 MHz | R.14-3 FDD | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.9 | ≥5 |
| 3 | 2x5 MHz | R.14-6 FDD | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 9.5 | ≥2 |
| | | | OP.1 FDD (Note 1) | | | 70 | 9.5 | |
| 4 | 10MHz+5 MHz | R.14 FDD for 10MHz CC | OP.1 FDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.1 | ≥3 |
| | | R.14-6 FDD for 5MHz CC | OP.1 FDD (Note 1) | | | 70 | 9.5 | |

Note 1: The OCNG pattern applies for each CC.
Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.1.4.3-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.14-4 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.4 |
| 3MHz | R.14-5 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 5MHz | R.14-6 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 10 MHz | R.14 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 15MHz | R.14-7 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 20MHz | R.14-3 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.3 |

**Table 8.2.1.4.3-6: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 3 | 20MHz+20MHz+10MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 4 | 20MHz+15MHz+15MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 5 | 20MHz+15MHz+10MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 6 | 20MHz+10MHz+10MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 7 | 15MHz+15MHz+10MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| 8 | 20MHz+10MHz+5MHz | As specified in Table 8.2.1.4.3-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 | | | |

### 8.2.1.4.3A Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.2.1.4.3A-3, based on single carrier requirement specified in Table 8.2.1.4.3A-2, with the addition of the parameters in Table 8.2.1.4.3A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity transmission.

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

| Parameter | | Unit | Values |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 1 |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000000000000000<br>0000111111111111111100000000<br>00000000 |
| PDSCH transmission mode | | | 4 |
| ACK/NACK transmission | | | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG |
| CSI feedback | | | Separate PUSCH feedbacks on the MCG and SCG |
| Time offset between MCG CC and SCG CC | | μs | 0 for UE under test supporting synchronous dual connectivity;<br>334 for UE under test supporting both asynchronous and synchrounous dual connectivity (Note 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: The same PDSCH transmission mode is applied to each component carrier.<br>Note 4: As defined in TS36.300 [11].<br>Note 5: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured. | | | |

**Table 8.2.1.4.3A-2: Single carrier performance for multiple dual connectivity configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.14-4 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 10.36 |
| 3MHz | R.14-5 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 5MHz | R.14-6 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 10 MHz | R.14 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 15MHz | R.14-7 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 20MHz | R.14-3 FDD | OP. 1 FDD | EVA5 | 4x2 Low | 70 | 10.3 |

**Table 8.2.1.4.3A-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num. | Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 2x20 MHz | As specified in Table 8.2.1.4.3A-2 per CC | ≥5 |
| 2 | 15+20 MHz | As specified in Table 8.2.1.4.3A-2 per CC | ≥5 |
| 3 | 10+20MHz | As specified in Table 8.2.1.4.3A-2 per CC | ≥5 |
| 4 | 2x15 MHz | As specified in Table 8.2.1.4.3A-2 per CC | ≥5 |
| 5 | 2x10 MHz | As specified in Table 8.2.1.4.3A-2 per CC | ≥3 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectvity configurations and bandwidth combination sets is defined in 8.1.2.3A. | | | |

### 8.2.1.5 MU-MIMO

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

### 8.2.1.7 Carrier aggregation with power imbalance

For CA, the requirements in this section verify the ability of an intraband adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only.

#### 8.2.1.7.1 Minimum Requirement

The requirements are specified in Table 8.2.1.7.1-2, with the addition of the parameters in Table 8.2.1.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.1.7.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1 | Test 2-3 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | Off (Note 2) | Off (Note 2) |
| Symbols for unused PRBs | | | OCNG (Note 3) | OCNG (Note 3) |
| Modulation | | | 64 QAM | 64 QAM |
| Maximum number of HARQ transmission | | | 1 | 1 |
| Redundancy version coding sequence | | | {0} | {0} |
| PDSCH transmission mode of PCell | | | 1 | 3 |
| PDSCH tramsmission mode of SCell | | | 3 | 1 |
| OCNG Pattern | PCell | | OP.1 FDD | OP.5 FDD |
| | SCell | | OP.5 FDD | OP.1 FDD |
| Propagation Conditions | PCell | | Clause B.1 | Clause B.1 |
| | SCell | | Clause B.1 | Clause B.1 |
| Correlation Matrix and Antenna | PCell | | 1x2 | 2x2 |
| | SCell | | 2x2 | 1x2 |
| Note 1: $P_B = 0$ for 1x2 and $P_B = 1$ for 2x2 antenna configuration.<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 8.2.1.7.1-2: Minimum performance (FRC) for CA**

| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/15KHz) | | Reference value Fraction of Maximum Throughput (%) | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | PCell | SCell | PCell | SCell | $\hat{E}_{s\_PCell}$ for PCell | $\hat{E}_{s\_SCell}$ for Scell | PCell | SCell | |
| 1 | 20 | 20 | R.49 FDD | NA | -85 | -79 | 85 | NA | ≥5 |
| 2 | 10 | 10 | NA | R.49-1 FDD | -79 | -85.8 | NA | 85 | ≥5 |
| 3 | 5 | 5 | NA | R.49-2 FDD | -79 | -85.9 | NA | 85 | ≥5 |
| Note 1: The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | | |

## 8.2.1.8 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.35-4 FDD | OP.1 FDD | EPA200 | 2x2 Low | 70 | 21.15 | N/A | ≥3 |
| | SCell | 10MHz | R.35-3 FDD | | EPA200 | 2x2 Low | 60 | 15.18 | -30.26 | |
| Note 1: The EPA200 propagation channels applied to PCell and SCell are statistically independent.<br>Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3. | | | | | | | | | | |

## 8.2.2 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 and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths unless otherwise stated |
| Cross carrier scheduling | | Not configured |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<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 with 2 DL CCs, the requirements are specified in Table 8.2.2.1.1-4, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.1.1-7, based on single carrier requirement specified in Table 8.2.2.1.1-5, with the addition of the parameters in Table 8.2.2.1.1-3 and the downlink physical channel setup according to Annex C.3.2.

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 | Value |
|---|---|---|---|
| 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 for Tests in Table 8.2.2.1.1-4; PUCCH format 3 for Tests in Table 8.2.2.1.1-7 |
| PDSCH transmission mode | | | 1 |

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

**Table 8.2.2.1.1-4: Minimum performance (FRC) for CA with 2DL CCs**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20MHz | R.42 TDD | OP.1 TDD (Note 1) | EVA5 | 1x2 Low | 70 | -1.2 | ≥5 |
| 2 | 20MHz+ 15MHz | R.42 TDD for 20MHz CC | OP.1 TDD (Note 1) | EVA5 | 1x2 Low | 70 | -1.4 | ≥5 |
| | | R.42-3 TDD for 15MHz CC | OP.1 TDD (Note 1) | | | 70 | -1.4 | |

Note 1: The OCNG pattern applies for each CC.
Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.2.1.1-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.4 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.6 |
| 3MHz | R.42-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.8 |
| 5MHz | R.42-2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.2 |
| 10MHz | R.2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 15MHz | R.42-3 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |
| 20MHz | R.42 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |

**Table 8.2.2.1.1-6: Void**

**Table 8.2.2.1.1-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.2.1.1-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.2.1.1-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 | | | |

### 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.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3..
Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

#### 8.2.2.2.4 Enhanced Performance Requirement Type A – 2 Tx Antenna Ports with TM3 interference model

The requirements are specified in Table 8.2.2.2.4-2, with the addition of parameters in Table 8.2.2.2.4-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two dominant interfering cells applying transmission mode 3 interference model defined in clause B.5.2. In Table 8.2.2.2.4-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.4-1: Test Parameters for Transmit diversity Performance (FRC) with TM3 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 | -3 |
| | 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.

#### 8.2.2.2.5 Minimum Requirement 2 Tx Antenna Port (when *EIMTA-MainConfigServCell-r12* is configured)

The requirements are specified in Table 8.2.2.2.5-2 with the addition of the parameters in Table 8.2.2.2.5-1 and the downlink physical channel setup according to Annex C.3.2. The test purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas in case of using eIMTA TDD UL-DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI on a PCell.

**Table 8.2.2.2.5-1: Test Parameters for Transmit diversity Performance (FRC) when EIMTA-MainConfigServCell-r12 is configured**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Uplink downlink configuration in SIB1 (Note 2) | | | 0 |
| Downlink HARQ reference configuration (eimta-HarqReferenceConfig-r12) (Note 2) | | | 5 |
| Set of dynamic TDD UL-DL configurations (Notes 2,3) | | | {0, 1, 2, 3, 4, 5, 6} |
| Periodicity of monitoring the L1 reconfiguration DCI (eimta-CommandPeriodicity-r12) | | ms | 10 |
| Set of subframes to monitor the L1 reconfiguration DCI (eimta-CommandSubframeSet-r12) (Note 4) | | | {0,1,5,6} |
| Number of DL HARQ processes | | Processes | 15 |
| PDSCH transmission mode | | | 2 |
| ACK/NACK feedback mode (Note 5) | | | Multiplexing |
| Note 1: $P_B = 1$.<br>Note 2: As specified in Table 4.2-2 in TS 36.211.<br>Note 3: UL/DL configuration in PDCCH with eIMTA-RNTI is randomly selected from the given set on a per-DCI basis with equal probability.<br>Note 4: The set of subframes to monitor PDCCH with eIMTA-RNTI for frame n includes subframes {1,5,6} in frame n-1 and subframe 0 in frame n. Subframes for reconfiguration DCI transmission are chosen in a random way on a per-DCI basis with equal probability.<br>Note 5: PUCCH Format 3 is used for DL HARQ feedback. | | | |

**Table 8.2.2.2.5-2: Minimum performance Transmit diversity when EIMTA-MainConfigServCell-r12 is configured**

| Test | Reference channel | OCNG Pattern | Propagation Conditions | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | R.67 TDD | OP.1 TDD | EVA5 | 2x2 Medium | 70 | 5.0 | ≥1 |

#### 8.2.2.2.6 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model

The requirements are specified in Table 8.2.2.2.6-2, with the addition of parameters in Table 8.2.2.2.6-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 2 interference model defined in clause B.6.1. In Table 8.2.2.2.6-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.6-1: Test Parameters for Transmit Diversity Performance (FRC) with TM2 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 | -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 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 6 | 1 |
| Number of control OFDM symbols in normal subframes | | | 3 | 3 | 3 |
| CFI indicated in PCFICH in normal subframes | | | 3 | 3 | 3 |
| Number of control OFDM symbols in special subframes | | | 2 | 2 | 2 |
| CFI indicated in PCFICH in special subframes | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 2 | 2 | 2 |
| Interference model | | | N/A | As specified in clause B.6.1 | As specified in clause B.6.1 |
| MBSFN | | | Not configured | Not configured | Not configured |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| NeighCellsInfo-r12 (NOTE 3) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.2.2.2.6-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM2 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-12 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 15.3 | ≥1 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

### 8.2.2.2.7 Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model

The requirements are specified in Table 8.2.2.2.7-2, with the addition of parameters in Table 8.2.2.2.7-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In Table 8.2.2.2.7-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.2.7-1: Test Parameters for Transmit Diversity Performance (FRC) with TM9 interference model**

<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 colspan="2">Uplink downlink Configuration</td><td></td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td>4</td><td>4</td><td>4</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td>0</td><td>0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (NOTE 1)</td><td>0</td><td>0</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td>-3</td><td>-3</td></tr>
<tr><td colspan="2">Cell-specific reference signals</td><td></td><td>Antenna ports 0,1</td><td>Antenna ports 0,1</td><td>Antenna ports 0,1</td></tr>
<tr><td colspan="2">$N_{oc}$ at antenna port</td><td>dBm/15kHz</td><td colspan="3">-98</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc}$</td><td>dB</td><td>N/A</td><td>3.28</td><td>0.74</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">Cyclic Prefix</td><td></td><td>Normal</td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td>0</td><td>1</td><td>6</td></tr>
<tr><td colspan="2">Number of control OFDM symbols in normal subframes</td><td></td><td>3</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">CFI indicated in PCFICH in normal subframes</td><td></td><td>3</td><td>Random from set {1,2,3}</td><td>Random from set {1,2,3}</td></tr>
<tr><td colspan="2">Number of control OFDM symbols in special subframes</td><td></td><td>2</td><td>2</td><td>2</td></tr>
<tr><td colspan="2">CFI indicated in PCFICH in special subframes</td><td></td><td>2</td><td>Random from set {1,2}</td><td>Random from set {1,2}</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>2</td><td>9</td><td>9</td></tr>
<tr><td colspan="2">Interference model</td><td></td><td>N/A</td><td>As specified in clause B.6.4</td><td>As specified in clause B.6.4</td></tr>
<tr><td colspan="2">CSI reference signals</td><td></td><td>N/A</td><td>Antenna ports 15,16</td><td>Antenna ports 15,16</td></tr>
<tr><td colspan="2">CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$</td><td>Subframes</td><td>N/A</td><td>10 / 4</td><td>10 / 4</td></tr>
<tr><td colspan="2">CSI reference signal configuration</td><td></td><td>N/A</td><td>6</td><td>7</td></tr>
<tr><td colspan="2">Zero-power CSI-RS configuration $I_{CSI-RS}$ / ZeroPowerCSI-RS bitmap</td><td>Subframes / bitmap</td><td>N/A</td><td>9 / 0100000000000000</td><td>9 / 0010000000000000</td></tr>
<tr><td colspan="2">Time offset to cell 1</td><td>us</td><td>N/A</td><td>5</td><td>-5</td></tr>
<tr><td colspan="2">Frequency offset to cell 1</td><td>Hz</td><td>N/A</td><td>600</td><td>-600</td></tr>
<tr><td colspan="2">MBSFN</td><td></td><td>Not configured</td><td>Not configured</td><td>Not configured</td></tr>
<tr><td rowspan="2">NeighCellsInfo-r12 (NOTE 4)</td><td>p-aList-r12</td><td></td><td>N/A</td><td>{dB-6, dB-3, dB0}</td><td>{dB-6, dB-3, dB0}</td></tr>
<tr><td>transmissionModeList-r12</td><td></td><td>N/A</td><td>{2,3,4,8,9}</td><td>{2,3,4,8,9}</td></tr>
<tr><td colspan="6">NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].</td></tr>
</table>

**Table 8.2.2.2.7-2: Minimum Performance for Enhanced Performance Requirement Type B, Transmit Diversity (FRC) with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-11 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 8.1 | ≥1 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

## 8.2.2.3 Open-loop spatial multiplexing performance

### 8.2.2.3.1 Minimum Requirement 2 Tx Antenna Port

For single carrier, the requirements are specified in Table 8.2.2.3.1-2, with the addition of the parameters in Table 8.2.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.3.1-4, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.3.1-7, based on single carrier requirement specified in Table 8.2.2.3.1-5, with the addition of the parameters in Table 8.2.2.3.1-3 and the downlink physical channel setup according to Annex C.3.2.

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

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

| Parameter | | Unit | Test 1-3 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | Bundling |
| PDSCH transmission mode | | | 3 |

Note 1: $P_B = 1$
Note 2: Void.
Note 3: Void.

**Table 8.2.2.3.1-2: Minimum performance Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 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 | ETU600 | 2x2 Low | 70 | 21.1 | ≥2 |
| Note 1: Void. | | | | | | | | |

**Table 8.2.2.3.1-3: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | PUCCH format 1b with channel selection for Tests in Table 8.2.2.3.1-4; PUCCH format 3 for Tests in Table 8.2.2.3.1-7 |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$<br>Note 2: Void<br>Note 3: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.2.3.1-4: Minimum performance Large Delay CDD (FRC) for CA with 2DL CCs**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20 MHz | R.30-1 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.7 | ≥5 |
| 2 | 20MHz+15MHz | R.30-1 TDD for 20MHz CC | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 13.0 | ≥5 |
| | | R.11-9 TDD for 15MHz CC | OP.1 TDD (Note 1) | EVA70 | | 70 | 12.9 | |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | |

**Table 8.2.2.3.1-5: Single carrier performance for multiple CA configurations**

| Bandwidth | Reference channel | OCNG pattern | Propagation condition | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.4MHz | R.11-5 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.2 |
| 3MHz | R.11-6 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 5MHz | R.11-7 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.6 |
| 10 MHz | R.11-8 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 15MHz | R.11-9 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 20MHz | R.30-1 TDD | OP. 1 TDD | EVA70 | 2x2 Low | 70 | 13.0 |

**Table 8.2.2.3.1-6: Void**

**Table 8.2.2.3.1-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.2.3.1-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.2.3.1-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 | | | |

### 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. | | | | | | | | |

#### 8.2.2.3.1B Enhanced Performance Requirement Type C - 2Tx Antenna Ports

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| ACK/NACK feedback mode | | | Bundling |
| PDSCH transmission mode | | | 3 |
| Note 1: $P_B = 1$ | | | |

**Table 8.2.2.3.1B-2: Enhanced Performance Requirement Type C for Large Delay CDD (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.11-1 TDD | OP.1 TDD | EVA70 | 2x2 Medium | 70 | 17.4 | ≥2 |

#### 8.2.2.3.1C Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference

The requirements are specified in Table 8.2.2.3.1C-2, with the addition of parameters in Table 8.2.2.3.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of open-loop spatial multiplexing performence with 2 transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of one dominant interfering cell with transmission mode 1. In Table 8.2.2.3.1C-1, Cell 1 is the serving cell, and Cell 2 is interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1 and Cell 2 respectively.

**Table 8.2.2.3.1C-1 Test parameters for Larger Delay CDD (FRC) with TM1 interference**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | |
| Downlink power allocation | $\rho_A$ | dB | -3 | 0 |
| | $\rho_B$ | | -3 (Note 1) | 0 |
| | σ | | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna port 0 |
| Cyclic Prefix | | | Normal | Normal |
| Cell ID | | | 0 | 1 |
| Transmission mode | | | 3 | Note 2 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | N/A |
| $\hat{E}_s/N_{oc}$ (Note 3) | | dB | Reference Value in Table 8.2.2.3.1C-2 | 12.95 |
| Correlation and antenna configuration | | | Medium (2x2) | Medium(1x2) |
| Number of OFDM symbols for PDCCH | | | 2 | N/A |
| Max number of HARQ transmissions | | | 4 | N/A |
| Redundancy version coding sequence | | | {0,1,2,3} | N/A |

Note 1: $P_B = 1$
Note 2: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.2 applying OCNG pattern OP.5 TDD as defined in Annex A.5.2.5.
Note 3: Cell 1 is the serving cell. Cell 2 is the interfering cell.
Note 4: All cells are time-synchronous.
Note 5: SIB-1 will not be transmitted in Cell2 in this test.

**Table 8.2.2.3.1C-2 Enhanced Performance Requirement Type C, Larger Delay CDD (FRC) with TM1 interference**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note 1) | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 1 | Cell 2 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) | |
| 1 | R.11-10 TDD | OP.1 TDD | OP.5 TDD | EVA70 | EVA70 | 70 | 19.6 | ≥2 |

Note 1: The propagation conditions for Cell 1 and Cell 2 are statistically independent.
Note 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1.

### 8.2.2.3.2 Minimum Requirement 4 Tx Antenna Port

The requirements are specified in Table 8.2.2.3.2-2, with the addition of the parameters in Table 8.2.2.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 4 transmitter antennas.

**Table 8.2.2.3.2-1: Test Parameters for Large Delay CDD (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | 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 $\hat{E}_s / N_{oc2}$ 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.

**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 | $\hat{E}_s/N_{oc2}$ | | OCNG Pattern | | | Propagation Conditions (Note1) | | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) Note 5 | SNR (dB) (Note 3) | |
| 1 | R.11 TDD Note 4 | 9 | 7 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 14.2 | ≥2 |
| 2 | R.35 TDD Note 4 | 9 | 1 | OP.1 TDD | OP.1 TDD | OP.1 TDD | EVA5 | EVA5 | EVA5 | 2x2 Low | 70 | 22.7 | ≥2 |

Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
Note 2: The correlation matrix and antenna configuration apply for Cell 1, Cell 2 and Cell 3.
Note 3: SNR corresponds to $\hat{E}_s/N_{oc2}$ of cell 1.
Note 4: Cell 1 Reference channel is modified: PDSCH other than SIB1/paging and its associated PDCCH/PCFICH are transmitted in the serving cell subframe when the subframe is overlapped with the ABS subframe of aggressor cell and the subframe is available in the definition of the reference channel.
Note 5: The maximum Throughput is calculated from the total Payload in 2 subframes, averaged over 20ms.

## 8.2.2.4 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 0000000000000000 0000000000000111 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: $P_B = 1$<br>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.<br>Note 3: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>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).<br>Note 5: All cells are time-synchronous.<br>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 $\hat{E}_s / N_{oc}'$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | |
| Note 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

#### 8.2.2.4.1C 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**

<table>
<tr><th rowspan="2">Test Number</th><th rowspan="2">Reference Channel</th><th colspan="3">OCNG Pattern</th><th colspan="3">Propagation Conditions (Note1)</th><th rowspan="2">Correlation Matrix and Antenna Configuration (Note 2)</th><th colspan="2">Reference Value</th><th rowspan="2">UE Category</th></tr>
<tr><th>Cell 1</th><th>Cell 2</th><th>Cell 3</th><th>Cell 1</th><th>Cell 2</th><th>Cell 3</th><th>Fraction of Maximum Throughput (%) Note 5</th><th>SNR (dB) (Note 3)</th></tr>
<tr><td>1</td><td>R.11 TDD Note 4</td><td>OP.1 TDD</td><td>OP.1 FDD</td><td>OP.1 TDD</td><td>EPA5</td><td>EPA5</td><td>EPA5</td><td>2x2 High</td><td>70</td><td>6.4</td><td>≥2</td></tr>
<tr><td colspan="12">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.</td></tr>
</table>

### 8.2.2.4.1D Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model

The requirements are specified in Table 8.2.2.4.1D-2, with the addition of the parameters in Table 8.2.2.4.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with wideband precoding with two transmit antennas when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 4 interference model defined in clause B.6.3. In Table 8.2.2.4.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.2.2.4.1D-1: Test Parameters for Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th colspan="2">Cell 2</th><th colspan="2">Cell 3</th></tr>
<tr><td colspan="2">Uplink downlink Configuration</td><td></td><td>1</td><td colspan="2">1</td><td colspan="2">1</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td>4</td><td colspan="2">4</td><td colspan="2">4</td></tr>
<tr><td rowspan="3">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td>-3</td><td colspan="2">-3</td><td colspan="2">-3</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td>-3 (NOTE 1)</td><td colspan="2">-3</td><td colspan="2">-3</td></tr>
<tr><td>σ</td><td>dB</td><td>0</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">Cell-specific reference signals</td><td></td><td>Antenna ports 0,1</td><td colspan="2">Antenna ports 0,1</td><td colspan="2">Antenna ports 0,1</td></tr>
<tr><td colspan="2">$N_{oc}$ at antenna port</td><td>dBm/15 kHz</td><td colspan="5">-98</td></tr>
<tr><td colspan="2">Test number (NOTE 4)</td><td></td><td></td><td>Test 1</td><td>Test 2</td><td>Test 1</td><td>Test 2</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc}$</td><td>dB</td><td>N/A</td><td>13.91</td><td>3.28</td><td>3.34</td><td>0.74</td></tr>
<tr><td colspan="2">Cell Id</td><td></td><td></td><td>6</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td colspan="2">CFI indicated in PCFICH in normal subframes</td><td></td><td></td><td>3</td><td>Random from set {1,2,3}</td><td>3</td><td>Random from set {1,2,3}</td></tr>
<tr><td colspan="2">CFI indicated in PCFICH in special subframes</td><td></td><td></td><td>3</td><td>Random from set {1,2}</td><td>3</td><td>Random from set {1,2}</td></tr>
<tr><td colspan="2">$BW_{Channel}$</td><td>MHz</td><td>10</td><td colspan="2">10</td><td colspan="2">10</td></tr>
<tr><td colspan="2">Cyclic Prefix</td><td></td><td>Normal</td><td colspan="2">Normal</td><td colspan="2">Normal</td></tr>
<tr><td colspan="2">Number of control OFDM symbols in normal subframes</td><td></td><td>3</td><td colspan="2">3</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Number of control OFDM symbols in special subframes</td><td></td><td>2</td><td colspan="2">2</td><td colspan="2">2</td></tr>
<tr><td colspan="2">PDSCH transmission mode</td><td></td><td>4</td><td colspan="2">4</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Interference model</td><td></td><td>N/A</td><td colspan="2">As specified in clause B.6.3</td><td colspan="2">As specified in clause B.6.3</td></tr>
<tr><td colspan="2">Precoding</td><td></td><td>Random wideband precoding per TTI</td><td colspan="2">As specified in clause B.6.3</td><td colspan="2">As specified in clause B.6.3</td></tr>
<tr><td colspan="2">Time offset to cell 1</td><td>us</td><td>N/A</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Frequency offset to cell 1</td><td>Hz</td><td>N/A</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td colspan="2">MBSFN</td><td></td><td>Not configured</td><td colspan="2">Not configured</td><td colspan="2">Not configured</td></tr>
<tr><td rowspan="2">NeighCellsInfo-r12 (NOTE 3)</td><td>p-aList-r12</td><td></td><td>N/A</td><td colspan="2">{dB-6, dB-3, dB0}</td><td colspan="2">{dB-6, dB-3, dB0}</td></tr>
<tr><td>transmissionModeList-r12</td><td></td><td>N/A</td><td colspan="2">{2,3,4,8,9}</td><td colspan="2">{2,3,4,8,9}</td></tr>
<tr><td colspan="8">NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].<br>NOTE 4: Test 1 and Test 2 are defined in Table 8.2.2.4.1D-2.</td></tr>
</table>

**Table 8.2.2.4.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, Single-layer Spatial Multiplexing (FRC) with TM4 interference model**

| Test Num | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.11-12 TDD | OP.1 TDD | N/A | N/A | EVA 5 | EVA 5 | EVA 5 | 2x2 Low | 85 | 16.1 | ≥1 |
| 2 | R.11-11 TDD | OP.1 TDD | N/A | N/A | EPA 5 | EPA 5 | EPA 5 | 2x2 Low | 85 | 9.5 | ≥1 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.2.2.4.2 Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.2-2, with the addition of the parameters in Table 8.2.2.4.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

**Table 8.2.2.4.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1-2 | Test 3 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Precoding granularity | | PRB | 50 | 8 |
| PMI delay (Note 2) | | ms | 10 or 11 | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 3-1 | PUSCH 1-2 |
| ACK/NACK feedback mode | | | Bundling | Bundling |
| CodeBookSubsetRestriction bitmap | | | 110000 | 110000 |
| PDSCH transmission mode | | | 4 | 4 |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbol | 2 | 1 |

Note 1: $P_B = 1$.
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 | UE DL category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | | |
| 1 | 10 MHz | R.35 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 19.5 | ≥2 | ≥6 |
| 2 | 10 MHz | R.11-1 TDD | OP.1 TDD | ETU70 | 2x2 Low | 70 | 13.9 | ≥2 | ≥6 |
| 3 | 20 MHz 256QAM | R. 65 TDD | OP.1 TDD | EVA5 | 2x2 Low | 70 | 24.9 | 11-12 | ≥11 |

#### 8.2.2.4.2A Enhanced Performance Requirement Type C Multi-Layer Spatial Multiplexing 2 Tx Antenna Port

The requirements are specified in Table 8.2.2.4.2A-2, with the addition of the parameters in Table 8.2.2.4.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband precoding.

**Table 8.2.2.4.2A-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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: $P_B = 1$.<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. | | | |

**Table 8.2.2.4.2A-2: Enhanced Performance Requirement Type C for Multi-Layer Spatial Multiplexing (FRC)**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz | R.11-1 TDD | OP.1 TDD | ETU70 | 2x2 Medium | 70 | 17.8 | ≥2 |

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

For single carrier, the requirements are specified in Table 8.2.2.4.3-2, with the addition of the parameters in Table 8.2.2.4.3-1 and the downlink physical channel setup according to Annex C.3.2.

For CA with 2 DL CCs, the requirements are specified in Table 8.2.2.4.3-4, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For CA with 3 DL CCs, the requirements are specified in Table 8.2.2.4.3-7, based on single carrier requirement specified in Table 8.2.2.4.3-5, with the addition of the parameters in Table 8.2.2.4.3-3 and the downlink physical channel setup according to Annex C.3.2.

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 | | | 0000000000000000000000000000 0000111111111111111100000000 00000000 |
| 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 | Value |
|---|---|---|---|
| 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 for Tests in Table 8.2.2.4.3-4; PUCCH format 3 for Tests in Table 8.2.2.4.3-7 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000000000000000 0000111111111111111100000000 00000000 |
| CSI request field (Note 4) | | | '10' |
| 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.
Note 4: Multiple CC-s under test are configured as the 1st set of serving cells by high layers.
Note 5: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.2.4.3-4: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for CA with 2DL CCs**

| Test number | Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20 MHz | R.43 TDD | OP.1 TDD (Note 1) | EVA5 | 4x2 Low | 70 | 11.1 | ≥5 |
| 2 | 20MHz +15MHz | R.43 TDD for 20MHz CC | OP.1 TDD (Note 1) | EVA5 | 4x2 Low | 70 | 10.7 | ≥5 |
| | | R.43-5 TDD for 15MHz CC | OP.1 TDD (Note 1) | | | | 10.6 | |

Note 1: The OCNG pattern applies for each CC.
Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.2.2.4.3-5: Single carrier performance for multiple CA configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.43-1 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 11.0 |
| 3MHz | R.43-2 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 9.8 |
| 5MHz | R.43-3 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.0 |
| 10 MHz | R.43-4 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.5 |
| 15MHz | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.6 |
| 20MHz | R.43 TDD | OP. 1 TDD | EVA5 | 4x2 Low | 70 | 10.7 |

**Table 8.2.2.4.3-6: Void**

**Table 8.2.2.4.3-7: Minimum performance (FRC) based on single carrier performance for CA with 3 DL CCs**

| Test num. | CA Band-width combination | Requirement | UE category |
|---|---|---|---|
| 1 | 3x20MHz | As specified in Table 8.2.2.4.3-5 per CC | ≥5 |
| 2 | 20MHz+20MHz+15MHz | As specified in Table 8.2.2.4.3-5 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3 | | | |

### 8.2.2.4.3A Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity

For dual connectivity the requirements are specified in Table 8.2.2.4.3A-3, based on single carrier requirement specified in Table 8.2.2.4.3A-2, with the addition of the parameters in Table 8.2.2.4.3A-1 and the downlink physical channel setup according to Annex C.3.2.The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding by using dual connectivity.

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

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, and 8 for 15MHz CCs and 20MHz CCs |
| PMI delay (Note 2) | | ms | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000000000000000000011111111111111111100000000 00000000 |
| PDSCH transmission mode | | | 4 |
| ACK/NACK transmission | | | Separate ACK/NACK feedbacks with PUCCH format 1b on the MCG and SCG |
| CSI feedback | | | Separate PUSCH feedbacks on the MCG and SCG |
| Time offset between MCG CC and SCG CC | | μs | 0 for UE under test supporting synchronous dual connectivity; 334 for UE under test supporting both asynchronous and synchrounous dual connectivity (Note 5) |
| 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: The same PDSCH transmission mode is applied to each component carrier.<br>Note 5: As defined in TS36.300 [11].<br>Note 6: If the UE supports both SCG bearer and Split bearer, the SCG bearer is configured. | | | |

**Table 8.2.2.4.3A-2: Single carrier performance for multiple dual connectivity configurations**

| Band-width | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1.4MHz | R.43-1 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 11.0 |
| 3MHz | R.43-2 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 9.8 |
| 5MHz | R.43-3 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.0 |
| 10 MHz | R.43-4 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.5 |
| 15MHz | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.6 |
| 20MHz | R.43 TDD | OP. 1 TDD | EVA5 | 4x2 Low | 70 | 10.7 |

**Table 8.2.2.4.3A-3: Minimum performance Multi-Layer Spatial Multiplexing (FRC) for dual connectivity**

| Test num. | Band-width combination | Requirement | UE category |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 2x20 MHz | As specified in Table 8.2.2.4.3A-2 per CC | ≥5 |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability of requirements for different dual connectivity configurations and bandwidth combination sets is defined in 8.1.2.3A. | | | |

#### 8.2.2.4.4 Void

### 8.2.2.5 MU-MIMO

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

### 8.2.2.7 Carrier aggregation with power imbalance

The requirements in this section verify the ability of an intraband adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only.

#### 8.2.2.7.1 Minimum Requirement

For CA, the requirements are specified in Table 8.2.2.7.1-2, with the addition of the parameters in Table 8.2.2.7.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.7.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1 | Test 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | Off (Note 2) | Off (Note 2) |
| Symbols for unused PRBs | | | OCNG (Note 3) | OCNG (Note 3) |
| Modulation | | | 64 QAM | 64 QAM |
| Maximum number of HARQ transmission | | | 1 | 1 |
| Redundancy version coding sequence | | | {0} | {0} |
| PDSCH transmission mode of PCell | | | 1 | 3 |
| PDSCH transmission mode of SCell | | | 3 | 1 |
| OCNG Pattern | PCell | | OP.1 TDD | OP.5 TDD |
| | SCell | | OP.5 TDD | OP.1 TDD |
| Propagation Conditions | PCell | | Clause B.1 | Clause B.1 |
| | SCell | | Clause B.1 | Clause B.1 |
| Correlation Matrix and Antenna | PCell | | 1x2 | 2x2 |
| | SCell | | 2x2 | 1x2 |
| Note 1: $P_B = 0$ for 1x2 and $P_B = 1$ for 2x2 antenna configuration.<br>Note 2: No external noise sources are applied.<br>Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data.<br>Note 4: Void. | | | | |

**Table 8.2.2.7.1-2: Minimum performance (FRC) for CA**

| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/15KHz) | | Reference value Fraction of Maximum Throughput (%) | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | PCell | SCell | PCell | SCell | $\hat{E}_{s\_PCell}$ for PCell | $\hat{E}_{s\_SCell}$ for Scell | PCell | SCell | |
| 1 | 20 | 20 | R.49 TDD | NA | -85 | -79 | 85 | NA | ≥5 |
| 2 | 20 | 15 | NA | R.49-1 TDD | -79 | -85.8 | NA | 85 | ≥5 |
| Note 1: The OCNG pattern for PCell is used to fill the control channel. The OCNG pattern for SCell is used to fill the control channel and PDSCH.<br>Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3. | | | | | | | | | |

### 8.2.2.8 Intra-band contiguous carrier aggregation with minimum channel spacing

The requirements in this section verify the ability of an UE supporting intraband contiguous carrier aggregation with minimum channel spacing to demodulate the signal transmitted by the PCell and SCell(s). Throughput is measured on each cell. The minimum channel spacing of intra-band contiguous carrier aggregation refers to the possible minimum channel spacing as any multiple of 300 kHz less than the nominal channel spacing defined in 5.7.1A.

#### 8.2.2.8.1 Minimum Requirement

For CA the requirements are specified in Table 8.2.2.8.1-2, with the addition of the parameters in Table 8.2.2.8.1-1 and the downlink physical channel setup according to Annex C.3.2.

**Table 8.2.2.8.1-1: Test Parameters for CA**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) |
| Modulation | | | 64QAM |
| ACK/NACK feedback mode | | | PUCCH format 1b with channel selection for Test 1; PUCCH format 3 for Test 2 |
| PDSCH transmission mode | | | 1 |
| Note 1: $P_B = 0$<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 8.2.2.8.1-2: Minimum performance (FRC) for intra-band CA with minimum channel spacing**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 2x20MHz | R.9 TDD | OP.1 TDD (Note 1) | EVA5 | 1x2 Low | 70 | 17.16 | ≥5 |
| | | R.9 TDD | OP.1 TDD (Note 1) | | | 70 | 17.16 | |
| 2 | 3x20MHz | R.9 TDD | OP.1 TDD (Note 1) | EVA5 | 1x2 Low | 70 | 17.16 | ≥5 |
| | | R.9 TDD | OP.1 TDD (Note 1) | | | 70 | 17.16 | |
| | | R.9 TDD | OP.1 TDD (Note 1) | | | 70 | 17.16 | |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3. | | | | | | | | |

## 8.2.3 TDD FDD CA (Fixed Reference Channel)

The parameters specified in Table 8.2.3-1 are valid for all the TDD FDD CA tests unless otherwise stated.

**Table 8.2.3-1: Common Test Parameters**

| Parameter | | Unit | Value |
|---|---|---|---|
| Uplink downlink configuration (Note 1) for TDD CC only | | | 1 |
| Special subframe configuration (Note 2) for TDD CC only | | | 4 |
| Inter-TTI Distance | | | 1 |
| Maximum number of HARQ processes per component carrier | FDD PCell | Processes | 8 for FDD and TDD CCs |
| | TDD PCell | Processes | 11 for FDD CC; 7 for TDD CC |
| Maximum number of HARQ transmission | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix | | | Normal |
| Cell_ID | | | 0 |
| Cross carrier scheduling | | | Not configured |
| ACK/NACK feedback mode | | | PUCCH format 3 |
| Downlink HARQ-ACK timing | FDD PCell | | As specified in Clause 7.3.3 in TS36.213 [6] |
| | TDD PCell | | As specified in Clause 7.3.4 in TS36.213 [6] |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. | | | |

The applicability of ther requirements are specified in Clause 8.1.2.3. The single carrier performance with different bandwidths for multiple CA configurations specified in Clause 8.2.3 cannot be applied for UE single carrier test.

### 8.2.3.1 Single-antenna port performance

The single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.3 is achieved. The purpose of these tests is to verify the single-antenna performance with different channel models and MCS.

#### 8.2.3.1.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.1.1-4 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.1.1-5 based on single carrier requirement specified in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3, with the addition of the parameters in Table 8.2.3.1.1-1 and the downlink physical channel setup according to Annex C.3.2.

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

**Table 8.2.3.1.1-1: Test Parameters for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | 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: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.3.1.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.4 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.3 |
| 3 MHz | R.42-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.1 |
| 5MHz | R.42-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 |
| 10MHz | R.2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |
| 15MHz | R.42-3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 20MHz | R.42 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |

**Table 8.2.3.1.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.4 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.6 |
| 3 MHz | R.42-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.8 |
| 5MHz | R.42-2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.2 |
| 10MHz | R.2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 15MHz | R.42-3 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |
| 20MHz | R.42 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |

**Table 8.2.3.1.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.<br>Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. | | | | | |

**Table 8.2.3.1.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | CA Bandwidth combination (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.1.1-2 and Table 8.2.3.1.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.<br>Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. | | | | | |

#### 8.2.3.1.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.1.2-4 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

For TDD FDD CA with TDD PCell with 3DL CCs, the requirements are specified in Table 8.2.3.1.2-5 based on single carrier requirement specified in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3, with the addition of the parameters in Table 8.2.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2.

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

**Table 8.2.3.1.2-1: Test Parameters for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 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: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.3.1.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.4 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.3 |
| 3 MHz | R.42-1 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.1 |
| 5MHz | R.42-2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.0 |
| 10MHz | R.2 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |
| 15MHz | R.42-3 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 20MHz | R.42 FDD | OP.1 FDD | EVA5 | 1x2 Low | 70 | -1.7 |

**Table 8.2.3.1.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.4 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.6 |
| 3 MHz | R.42-1 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -0.8 |
| 5MHz | R.42-2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.2 |
| 10MHz | R.2 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.6 |
| 15MHz | R.42-3 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |
| 20MHz | R.42 TDD | OP.1 TDD | EVA5 | 1x2 Low | 70 | -1.4 |

**Table 8.2.3.1.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B<br>Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. | | | | | |

**Table 8.2.3.1.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.1.2-2 and Table 8.2.3.1.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B.<br>Note 2: 30usec timing difference between PCell and any SCell is applied in inter-band CA case, where PCell can be assigned on any CC. | | | | | |

## 8.2.3.2 Open-loop spatial multiplexing performance 2Tx Antenna port

### 8.2.3.2.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.2.1-4 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.2.1-5 based on single carrier requirement specified in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3, with the addition of the parameters in Table 8.2.3.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

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

**Table 8.2.3.2.1-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -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: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.3.2.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.11-5 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 13.6 |
| 3 MHz | R.11-6 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 5MHz | R.11-2 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 10MHz | R.11 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 15MHz | R.11-7 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 20MHz | R.30 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |

**Table 8.2.3.2.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.11-5 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.2 |
| 3 MHz | R.11-6 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 5MHz | R.11-7 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.6 |
| 10MHz | R.11-8 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 15MHz | R.11-9 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 20MHz | R.30-1 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.0 |

**Table 8.2.3.2.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B | | | | | |

**Table 8.2.3.2.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.2.1-2 and Table 8.2.3.2.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. | | | | | |

#### 8.2.3.2.1A Soft buffer management test for FDD PCell

For TDD-FDD CA, the requirements are specified in Table 8.2.3.2.1A-2, with the addition of the parameters in Table 8.2.3.2.1A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation for FDD as PCell.

**Table 8.2.3.2.1A-1: Test Parameters for CA**

| Parameter | | Unit | Value | |
|---|---|---|---|---|
| | | | FDD Carrier | TDD Carrier |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| PDSCH transmission mode | | | 3 | 3 |
| Note 1: $P_B = 1$.<br>Note 2: The same PDSCH transmission mode is applied to each component carrier. | | | | |

**Table 8.2.3.2.1A-2: Minimum performance (FRC) for CA**

| Test num. | Band-width | | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | PCell | 20MHz | R.30 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | [15.8] | 3 |
| | SCell | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1) | | | 70 | [12.7] | |
| 2 | PCell | 20MHz | R.35-1 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.3 | 4 |
| | SCell | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | | | 70 | 16.3 | |
| 3 | PCell | 10MHz | R.35-3 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | [16.0] | 3 |
| | SCell | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1) | | | 70 | [12.7] | |
| 4 | PCell | 10MHz | R.35-3 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.0 | 4 |
| | SCell | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | | | 70 | 16.3 | |
| 5 | PCell | 15MHz | R.35-2 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | [16.0] | 3 |
| | SCell | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1) | | | 70 | [12.7] | |
| 6 | PCell | 15MHz | R.35-2 FDD | OP.1 FDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.0 | 4 |
| | SCell | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | | | 70 | 16.3 | |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3B. | | | | | | | | | |

#### 8.2.3.2.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.2.2-4 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table

8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.2.2-5 based on single carrier requirement specified in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3, with the addition of the parameters in Table 8.2.3.2.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of large delay CDD with 2 transmitter antennas.

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

**Table 8.2.3.2.2-1: Test Parameters for Large Delay CDD (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -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: The same PDSCH transmission mode is applied to each component carrier. | | | |

**Table 8.2.3.2.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.11-5 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 13.6 |
| 3 MHz | R.11-6 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 5MHz | R.11-2 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.3 |
| 10MHz | R.11 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 15MHz | R.11-7 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 20MHz | R.30 FDD | OP.1 FDD | EVA70 | 2x2 Low | 70 | 12.9 |

**Table 8.2.3.2.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.11-5 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.2 |
| 3 MHz | R.11-6 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 5MHz | R.11-7 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.6 |
| 10MHz | R.11-8 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.8 |
| 15MHz | R.11-9 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 12.9 |
| 20MHz | R.30-1 TDD | OP.1 TDD | EVA70 | 2x2 Low | 70 | 13.0 |

**Table 8.2.3.2.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B | | | | | |

**Table 8.2.3.2.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.2.2-2 and Table 8.2.3.2.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. | | | | | |

### 8.2.3.2.2A Soft buffer management test for TDD PCell

For TDD-FDD CA, the requirements are specified in Table 8.2.3.2.2A-2, with the addition of the parameters in Table 8.2.3.2.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the UE performance with proper instantaneous buffer implementation for TDD as PCell.

**Table 8.2.3.2.2A-1: Test Parameters for CA**

| Parameter | | Unit | Value | |
|---|---|---|---|---|
| | | | FDD Carrier | TDD Carrier |
| Downlink power allocation | $\rho_A$ | dB | -3 | -3 |
| | $\rho_B$ | dB | -3 (Note 1) | -3 (Note 1) |
| | σ | dB | 0 | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| PDSCH transmission mode | | | 3 | 3 |
| Note 1: $P_B = 1$.<br>Note 2: The same PDSCH transmission mode is applied to each component carrier. | | | | |

**Table 8.2.3.2.2A-2: Minimum performance (FRC) for CA**

| Test num. | Band-width | | Reference channel | OCNG pattern | Propa-gation condi-tion | Correlation matrix and antenna config. | Reference value | | UE category |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Fraction of maximum throughput (%) | SNR (dB) | |
| 1 | **PCell** | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1)) | EVA70 | 2x2 Low | 70 | [12.7] | 3 |
| | **SCell** | 20MHz | R.30 FDD | OP.1 FDD (Note 1 | | | 70 | [15.8] | |
| 2 | **PCell** | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.2 | 4 |
| | **SCell** | 20MHz | R.35-1 FDD | OP.1 FDD (Note 1) | | | 70 | 16.2 | |
| 3 | **PCell** | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | [12.7] | 3 |
| | **SCell** | 10MHz | R.35-3 FDD | OP.1 FDD (Note 1) | | | 70 | [16.0] | |
| 4 | **PCell** | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.2 | 4 |
| | **SCell** | 10MHz | R.35-3 FDD | OP.1 FDD (Note 1) | | | 70 | 15.8 | |
| 5 | **PCell** | 20MHz | R.30-2 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | [12.7] | 3 |
| | **SCell** | 15MHz | R.35-2 FDD | OP.1 FDD (Note 1) | | | 70 | [15.8] | |
| 6 | **PCell** | 20MHz | R.35-1 TDD | OP.1 TDD (Note 1) | EVA70 | 2x2 Low | 70 | 16.2 | 4 |
| | **SCell** | 15MHz | R.35-2 FDD | OP.1 FDD (Note 1) | | | 70 | 15.8 | |
| Note 1: The OCNG pattern applies for each CC.<br>Note 2: The applicability and test rules of requirements for different CA configurations and bandwidth combination sets are defined in 8.1.2.3B. | | | | | | | | | |

## 8.2.3.3 Closed-loop spatial multiplexing performance 4Tx Antenna Port

### 8.2.3.3.1 Minimum Requirement for FDD PCell

For TDD FDD CA with FDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.3.1-4 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with FDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.3.1-5 based on single carrier requirement specified in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3, with the addition of the parameters in Table 8.2.3.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

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

**Table 8.2.3.3.1-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | Wideband precoding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2) | FDD CC | ms | 8 |
| | TDD CC | ms | 10 or 11 |
| Reporting interval | FDD CC | ms | 1 |
| | TDD CC | ms | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000000000000000000011111111111111111000000000000000 |
| CSI request field (Note 3) | | | '10' |
| PDSCH transmission mode | | | 4 |

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at 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: Multiple CC-s under test are configured as the 1st set of serving cells by higher layers.
Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.
Note 5: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.3.3.1-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.14-4 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.4 |
| 3 MHz | R.14-5 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 5MHz | R.14-6 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 10MHz | R.14 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 15MHz | R.14-7 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 20MHz | R.14-3 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.3 |

**Table 8.2.3.3.1-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.43-1 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 11.0 |
| 3 MHz | R.43-2 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 9.8 |
| 5MHz | R.43-3 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.0 |
| 10MHz | R.43-4 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.5 |
| 15MHz | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.6 |
| 20MHz | R.43 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.7 |

**Table 8.2.3.3.1-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B | | | | | |

**Table 8.2.3.3.1-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.3.1-2 and Table 8.2.3.3.1-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B | | | | | |

### 8.2.3.3.2 Minimum Requirement for TDD PCell

For TDD FDD CA with TDD PCell and 2DL CCs, the requirements are specified in Table 8.2.3.3.2-4 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

For TDD FDD CA with TDD PCell and 3DL CCs, the requirements are specified in Table 8.2.3.3.2-5 based on single carrier requirement specified in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3, with the addition of the parameters in Table 8.2.3.3.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-two performance with wideband and frequency selective precoding.

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

**Table 8.2.3.3.2-1: Test Parameters for Multi-Layer Spatial Multiplexing (FRC) for CA**

| Parameter | | Unit | Value |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -6 |
| | $\rho_B$ | dB | -6 (Note 1) |
| | σ | dB | 3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | Widelband pre-coding for 1.4MHz, 4 for 3MHz and 5MHz CCs, 6 for 10MHz CCs, 8 for 15MHz and 20MHz CCs |
| PMI delay (Note 2) | FDD CC | ms | 8 |
| | TDD CC | ms | 10 or 11 |
| Reporting interval | FDD CC | ms | 1 |
| | TDD CC | ms | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 0000000000000000000000000000 0000111111111111111100000000 00000000 |
| CSI request field (Note 3) | | | '10' |
| PDSCH transmission mode | | | TM4 |

Note 1: $P_B = 1$.
Note 2: If the UE reports in an available uplink reporting instance at 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: Multiple CC-s under test are configured as the 1st set of serving cells by higher layers.
Note 4: ACK/NACK bits are transmitted using PUSCH with PUCCH format 3.
Note 5: The same PDSCH transmission mode is applied to each component carrier.

**Table 8.2.3.3.2-2: Single carrier performance with different bandwidths for multiple CA configurations for FDD SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.14-4 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.4 |
| 3 MHz | R.14-5 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 5MHz | R.14-6 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 9.5 |
| 10MHz | R.14 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 15MHz | R.14-7 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.1 |
| 20MHz | R.14-3 FDD | OP.1 FDD | EVA5 | 4x2 Low | 70 | 10.3 |

**Table 8.2.3.3.2-3: Single carrier performance with different bandwidths for multiple CA configurations for TDD PCell and SCell (FRC)**

| Band-width | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Fraction of Maximum Throughput (%) | SNR (dB) |
| 1.4 MHz | R.43-1 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 11.0 |
| 3 MHz | R.43-2 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 9.8 |
| 5MHz | R.43-3 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.0 |
| 10MHz | R.43-4 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.5 |
| 15MHz | R.43-5 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.6 |
| 20MHz | R.43 TDD | OP.1 TDD | EVA5 | 4x2 Low | 70 | 10.7 |

**Table 8.2.3.3.2-4: Minimum performance for multiple CA configurations with 2DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 2x20 | 20 | 20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 2 | 20+10 | 10 | 20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 3 | 20+15 | 15 | 20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B | | | | | |

**Table 8.2.3.3.2-5: Minimum performance for multiple CA configurations with 3DL CCs (FRC)**

| Test number | Aggregated Bandwidth (MHz) | | | Minimum performance requirement | UE Category |
|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | |
| 1 | 3x20 | 20 | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 2 | 20+20+15 | 15 | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| 3 | 20+20+10 | 10 | 2x20 | As defined in Table 8.2.3.3.2-2 and Table 8.2.3.3.2-3 per CC | ≥5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3B. | | | | | |

# 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 and 256QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 2 |
| Precoder update granularity | | Frequency domain: 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms |
| Note 1: Void.<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**

| parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | -3 | -3 | -3 |
| Beamforming model | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| Cell-specific reference signals | | | Antenna ports 0,1 | | |
| CSI reference signals | | | Antenna ports 15,…,18 | Antenna ports 15,…,18 | Antenna ports 15, …, 18 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 2 | 5 / 2 | 5 / 2 |
| CSI reference signal configuration | | | 0 | 3 | 0 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 3 / 0001000000000000 | 3 / 0001000000000000 | 3 / 0001000000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) |
| Number of allocated resource blocks (Note 2) | | PRB | 50 | 50 | 50 |
| Simultaneous transmission | | | No | Yes (Note 3, 5) | No |
| PDSCH transmission mode | | | 9 | 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 $n_{\mathrm{SCID}}$ are set to 0 for CDM-multiplexed DM RS with interfering simultaneous transmission test cases.

**Table 8.3.1.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category | UE DL Cat-egory |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | | |
| 1 | 10 MHz QPSK 1/3 | R.43 FDD | OP.1 FDD | EVA5 | 2x2 Low | 70 | -1 | ≥1 | ≥6 |
| 3 | 10MHz 256QAM | R. 66 FDD | OP.1 FDD | EPA5 | 2x2 Low | 70 | 24.3 | 11-12 | ≥11 |

**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 $I_{CSI-RS}$ / *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.

## 8.3.1.1C Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference model

The requirements are specified in Table 8.3.1.1C-2, with the addition of the parameters in Table 8.3.1.1C-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7, 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In 8.3.1.1C-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1C-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM9 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (NOTE 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | 3 | 3 |
| PDSCH transmission mode | | | 9 | 9 | 9 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals | | | Antenna ports 15, 16, 17, 18 | Antenna ports 15, 16 | Antenna ports 15, 16 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 10 / 1 | 10 / 1 | 10 / 1 |
| CSI reference signal configuration | | | 5 | 6 | 7 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ /*ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 6 / 1000000000000000 | 6 / 0100000000000000 | 6 / 0010000000000000 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.1.1C-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration | | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.69 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 4x2 Low | 2x2 Low | 2x2 Low | 85 | 18.5 | ≥1 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | | | |

### 8.3.1.1D Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model

The requirements are specified in Table 8.3.1.1D-2, with the addition of the parameters in Table 8.3.1.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by the CRS of the interfering cell, applying the CRS interference model defined in clause B.6.5. In 8.3.1.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1D-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with CRS interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (NOTE 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | 3 | 3 |
| PDSCH transmission mode | | | 8 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.6.5 | As specified in clause B.6.5 |
| Precoding | | | Random wideband precoding per TTI | N/A | N/A |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 3) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.1.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with CRS interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.71 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 14.3 | ≥2 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.3.1.1E Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference model

The requirements are specified in Table 8.3.1.1E-2, with the addition of the parameters in Table 8.3.1.1E-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 3 interference model defined in clause B.6.2. In 8.3.1.1E-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1E-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM3 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 |
| | $\rho_B$ | dB | 0 (NOTE 1) | -3 | -3 |
| | σ | dB | -3 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 3.28 | 0.74 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | Random from {1,2,3} | Random from {1,2,3} |
| PDSCH transmission mode | | | 8 | 3 | 3 |
| Interference model | | | N/A | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |

NOTE 1: $P_B = 1$
NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.
NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.
NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 8.3.1.1E-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.70 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 11.5 | ≥1 |

NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.
NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.
NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3.

### 8.3.1.1F Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model

The requirements are specified in Table 8.3.1.1F-2, with the addition of the parameters in Table 8.3.1.1F-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission configured with TM10 in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.6.3. The NAICS network assistance is provided when the serving cell TM10 is configured with QCL-type A and PCID based DM-RS scrambling. The neighbouring cell has transmission mode TM9 and NeighCellsInfo-r12 for interfering cell indicates presence of TM9. In 8.3.1.1F-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.1.1F-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with TM10 serving cell configuration and TM9 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols | | | 3 | 3 | 3 |
| CFI indicated in PCFICH | | | 3 | 3 | 3 |
| PDSCH transmission mode | | | 10 | 9 | 9 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals | | | Antenna ports 15, 16, 17, 18 | Antenna ports 15, 16 | Antenna ports 15, 16 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 10 / 1 | 10 / 1 | 10 / 1 |
| CSI reference signal configuration | | | 5 | 6 | 7 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ /*ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 6 / 1000000000000000 | 6 / 0100000000000000 | 6 / 0010000000000000 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (Note 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| Note 1: $P_B = 1$<br>Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.1.1F-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM10 serving cell configuration and TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration | | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) | |
| 1 | R.69 FDD | OP.1 FDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 4x2 Low | 2x2 Low | 2x2 Low | 85 | 18.2 | ≥1 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | | | |
| Note 2: SINR corresponds to $\widehat{E}_s / N_{oc}$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | | | |

### 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 | N/A |
| | PDSCH_RB | dB | 4 | N/A |

| | | | |
|---|---|---|---|
| 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 |
| 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. | | | | | | | | | | |

## 8.3.1.2A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing

The requirements are specified in Table 8.3.1.2A-2, with the addition of the parameters in Table 8.3.1.2A-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of this test is to verify rank two performance for full RB allocation upon antenna ports 7 and 8.

**Table 8.3.1.2A-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | -3 |
| Cell-specific reference signals | | | Antenna ports 0 and 1 |
| CSI reference signals | | | Antenna ports 15,16 |
| Beamforming model | | | Annex B.4.2 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 2 |
| CSI reference signal configuration | | | 8 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 3 / 0010000000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Symbols for unused PRBs | | | OCNG (Note 2) |
| Number of allocated resource blocks (Note 2) | | PRB | 50 |
| Simultaneous transmission | | | No |
| PDSCH transmission mode | | | 9 |
| Note 1: $P_B = 1$<br>Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.1.2A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.51 FDD | OP.1 FDD | EPA5 | 2x2 Medium | 70 | 17.4 | ≥2 |

## 8.3.1.3 Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports

### 8.3.1.3.1 Minimum requirement with Same Cell ID (with single NZP CSI-RS resource)

The requirements are specified in Table 8.3.1.3.1-3, with the additional parameters in Table 8.3.1.3.1-1 and Table 8.3.1.3.1-2. The purpose of this test is to verify the UE capability of supporting non quasi-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 Tables 8.3.1.3.1-1 and 8.3.1.3.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | 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 | 5/2 |
| *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 | 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 |
| $BW_{Channel}$ | | 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: $P_B = 1$
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 8.3.1.3.1-2: 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 | ZP CSI-RS configuration | TP 1 | TP 2 |

| | | | | |
|---|---|---|---|---|
| | co-location) | | | |
| 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 Tables 8.3.1.3.2-1 and 8.3.1.3.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-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 Tables 8.3.1.3.2-1 and 8.3.1.3.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.1.3.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 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: $P_B = 1$<br>Note 2: REs for antenna ports 0 and 1 have zero transmission power.<br>Note 3: PDSCH transmission from TPs shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TPs are specified.<br>Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.1.3.2-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | PDSCH | Blanked |
| PQI set 3 | CSI-RS 1 | ZP CSI-RS 1 | Blanked | PDSCH |

**Table 8.3.1.3.2-3: Performance Requirements for timing offset compensation with DPS transmission**

| Test Number | Timing offset(us) | Reference Channel | OCNG Pattern | | Propagation Conditions | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | 2 | R.53 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.2 | ≥2 |
| 2 | -0.5 | R.53 FDD | OP.1 FDD | OP.1 FDD | EPA5 | EPA5 | 2x2 Low | 70 | 12.5 | ≥2 |
| | | | | | | | | | | |
| Note 1: The propagation conditions for TP 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 $\widehat{E}_s/N_{oc}$ 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 Table 8.3.1.3.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.1.3.3-1: Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 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 and 256QAM |
| Number of OFDM symbols for PDCCH | OFDM symbols | 2 |
| Precoder update granularity | | Frequency domain: 1 PRB for Transmission mode 8, 1 PRG for Transmission modes 9 and 10<br>Time domain: 1 ms |
| ACK/NACK feedback mode | | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4]<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: $P_B = 1$.
Note 2: The modulation symbols of the signal under test is mapped onto antenna port 7 or 8.
Note 3: Modulation symbols of an interference signal is mapped onto the antenna port (7 or 8) not used for the input signal under test.
Note 4: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
Note 5: The two UEs' scrambling identities $n_{\mathrm{SCID}}$ 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 | Test 3 |
|---|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 (Note 1) | 0 (Note 1) |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | | |
| CSI reference signals | | | Antenna ports 15,…,22 | Antenna ports 15,…,18 | Antenna ports 15,…,18 |
| Beamforming model | | | Annex B.4.1 | 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 | 5 / 4 |
| CSI reference signal configuration | | | 1 | 3 | 3 |
| Zero-power CSI-RS configuration $I_{\text{CSI-RS}}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 4 / 0010000100000000 | 4 / 0010000000000000 | 4/ 0010000000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) | OCNG (Note 4) | OCNG (Note 4) |
| Number of allocated resource blocks (Note 2) | | PRB | 50 | 50 | 100 |
| Simultaneous transmission | | | No | Yes (Note 3, 5) | No |
| PDSCH transmission mode | | | 9 | 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 | UE DL Cat-egory |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 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 | ≥6 |
| 3 | 20MHz 256QAM | R. 66 TDD | OP.1 TDD | EPA5 | 2x2 Low | 70 | 24.3 | 11-12 | ≥11 |

**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. | | | | | | | | | | | |

## 8.3.2.1D Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference

The requirements are specified in Table 8.3.2.1D-2, with the addition of the parameters in Table 8.3.2.1D-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 9 interference model defined in clause B.6.4. In 8.3.2.1D-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1D-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM9 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (NOTE 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols in normal subframes | | | 3 | 3 | 3 |
| CFI indicated in PCFICH in normal subframes | | | 3 | 3 | 3 |
| Number of control OFDM symbols in special subframes | | | 2 | 2 | 2 |
| CFI indicated in PCFICH in special subframes | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 9 | 9 | 9 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals | | | Antenna ports 15, 16, 17, 18 | Antenna ports 15, 16 | Antenna ports 15, 16 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 10 / 4 | 10 / 4 | 10 / 4 |
| CSI reference signal configuration | | | 5 | 6 | 7 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ /*ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 9 / 1000000000000000 | 9 / 0100000000000000 | 9 / 0010000000000000 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.2.1D-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration | | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.69 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 4x2 Low | 2x2 Low | 2x2 Low | 85 | 18.0 | ≥1 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | | | |
| NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | | | |

### 8.3.2.1E Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model

The requirements are specified in Table 8.3.2.1E-2, with the addition of the parameters in Table 8.3.2.1E-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by the CRS of the interfering cell, applying the CRS interference model defined in clause B.6.5. In 8.3.2.1E-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1E-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with CRS interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (NOTE 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| BW$_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols in normal subframes | | | 3 | 3 | 3 |
| CFI indicated in PCFICH in normal subframes | | | 3 | 3 | 3 |
| Number of control OFDM symbols in special subframes | | | 2 | 2 | 2 |
| CFI indicated in PCFICH in special subframes | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 8 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.6.5 | As specified in clause B.6.5 |
| Precoding | | | Random wideband precoding per TTI | N/A | N/A |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 3) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.2.1E-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with CRS interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.71 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 14.0 | ≥2 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.<br>NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1.<br>NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

### 8.3.2.1F Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference

The requirements are specified in Table 8.3.2.1F-2, with the addition of the parameters in Table 8.3.2.1F-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission in the serving cell is interfered by PDSCH of two interfering cells applying transmission mode 3 interference model defined in clause B.6.2. In 8.3.2.1F-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1F-1: Test Parameters for Testing CDM-multiplexed DM RS (Single-layer) with TM3 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | -3 | -3 |
| | $\rho_B$ | dB | 0 (NOTE 1) | -3 | -3 |
| | σ | dB | -3 | 0 | 0 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\widehat{E}_s/N_{oc}$ | | dB | N/A | 3.28 | 0.74 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols in normal subframes | | | 3 | 3 | 3 |
| CFI indicated in PCFICH in normal subframes | | | 3 | Random from set {1,2,3} | Random from set {1,2,3} |
| Number of control OFDM symbols in special subframes | | | 2 | 2 | 2 |
| CFI indicated in PCFICH in special subframes | | | 2 | Random from set {1,2} | Random from set {1,2} |
| PDSCH transmission mode | | | 8 | 3 | 3 |
| Interference model | | | N/A | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.2 | As specified in clause B.6.2 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (NOTE 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| NOTE 1: $P_B = 1$<br>NOTE 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.<br>NOTE 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.<br>NOTE 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 8.3.2.1F-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS with TM3 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration (NOTE 3) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | | Fraction of Maximum Throughput (%) | SNR (dB) (NOTE 2) | |
| 1 | R.70 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 2x2 Low | 85 | 11.3 | ≥1 |
| NOTE 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | |
| NOTE 2: SNR corresponds to $\hat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | |
| NOTE 3: Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | | | | | |

#### 8.3.2.1G Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model

The requirements are specified in Table 8.3.2.1G-2, with the addition of the parameters in Table 8.3.2.1G-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify closed loop rank one performance on one of the antenna ports 7 or 8 without a simultaneous transmission on the other antenna port in the serving cell when the PDSCH transmission configured with TM10 in the serving cell is interfered by PDSCH of one dominant interfering cell applying transmission mode 9 interference model defined in clause B.6.3. The NAICS network assistance is provided when the serving cell TM10 is configured with QCL-type A and PCID based DM-RS scrambling. The neighbouring cell has transmission mode TM9 and NeighCellsInfo-r12 for interfering cell indicates presence of TM9. In 8.3.2.1G-1, Cell 1 is the serving cell, and Cell 2, 3 are interfering cells. The downlink physical channel setup is according to Annex C.3.2 for each of Cell 1, Cell 2 and Cell 3, respectively.

**Table 8.3.2.1G-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) Multiplexing with TM10 serving cell configuration and TM9 interference model**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink Configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 | 0 |
| | σ | dB | -3 | -3 | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | | |
| $\widehat{E}_s/N_{oc}$ | | dB | N/A | 13.91 | 3.34 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell Id | | | 0 | 1 | 6 |
| Number of control OFDM symbols in normal subframes | | | 3 | 3 | 3 |
| CFI indicated in PCFICH in normal subframes | | | 3 | 3 | 3 |
| Number of control OFDM symbols in special subframes | | | 2 | 2 | 2 |
| CFI indicated in PCFICH in special subframes | | | 2 | 2 | 2 |
| PDSCH transmission mode | | | 10 | 9 | 9 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Precoding | | | Random wideband precoding per TTI | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI reference signals | | | Antenna ports 15, 16, 17, 18 | Antenna ports 15, 16 | Antenna ports 15, 16 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 10 / 4 | 10 / 4 | 10 / 4 |
| CSI reference signal configuration | | | 5 | 6 | 7 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ /*ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 9 / 1000000000000000 | 9 / 0100000000000000 | 9 / 0010000000000000 |
| Time offset to cell 1 | | us | N/A | 2 | 3 |
| Frequency offset to cell 1 | | Hz | N/A | 200 | 300 |
| MBSFN | | | Not configured | Not configured | Not configured |
| NeighCellsInfo-r12 (Note 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |

Note 1: $P_B = 1$
Note 2: Cell 1 is the serving cell. Cell 2, 3 are the interfering cells.
Note 3: CSI-RS configurations are according to [4] subclause 6.10.5.2.
Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 8.3.2.1G-2: Minimum Performance for Enhanced Performance Requirement Type B, CDM-multiplexed DM RS Multiplexing with TM10 serving cell configuration and TM9 interference model**

| Test Number | Reference Channel | OCNG Pattern | | | Propagation Conditions | | | Correlation Matrix and Antenna Configuration | | | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Cell 1 | Cell 2 | Cell 3 | Fraction of Maximum Throughput (%) | SNR (dB) (Note 2) | |
| 1 | R.69 TDD | OP.1 TDD | N/A | N/A | EPA5 | EPA5 | EPA5 | 4x2 Low | 2x2 Low | 2x2 Low | 85 | 18.0 | ≥1 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent. | | | | | | | | | | | | | |
| Note 2: SINR corresponds to $\widehat{E}_s/N_{oc}$ of Cell 1 as defined in clause 8.1.1. | | | | | | | | | | | | | |

## 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: $P_B = 1$. | | | | |
| 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 |

### 8.3.2.2A Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing

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

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

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | -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 |
| Symbols for unused PRBs | | | OCNG (Note 2) |
| Number of allocated resource blocks | | PRB | 50 |
| PDSCH transmission mode | | | 8 |
| Note 1: $P_B = 1$. | | | |
| Note 2: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. | | | |

**Table 8.3.2.2A-2: Enhanced Performance Requirement Type C for CDM-multiplexed DM RS (FRC)**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE Category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.32 TDD | OP.1 TDD | EPA5 | 2x2 Medium | 70 | 17.0 | ≥2 |

### 8.3.2.3 Dual-Layer Spatial Multiplexing (with multiple CSI-RS configurations)

For dual-layer transmission on antenna ports 7 and 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.3.2.3-2, with the addition of the parameters in Table 8.3.2.3-1 where Cell 1 is the serving cell and Cell 2 is the interfering cell. The downlink physical channel setup is set according to Annex C.3.2. The purpose of these tests is to verify the rank-2 performance for full RB allocation, to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power, and to verify that the UE correctly estimate SNR.

**Table 8.3.2.3-1: Test Parameters for Testing CDM-multiplexed DM RS (dual layer) with multiple CSI-RS configurations**

| Parameter | | Unit | Test 1 | |
|---|---|---|---|---|
| | | | **Cell 1** | **Cell 2** |
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | σ | dB | -3 | -3 |
| | PDSCH_RA | dB | 4 | N/A |
| | PDSCH_RB | dB | 4 | N/A |
| 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: $P_B = 1$ | | | | |
| 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 |
| 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 Tables 8.3.2.4.1-1 and 8.3.2.4.1-2, transmission point 1 (TP 1) is the serving cell and transmission point 2 (TP 2) transmits PDSCH. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.1-1: Test Parameters for quasi co-location type B: same Cell ID**

| Parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 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: $P_B = 1$<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 8.3.2.4.1-2: Configurations of PQI and DL transmission hypothesis for each PQI set**

| PQI set index | Parameters in each PQI set | | DL transmission hypothesis for each PQI Set | |
|---|---|---|---|---|
| | NZP CSI-RS Index (For quasi co-location) | ZP CSI-RS configuration | TP 1 | TP 2 |
| PQI set 0 | CSI-RS 0 | ZP CSI-RS 0 | Blanked | PDSCH |

**Table 8.3.2.4.1-3: Minimum performance for quasi co-location type B: same Cell ID**

| Test Number | Reference Channel | OGCN pattern | | Time offset between TPs (μs) | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.52 TDD | NA | OP.1 TDD | 2 | EPA5 | EPA5 | 2x2 Low | 70 | 12 | ≥2 |
| 2 | R.52 TDD | NA | OP.1 TDD | -0.5 | EPA5 | EPA5 | 2x2 Low | 70 | 12.4 | ≥2 |
| Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.<br>Note 2: The correlation matrix and antenna configuration apply for TP 1 and TP 2.<br>Note 3: SNR corresponds to $\hat{E}_s / N_{oc}$ of TP 2 as defined in clause 8.1.1. | | | | | | | | | | |

#### 8.3.2.4.2 Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources)

The requirements are specified in Table 8.3.2.4.2-3, with the additional parameters in Tables 8.3.2.4.2-1 and 8.3.2.4.2-2. The purpose of this test is to verify the UE capability of supporting non quasi-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 Tables 8.3.2.4.2-1 and 8.3.2.4.2-2, transmission point 1 (TP 1) is the serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) has same Cell ID as TP 1. Multiple NZP CSI-RS resources and ZP CSI-RS resources are configured. In each sub-frame, DL PDSCH transmission is dynamically switched between 2 TPs with multiple PDSCH RE Mapping and Quasi-Co-Location Indicator configuration (PQI). Configurations of PDSCH RE Mapping and Quasi-Co-Location Indicator and downlink transmission hypothesis are defined in Table 8.3.2.4.2-2. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.2-1: Test Parameters for timing offset compensation with DPS transmission**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 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.<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. | | | | | | | | | | |

### 8.3.2.4.3 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 Table 8.3.2.4.3-1, transmission point 1 (TP 1) is serving cell transmitting PDCCH, synchronization signals and PBCH, and transmission point 2 (TP 2) transmits PDSCH with different Cell ID. The downlink physical channel setup for TP 1 is according to Table C.3.4-1 and for TP 2 according to Table C.3.4-2.

**Table 8.3.2.4.3-1: Test Parameters for quasi co-location type B with different Cell ID and Colliding CRS**

| parameter | | Unit | TP 1 | TP 2 |
|---|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 | 0 |
| | $\rho_B$ | dB | 0 (Note 1) | 0 |
| | 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: $P_B = 1$

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

**Table 8.3.2.4.3-2: Performance Requirements for quasi co-location type B with different Cell ID and Colliding CRS**

| Test Number | Reference Channel | OCNG Pattern | | Propagation Conditions (Note1) | | Correlation Matrix and Antenna Configuration (Note 2) | Reference Value | | UE Category |
|---|---|---|---|---|---|---|---|---|---|
| | | TP 1 | TP 2 | TP 1 | TP 2 | | Fraction of Maximum Throughput (%) | SNR (dB) (Note 3) | |
| 1 | R.54 TDD | N/A | OP.1 TDD | EPA5 | ETU5 | 2x2 Low | 70 | 14.7 | ≥2 |

Note 1: The propagation conditions for TP 1 and TP 2 are statistically independent.

Note 2: Correlation matrix and antenna configuration parameters apply for each of TP 1 and TP 2.

Note 3: SNR corresponds to $\widehat{E}_s/N_{oc}$ 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**

| Parameter | | Unit | Single antenna port | Transmit diversity |
|---|---|---|---|---|
| Number of PDCCH symbols | | symbols | 2 | 2 |
| PHICH Ng (Note 1) | | | 1 | 1 |
| PHICH duration | | | Normal | Normal |
| Unused RE-s and PRB-s | | | OCNG | OCNG |
| Cell ID | | | 0 | 0 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | 0 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | 0 | -3 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | | | Normal | Normal |
| Note 1: According to Clause 6.9 in TS 36.211 [4]. | | | | |

### 8.4.1.1 Single-antenna port performance

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

**Table 8.4.1.1-1: Minimum performance PDCCH/PCFICH**

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

### 8.4.1.2 Transmit diversity performance

#### 8.4.1.2.1 Minimum Requirement 2 Tx Antenna Port

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

**Table 8.4.1.2.1-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 10 MHz | 4 CCE | R.16 FDD | OP.1 FDD | EVA70 | 2 x 2 Low | 1 | -0.6 |

#### 8.4.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.4.1-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.2-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.4.1.2.2-1: Minimum performance PDCCH/PCFICH**

| Test number | Bandwidth | Aggregation level | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pm-dsg (%) | SNR (dB) |
| 1 | 5 MHz | 2 CCE | R.17 FDD | OP.1 FDD | EPA5 | 4 x 2 Medium | 1 | 6.3 |

#### 8.4.1.2.3 Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)

For the parameters for non-MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-2. The downlink physical setup is in accordance with Annex C.3.2 and Annex C.3.3. In Table 8.4.1.2.3-1, Cell 1 is the serving cell, and Cell 2 is the aggressor cell. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

For the parameters for MBSFN ABS specified in Table 8.4.1-1 and Table 8.4.1.2.3-3, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.4.1.2.3-4. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 is according to Annex C.3.3, respectively.

**Table 8.4.1.2.3-1: Test Parameters for PDCCH/PCFICH – Non-MBSFN ABS**

| Parameter | | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -100.5 (Note 1) | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A |
| | $N_{oc3}$ | dBm/15kHz | -95.3 (Note 3) | N/A |
| $\widehat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.1.2.3-2 | 1.5 |
| $BW_{Channel}$ | | 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 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: | 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 $\hat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | | |

#### 8.4.1.2.4 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**

<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="2">Downlink power allocation</td><td>PDCCH_RA<br>PHICH_RA<br>OCNG_RA</td><td>dB</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td>PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB</td><td>dB</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-98(Note 1)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 2)</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-93 (Note 3)</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 8.4.1.2.4-2</td><td>5</td><td>3</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>126</td><td>1</td></tr>
<tr><td colspan="2">ABS pattern (Note 4)</td><td></td><td>N/A</td><td>00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>00000100<br>00000100<br>00000100<br>00000100<br>00000100</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern (Note 5)</td><td></td><td>00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets (Note 6)</td><td>$C_{CSI,0}$</td><td></td><td>00000100<br>00000100<br>00000100<br>00000100<br>00000100</td><td>N/A</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>11111011<br>11111011<br>11111011<br>11111011<br>11111011</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 7</td><td>Note 7</td></tr>
<tr><td colspan="2">PHICH Ng (Note 10)</td><td></td><td>1</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">PHICH duration</td><td></td><td>Normal</td><td>N/A</td><td>N/A</td></tr>
<tr><td colspan="2">Unused RE-s and PRB-s</td><td></td><td>OCNG</td><td>OCNG</td><td>OCNG</td></tr>
<tr><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td><td>Normal</td></tr>
</table>

| | |
|---|---|
| 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.<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. | | | | | | | | | | | |

**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**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Cell 1</th><th>Cell 2</th></tr>
<tr><td colspan="2">Uplink downlink configuration</td><td></td><td>1</td><td>1</td></tr>
<tr><td colspan="2">Special subframe configuration</td><td></td><td>4</td><td>4</td></tr>
<tr><td rowspan="2">Downlink power allocation</td><td>PDCCH_RA<br>PHICH_RA<br>OCNG_RA</td><td>dB</td><td>-3</td><td>-3</td></tr>
<tr><td>PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB</td><td>dB</td><td>-3</td><td>-3</td></tr>
<tr><td rowspan="3">$N_{oc}$ at antenna port</td><td>$N_{oc1}$</td><td>dBm/15kHz</td><td>-100.5 (Note 1)</td><td>N/A</td></tr>
<tr><td>$N_{oc2}$</td><td>dBm/15kHz</td><td>-98 (Note 2)</td><td>N/A</td></tr>
<tr><td>$N_{oc3}$</td><td>dBm/15kHz</td><td>-95.3 (Note 3)</td><td>N/A</td></tr>
<tr><td colspan="2">$\hat{E}_s/N_{oc2}$</td><td>dB</td><td>Reference Value in Table 8.4.2.2.3-2</td><td>1.5</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 4)</td><td></td><td>N/A</td><td>0000010001<br>0000000001</td></tr>
<tr><td colspan="2">RLM/RRM Measurement Subframe Pattern(Note 5)</td><td></td><td>0000000001<br>0000000001</td><td>N/A</td></tr>
<tr><td rowspan="2">CSI Subframe Sets(Note 6)</td><td>$C_{CSI,0}$</td><td></td><td>0000010001<br>0000000001</td><td>N/A</td></tr>
<tr><td>$C_{CSI,1}$</td><td></td><td>1100101000<br>1100111000</td><td>N/A</td></tr>
<tr><td colspan="2">Number of control OFDM symbols</td><td></td><td>3</td><td>3</td></tr>
<tr><td colspan="2">ACK/NACK feedback mode</td><td></td><td>Multiplexing</td><td>N/A</td></tr>
<tr><td colspan="2">PHICH Ng (Note 9)</td><td></td><td>1</td><td>N/A</td></tr>
<tr><td colspan="2">PHICH duration</td><td></td><td>extended</td><td>N/A</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">Cyclic prefix</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="5">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.<br>Note 2: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS.<br>Note 3: This noise is applied in OFDM symbols of a subframe overlapping with aggressor non-ABS<br>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.<br>Note 5: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7].<br>Note 6: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7].<br>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.<br>Note 8: SIB-1 will not be transmitted in Cell2 in the test.<br>Note 9: According to Clause 6.9 in TS 36.211 [4].</td></tr>
</table>

**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 |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.4.2.2.3-4 | 1.5 |
| $BW_{Channel}$ | | MHz | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | MBSFN |
| Time Offset between Cells | | 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 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: 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 $\widehat{E}_s/N_{oc2}$ of cell 1. | | | | | | | | | |
| Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | | |

#### 8.4.2.2.4 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 |
| 1A | 5MHz (Note 1) | R.19-1 | OP.1 FDD | EVA 70 | 2x2 Low | 0.1 | 4 |
| Note 1: Test case applicability is defined in 8.1.2.1. | | | | | | | |

#### 8.5.1.2.2 Minimum Requirement 4 Tx Antenna Port

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (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 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: 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**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Single antenna port</th><th>Transmit diversity</th></tr>
<tr><td colspan="2">Uplink downlink configuration (Note 1)</td><td></td><td>1</td><td>1</td></tr>
<tr><td colspan="2">Special subframe configuration (Note 2)</td><td></td><td>4</td><td>4</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">PHICH duration</td><td></td><td>Normal</td><td>Normal</td></tr>
<tr><td colspan="2">PHICH Ng (Note 3)</td><td></td><td>Ng = 1</td><td>Ng = 1</td></tr>
<tr><td colspan="2">PDCCH Content</td><td></td><td colspan="2">UL Grant should be included with the proper information aligned with A.3.6.</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 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="2">ACK/NACK feedback mode</td><td></td><td>Multiplexing</td><td>Multiplexing</td></tr>
<tr><td colspan="5">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]</td></tr>
</table>

### 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.<br>Note 2: SNR corresponds to $\hat{E}_s / N_{oc2}$ of cell 1.<br>Note 3: The correlation matrix and antenna configuration apply for Cell 1 and Cell 2. | | | | | | | | |

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

For the parameters specified in Table 8.5.2-1 and Table 8.5.2.2.4-1, the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.5.2.2.4-2. In Table 8.5.2.2.4-1, Cell 1 is the serving cell, and Cell 2 and Cell 3 are the aggressor cells. The downlink physical channel setup for Cell 1 is according to Annex C.3.2 and for Cell 2 and Cell 3 is according to Annex C.3.3, respectively. The CRS assistance information [7] including Cell 2 and Cell 3 is provided.

**Table 8.5.2.2.4-1: Test Parameters for PHICH**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Uplink downlink configuration | | | 1 | 1 | 1 |
| Special subframe configuration | | | 4 | 4 | 4 |
| Downlink power allocation | PDCCH_RA<br>PHICH_RA<br>OCNG_RA | dB | -3 | -3 | -3 |
| | PCFICH_RB<br>PDCCH_RB<br>PHICH_RB<br>OCNG_RB | dB | -3 | -3 | -3 |
| $N_{oc}$ at antenna port | $N_{oc1}$ | dBm/15kHz | -98 (Note 1) | N/A | N/A |
| | $N_{oc2}$ | dBm/15kHz | -98 (Note 2) | N/A | N/A |
| | $N_{oc3}$ | dBm/15kHz | -93 (Note 3) | N/A | N/A |
| $\hat{E}_s/N_{oc2}$ | | dB | Reference Value in Table 8.5.2.2.4-2 | 5 | 3 |
| $BW_{Channel}$ | | MHz | 10 | 10 | 10 |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Time Offset between Cells | | 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 (single carrier and CA)

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

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

| Parameter | Unit | Value |
|---|---|---|
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.1-3, with the addition of the parameters in Table 8.7.1-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.1-4. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.1-6, with the addition of the parameters in Table 8.7.1-5 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.1-7, the TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.1-3 is not applicable.

For UE supporting 256QAM and category 9/10 and category 13, the requirements are specified in both Table 8.7.1-3 and Table 8.7.1-6, with the addition of the parameters in Table 8.7.1-2 and in Table 8.7.1-5 respectivly. The downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.1-4 and in Table 8.7.1-7 for the category 9/10 and category 13, the TB success rate shall be sustained during at least 300 frames.

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

**Table 8.7.1-2: test parameters for sustained downlink data rate (FDD 64QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | 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 |
| 6E | 2x15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7 | 3x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7A | 15+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7B | 10+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7C | 15+15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7D | 10+15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7E | 10+10+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7F | 10+15+15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7G | 5+10+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 for Test 1-6E, and PUCCH format 3 is used to feedback ACK/NACK for Test 7-7G. | | | | | | | | | |

**Table 8.7.1-3: Minimum requirement (FDD 64QAM)**

| Test | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value<br>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 |
| 6E | 55056 (Note 5) for two 15MHz CCs | R.31-4B FDD for two 15MHz CCs | 85 |
| 7 | 75376 (Note 3) | R.31-4 FDD | 85 |
| 7A | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 7B | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 7C | 55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 7D | 36696 (Note 2) for 10MHz CC<br>55056 (Note 5) for 15MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 7E | 36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |
| 7F | 36696 (Note 2) for 10MHz CC<br>55056 (Note 5) for 15MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-5 FDD for 15MHz CC | 85 |
| 7G | 18336 (Note 6) for 5MHz CC<br>36696 (Note 2) for 10MHz CC<br>75376 (Note 3) for 20MHz CC | R.31-6 FDD for 5MHz CC<br>R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.
Note 2: 35160 bits for sub-frame 5.
Note 3: 71112 bits for sub-frame 5.
Note 4: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks.
Note 5: 52752bits for sub-frame 5.
Note 6: 15840bits for sub-frame 0.

**Table 8.7.1-4: Test points for sustained data rate (FRC 64QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9,10 | Cat. 11, 12 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | DL Cat. 11, 12 |
| Single carrier | 10 | 1 | 2 | 3A | 3A | - | - | - |
| | 15 | - | - | 3C | 4B | - | - | - |
| | 20 | - | - | 3 | 4 | 6 | - | - |
| CA with 2CCs | 10+10 | - | - | 3B | 4A | 4A | 4A | - |
| | 10+15 | - | - | 3B | 4A | 6B | 6B | - |
| | 10+20 | - | - | 3B | 4A | 6C | 6C | - |
| | 15+15 | | | 3B | 4A | 6E | 6E | - |
| | 15+20 | - | - | 3B | 4A | 6D | 6D | - |
| | 20+20 | - | - | 3B or 3 (Note 4) | 4A or 4 (Note 4) | 6A | 6A | - |
| CA with 3CCs | 3x20 | - | - | - | - | 6A | 7 | 7 |
| | 15+20+20 | - | - | - | - | 6A | 7A | 7A |
| | 10+20+20 | - | - | - | - | 6A | 7B | 7B |
| | 15+15+20 | | | | | 6D | 7C | 7C |
| | 10+15+20 | - | - | - | - | 6D | 7D | 7D |
| | 10+10+20 | - | - | - | - | 7E | 7E | 7E |
| | 10+15+15 | - | - | - | - | 7F | 7F | 7F |
| | 5+10+20 | - | - | - | - | 7G | 7G | 7G |

Note 1: Void.
Note 2: For non-CA UE, test is selected for maximum supported bandwidth.
Note 3: Void.
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.
Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.7.1-5: test parameters for sustained downlink data rate (FDD 256QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15kHz) | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | | |
| 1 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 2 | 2x10 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 3 | 10+15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 4 | 10+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 5 | 2x15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 6 | 15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 7 | 2x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 8 | 3x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 9 | 15+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 10 | 10+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 11 | 15+15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 12 | 10+15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 13 | 10+10+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 14 | 10+15+15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |
| 15 | 5+10+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | OP.1 FDD |

Note 1: For CA test cases, PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.1-6: Minimum requirement (FDD 256QAM)**

| Test | Measurement channel | Reference value<br>TB success rate [%] |
|---|---|---|
| 1 | R.68 FDD | 85 |
| 2 | R.68-2 FDD | 85 |
| 3 | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC | 85 |
| 4 | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 5 | R.68-1 FDD | 85 |
| 6 | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 7 | R.68 FDD | 85 |
| 8 | R.68 FDD | 85 |
| 9 | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 10 | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 11 | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 12 | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 13 | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| 14 | R.68-2 FDD for 10MHz CC<br>R.68-1 FDD for 15MHz CC | 85 |
| 15 | R.68-3 FDD for 5MHz CC<br>R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 |
| Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.<br>Note 2: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. | | |

**Table 8.7.1-7: Test points for sustained data rate (FRC 256QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 11, 12<br>DL Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|
| Single carrier | 20 | - | 1 | | | | |
| CA with 2CCs | 2x10 | 2 | 2 | | | | |
| | 10+15 | 3 | 3 | | | | |
| | 10+20 | 4 | 4 | | | | |
| | 2x15 | 5 | 5 | | | | |
| | 15+20 | 6 | 6 | | | | |
| | 20+20 | 7 | 7 | | | | |
| CA with 3CCs | 3x20 | 8 | 7 | | | | |
| | 15+20+20 | 9 | 7 | | | | |
| | 10+20+20 | 10 | 7 | | | | |
| | 15+15+20 | 11 | 6 | | | | |
| | 10+15+20 | 12 | 6 | | | | |
| | 10+10+20 | 13 | 13 | | | | |
| | 10+15+15 | 14 | 14 | | | | |
| | 5+10+20 | 15 | 15 | | | | |

### 8.7.2 TDD (single carrier and CA)

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

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

| Parameter | Unit | Value |
|---|---|---|
| Special subframe configuration (Note 1) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Propagation condition | | Static propagation condition<br>No external noise sources are applied |
| Note 1: as specified in Table 4.2-1 in TS 36.211 [4]. | | |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.2-3, with the addition of the parameters in Table 8.7.2-2 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.2-4. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.2-6, with the addition of the parameters in Table 8.7.2-5 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.2-7. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.2-3 is not applicable.

For UE supporting 256QAM and category 9/10 and category 13, the requirements are specified in both Table 8.7.2-3 and Table 8.7.2-6, with the addition of the parameters in Table 8.7.2-2 and in Table 8.7.2-5 respectivly. The downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.2-4 and in Table 8.7.2-7 for the category 9/10 and category 13, the TB success rate shall be sustained during at least 300 frames.

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

**Table 8.7.2-2: test parameters for sustained downlink data rate (TDD 64QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15 kHz) | ACK/NACK feedback mode | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | 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 |
| 6B | 20+15 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 7 | 3x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 2) | OP.1 TDD |
| 7A | 15+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 2) | OP.1 TDD |

Note 1: PUCCH format 1b with channel selection is used to feedback ACK/NACK.
Note 2: PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.2-3: Minimum requirement (TDD 64QAM)**

| Test | Number of bits of a DL-SCH transport block received within a TTI for normal/special sub-frame | Measurement channel | Reference value TB success rate [%] |
|---|---|---|---|
| 1 | 10296/0 | 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 |
| 6B | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 2) | R31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85 |
| 7 | 75376/0 (Note 2) | R.31-4 TDD | 85 |
| 7A | 55056/0 for 15MHz CC<br>75376/0 for 20MHz CC (Note 2) | R.31-5 TDD for 15MHz CC<br>R.31-4 TDD for 20MHz CC | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.
Note 2: 71112 bits for sub-frame 5.
Note 3: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks.

**Table 8.7.2-4: Test points for sustained data rate (FRC 64QAM)**

| CA config | Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9, 10 | Cat. 11, 12 / DL Cat. 11, 12 |
|---|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | - | - | - | - | - |
| | 15 | - | - | 3A | 3A | - | - | - |
| | 20 | - | - | 3 | 4 | 6 | - | - |
| CA with 2CCs | 20+20 | - | -- | 3(Note 4) | 4 (Note 4) | 6A | 6A | - |
| | 15+20 | - | - | 3(Note 4) | 4 (Note 4) | 6B | 6B | - |
| CA with 3 CCs | 3x20 | - | - | - | - | 6A | 7 | 7 |
| | 15+20+20 | - | - | - | - | 6A | 7A | 7A |

Note 1: Void.
Note 2: For non-CA UE, test is selected for maximum supported bandwidth.
Note 3: Void.
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.
Note 5: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 8.1.2.3.

**Table 8.7.2-5: test parameters for sustained downlink data rate (TDD 256QAM)**

| Test | Bandwidth (MHz) | Transmission mode | Antenna configuration | Codebook subset restriction | Downlink power allocation (dB) | | | $\hat{E}_s$ at antenna port (dBm/15 kHz) | ACK/NACK feedback mode | Symbols for unused PRBs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho_A$ | $\rho_B$ | σ | | | |
| 1 | 20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | Bundling | OP.1 TDD |
| 2 | 15+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 3 | 2x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 4 | 3x20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |
| 5 | 15+20+20 | 3 | 2 x 2 | 10 | -3 | -3 | 0 | -85 | (Note 1) | OP.1 TDD |

Note 1: For CA test cases, PUCCH format 3 is used to feedback ACK/NACK.

**Table 8.7.2-6: Minimum requirement (TDD 256QAM)**

| Test | Measurement channel | Reference value TB success rate [%] |
|---|---|---|
| 1 | R.68 TDD | 85 |
| 2 | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85 |
| 3 | R.68 TDD | 85 |
| 4 | R.68 TDD | 85 |
| 5 | R.68-1 TDD for 15MHz CC<br>R.68 TDD for 20MHz CC | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.
Note 2: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks.

**Table 8.7.2-7: Test points for sustained data rate (FRC 256QAM)**

| CA config | Bandwidth/ Bandwidth combination (MHz) | Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|
| | | DL Cat. 11, 12 | | | | | |
| Single carrier | 20 | - | 1 | | | | |
| CA with 2CCs | 15+20 | 2 | 2 | | | | |
| | 2x20 | 3 | 3 | | | | |
| CA with 3 CCs | 3x20 | 4 | 3 | | | | |
| | 15+20+20 | 5 | 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.
Note 2: 35160 bits for sub-frame 5.
Note 3: 71112 bits for sub-frame 5.
Note 4: The TB success rate is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks.
Note 5: 52752 bits for sub-frame 5.

**Table 8.7.3-4: Test points for sustained data rate (FRC)**

| CA config | Bandwidth (MHz) | Category 1 | Category 2 | Category 3 | Category 4 | Category 6 | Category 7 |
|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | 3A | 3A | - | - |
| | 15 | - | - | 3C | 4B | - | - |
| | 20 | - | - | 3 | 4 | 6 | 6 |

Note 1: The test is selected for maximum supported bandwidth.

## 8.7.4 TDD (EPDCCH scheduling)

The parameters specified in Table 8.7.4-1 are valid for all TDD tests unless otherwise stated.

**Table 8.7.4-1: Common test parameters (TDD)**

| Parameter | Unit | Value |
|---|---|---|
| Special subframe configuration (Note 1) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 1 |
| Cross carrier scheduling | | Not configured |
| Number of EPDCCH sets | | 1 |
| EPDCCH transmission type | | Localized |
| Number of PRB per EPDCCH set and EPDCCH PRB pair allocation | | 2 PRB pairs<br>10MHz BW: Resource blocks $n_{PRB}$ = 48, 49<br>15MHz BW: Resource blocks $n_{PRB}$ = 70, 71<br>20MHz BW: Resource blocks $n_{PRB}$ = 98, 99 |
| EPDCCH Starting Symbol | | Derived from CFI (i.e. default behaviour) |
| ECCE Aggregation Level | | 2 ECCEs |
| Number of EREGs per ECCE | | 4 for normal subframe and for special subframe |
| EPDCCH scheduling | | EPDCCH candidate is randomly assigned in each subframe |
| EPDCCH precoder (Note 2) | | Fixed PMI 0 |
| EPDCCH monitoring SF pattern | | UL-DL configuration 1: 1101111111 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. | | | | | | | |

## 8.7.5 TDD FDD CA

The parameters specified in Table 8.7.5-1 are valid for all TDD FDD CA tests unless otherwise stated.

**Table 8.7.5-1: Common Test Parameters (TDD FDD CA)**

| Parameter | | Unit | Value |
|---|---|---|---|
| Uplink downlink configuration (Note 1) for TDD CC | | | 1 |
| Special subframe configuration (Note 2) for TDD CC | | | 4 |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | σ | dB | 0 |
| Cyclic prefix | | | Normal |
| Cell ID | | | 0 |
| Inter-TTI Distance | | | 1 |
| Maximum number of HARQ processes per component carrier | FDD PCell | Processes | 8 for FDD and TDD CCs |
| | TDD PCell | Processes | 11 for FDD CC; 7 for TDD CC |
| Maximum number of HARQ transmission | | | 4 |
| Redundancy version coding sequence | | | {0,0,1,2} for 64QAM, 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbols | 1 |
| Cross carrier scheduling | | | Not configured |
| Propagation condition | | | Static propagation condition<br>No external noise sources are applied |
| Transmission mode | | | TM3 |
| Codebook subset restriction | | | 10 |
| Antenna configuration | | | 2 x 2 |
| $\hat{E}_s$ at antenna port (dBm/15kHz) | | | -85 |
| Symbols for unused PRBs | | | OP.1 FDD for FDD CC,<br>OP.1 TDD for TDD CC |
| ACK/NACK feedback mode | | | PUCCH format 3 |
| Downlink HARQ-ACK timing | FDD PCell | | As specified in Clause 7.3.3 in TS36.213 [6] |
| | TDD PCell | | As specified in Clause 7.3.4 in TS36.213 [6] |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. | | | |

### 8.7.5.1 Minimum Requirement FDD PCell

For UE not supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.1-1 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.5.1-2. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.1-3 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category or UE DL category, and bandwidth combination with the maximum aggregated bandwidth as specified in Table 8.7.5.1-4. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirement in Table 8.7.5.1-1 is not applicable.

The applicability of the requirements are specified in Clause 8.1.2.3B. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.5.1-1: test parameters for sustained downlink data rate (TDD FDD CA 64QAM)**

| Test number | Bandwidth (MHz) | | | Number of bits of a DL-SCH transport block received within a TTI (for normal/special subframe for TDD, except for subframe #5) | | Measurement channel | | Reference value |
|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | FDD CC | TDD CC | FDD CC | TDD CC | TB success rate [%] |
| 1 | 2x20 | 20 | 20 | 75376 | 75376/0 | R.31-4 FDD | R.31-4 TDD | 85 |
| 2 | 10+20 | 10 | 20 | 36696 | 75376/0 | R.31-3A FDD | R.31-4 TDD | 85 |
| 2A | 15+20 | 15 | 20 | 55056 | 75376/0 | R.31-5 FDD | R.31-4 TDD | 85 |
| 3 | 10+10 | 10 | 10 | 36696 | 36696/0 | R.31-3A FDD | R.31-6 TDD | 85 |
| 4 | 3x20 | 20 | 2x20 | 75376 | 75376/0 | R.31-4 FDD | R.31-4 TDD | 85 |
| 5 | 15+20+20 | 15 | 2x20 | 55056 | 75376/0 | R.31-5 FDD | R.31-4 TDD | 85 |
| 6 | 10+20+20 | 10 | 2x20 | 36696 | 75376/0 | R.31-3A FDD | R.31-4 TDD | 85 |

**Table 8.7.5.1-2: Test points for sustained data rate (FRC 64QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | | | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9,10 | Cat. 11, 12, |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | | | | DL Cat. 6,7 | DL Cat. 9, 10 | DL Cat. 11, 12 |
| CA with 2CCs | 2x20 | 20 | 20 | - | - | 3 | 3 | 1 | 1 | - |
| | 10+20 | 10 | 20 | - | - | 3 | 3 | 2 | 2 | - |
| | 15+20 | 15 | 20 | - | - | 3 | 3 | 2A | 2A | - |
| CA with 3CCs | 3x20 | 20 | 2x20 | - | - | - | - | 1 | 4 | 4 |
| | 15+20+20 | 15 | 2x20 | - | - | - | - | 2A | 5 | 5 |
| | 10+20+20 | 10 | 2x20 | - | - | - | - | 2 | 6 | 6 |
| Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.<br>Note 2: Void. | | | | | | | | | | |

**Table 8.7.5.1-3: Minimum requirement (TDD FDD CA 256QAM)**

| Test number | Bandwidth (MHz) | | | Measurement channel | | Reference value |
|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | FDD CC | TDD CC | TB success rate [%] |
| 1 | 2x20 | 20 | 20 | R.68 FDD | R.68 TDD | 85 |
| 2 | 10+20 | 10 | 20 | R.68-2 FDD | R.68 TDD | 85 |
| 3 | 15+20 | 15 | 20 | R.68-1 FDD | R.68 TDD | 85 |
| 4 | 3x20 | 20 | 2x20 | R.68 FDD | R.68 TDD | 85 |
| 5 | 15+20+20 | 15 | 2x20 | R.68-1 FDD | R.68 TDD | 85 |
| 6 | 10+20+20 | 10 | 2x20 | R.68-2 FDD | R.68TDD | 85 |

**Table 8.7.5.1-4: Test points for sustained data rate (FRC 256QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | | | Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | DL Cat. 11, 12 | | | | | |
| CA with 2CCs | 2x20 | 20 | 20 | 1 | 1 | | | | |
| | 10+20 | 10 | 20 | 2 | 2 | | | | |
| | 15+20 | 15 | 20 | 3 | 3 | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CA with 3CCs | 3x20 | 20 | 2x20 | 4 | 1 | | | | |
| | 15+20+20 | 15 | 2x20 | 5 | 3 | | | | |
| | 10+20+20 | 10 | 2x20 | 6 | 2 | | | | |
| Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. | | | | | | | | | |

### 8.7.5.2 Minimum Requirement TDD PCell

For UE not supporting 256QAM, the requirements for TDD FDD CA with TDD PCell are specified in Table 8.7.5.2-1 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.5.2-2. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements for TDD FDD CA with FDD PCell are specified in Table 8.7.5.2-3 with the additional parameters specified in Table 8.7.5-1, and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category or UE DL category, and bandwidth combination with maximum aggregated bandwidth as specified in Table 8.7.5.2-4. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.5.2-1 is not applicable.

The applicability of ther requirements are specified in Clause 8.1.2.3B. The test coverage for different number of component carriers is defined in 8.1.2.4.

**Table 8.7.5.2-1: test parameters for sustained downlink data rate (TDD FDD CA 64QAM)**

| Test number | Bandwidth (MHz) | | | Number of bits of a DL-SCH transport block received within a TTI (for normal/special subframe for TDD, except for subframe #5) | | Measurement channel | | Reference value |
|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | FDD CC | TDD CC | FDD CC | TDD CC | TB success rate [%] |
| 1 | 2x20 | 20 | 20 | 75376 | 75376/0 | R.31-4 FDD | R.31-4 TDD | 85 |
| 2 | 10+20 | 10 | 20 | 36696 | 75376/0 | R.31-3A FDD | R.31-4 TDD | 85 |
| 2A | 15+20 | 15 | 20 | 55056 | 75376/0 | R.31-5 FDD | R.31-4 TDD | 85 |
| 3 | 10+10 | 10 | 10 | 36696 | 36696/0 | R.31-3A FDD | R.31-6 TDD | 85 |
| 4 | 3x20 | 20 | 2x20 | 75376 | 75376/0 | R.31-4 FDD | R.31-4 TDD | 85 |
| 5 | 15+20+20 | 15 | 2x20 | 55056 | 75376/0 | R.31-5 FDD | R.31-4 TDD | 85 |
| 6 | 10+20+20 | 10 | 2x20 | 36696 | 75376/0 | R.31-3A FDD | R.31-4 TDD | 85 |

**Table 8.7.5.2-2: Test points for sustained data rate (FRC 64QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | | | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9,10 | Cat. 11, 12, |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | | | | | DL Cat. 6,7 | DL Cat. 9, 10 | DL Cat. 11, 12 |
| CA with 2CCs | 2x20 | 20 | 20 | - | - | 3 | 3 | 1 | 1 | - |
| | 10+20 | 10 | 20 | - | - | 3 | 3 | 2 | 2 | - |
| | 15+20 | 15 | 20 | - | - | 3 | 3 | 2A | 2A | - |
| CA with 3CCs | 3x20 | 20 | 2x20 | - | - | - | - | 1 | 4 | 4 |
| | 15+20+20 | 15 | 2x20 | - | - | - | - | 2A | 5 | 5 |
| | 10+20+20 | 10 | 2x20 | - | - | - | - | 2 | 6 | 6 |
| Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled.<br>Note 2: Void. | | | | | | | | | | |

**Table 8.7.5.2-3: Minimum requirement (TDD FDD CA 256QAM)**

| Test number | Bandwidth (MHz) | | | Measurement channel | | Reference value |
|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | FDD CC | TDD CC | TB success rate [%] |
| 1 | 2x20 | 20 | 20 | R.68 FDD | R.68 TDD | 85 |
| 2 | 10+20 | 10 | 20 | R.68-2 FDD | R.68 TDD | 85 |
| 3 | 15+20 | 15 | 20 | R.68-1 FDD | R.68 TDD | 85 |
| 4 | 3x20 | 20 | 2x20 | R.68 FDD | R.68 TDD | 85 |
| 5 | 15+20+20 | 15 | 2x20 | R.68-1 FDD | R.68 TDD | 85 |
| 6 | 10+20+20 | 10 | 2x20 | R.68-2 FDD | R.68TDD | 85 |

**Table 8.7.5.2-4: Test points for sustained data rate (FRC 256QAM)**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | | | Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | FDD CC | TDD CC | DL Cat. 11, 12 | | | | | |
| CA with 2CCs | 2x20 | 20 | 20 | 1 | 1 | | | | |
| | 10+20 | 10 | 20 | 2 | 2 | | | | |
| | 15+20 | 15 | 20 | 3 | 3 | | | | |
| CA with 3CCs | 3x20 | 20 | 2x20 | 4 | 1 | | | | |
| | 15+20+20 | 15 | 2x20 | 5 | 3 | | | | |
| | 10+20+20 | 10 | 2x20 | 6 | 2 | | | | |
| Note 1: If DL category is signalled by the UE under test, then select the test point according to UE DL Category. Otherwise, select the test point according to the UE category signalled. | | | | | | | | | |

## 8.7.6 FDD (DC)

The parameters specified in Table 8.7.6-1 are valid for all FDD DC tests unless otherwise stated.

**Table 8.7.6-1: Common Test Parameters (FDD)**

| Parameter | | Unit | Value |
|---|---|---|---|
| Cyclic prefix | | | Normal |
| Cell ID | | | 0 |
| Inter-TTI Distance | | | 1 |
| Number of HARQ processes per component carrier | | Processes | 8 |
| Maximum number of HARQ transmission | | | 4 |
| Redundancy version coding sequence | | | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbols | 1 |
| Cross carrier scheduling | | | Not configured |
| Propagation condition | | | Static propagation condition<br>No external noise sources are applied |
| Transmission mode | | | TM3 |
| Codebook subset restriction | | | 10 |
| Antenna configuration | | | 2x2 |
| $\hat{E}_s$ at antenna port (dBm/15kHz) | | | -85 |
| Symbols for unused PRBs | | | OP.1 FDD |
| ACK/NACK feedback mode | | | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG |
| Time offset between MCG CC and SCG CC | | μs | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchrounous dual connectivity (Note 1) |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | σ | dB | 0 |
| Note 1: Asynchronous and synchrous dual connectivity are defined in TS36.300 [11].<br>Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. | | | |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.6-2, with the addition of the parameters in Table 8.7.6-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.6-3. The TB success rate across CGs shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.6-4, with the addition of the parameters in Table 8.7.6-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.6-5. The TB success rate across CGs shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.6-2 are not applicable.

The applicability of ther requirements are specified in Clause 8.1.2.3A.

**Table 8.7.6-2: Minimum requirement (DC 64QAM)**

| Test number | Bandwidth combination (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value TB success rate(%) | | |
|---|---|---|---|---|---|---|
| | | | | DRB type of Split bearer (Note 2) | DRB type of SCG bearer (Note 3) | |
| | | | | | MCG | SCG |
| 1 | 2x10 | 25456 | R.31-2 FDD | 95 | 95 | 95 |
| 2 | 2x10 | 36696 (Note 4) | R.31-3A FDD | 85 | 85 | 85 |
| 3 | 10+20 | 36696 (Note 4) for 10MHz CC<br>75376 (Note 5) for 20MHz CC | R.31-3A FDD for 10MHz CC<br>R.31-4 FDD for 20MHz CC | 85 | 85 | 85 |
| 4 | 2x15 | 55056 (Note 6) | R.31-4B FDD | 85 | 85 | 85 |
| 5 | 15+20 | 55056 for 15MHz CC<br>75376 (Note 5) for 20MHz CC | R.31-5 FDD for 15MHz CC<br>R.31-4 FDD for 20MHz CC | 85 | 85 | 85 |
| 6 | 2x20 | 75376 (Note 5) | R.31-4 FDD | 85 | 85 | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.

Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks , $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes across all the CGs used for DC transmission or reception.

Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes per CG used for DC transmission or reception, separately.

Note 4: 35160 bits for sub-frame 5.

Note 5: 71112 bits for sub-frame 5.

Note 6: 52752 bits for sub-frame 5.

**Table 8.7.6-3: Test points for sustained data rate (FRC DC 64QAM)**

| DC config | Maximum supported Bandwidth combination (MHz) | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9, 10 | Cat. 11, 12 | |
|---|---|---|---|---|---|---|---|
| DC with 2CCs | 2x10 | 1 | 2 | 2 | 2 | - | |
| | 10+20 | 1 | 2 | 3 | 3 | - | |
| | 2x15 | 1 | 2 | 4 | 4 | - | |
| | 15+20 | 1 | 2 | 5 | 5 | - | |
| | 2x20 | 1 | 2 | 6 | 6 | - | |

**Table 8.7.6-4: Minimum requirement (DC 256QAM)**

| Test number | Bandwidth combination (MHz) | Measurement channel | Reference value TB success rate (%) | | |
|---|---|---|---|---|---|
| | | | DRB type of Split bearer (Note 2) | DRB type of SCG bearer (Note 3) | |
| | | | | MCG | SCG |
| 1 | 2x10 | R.68-2 FDD | 85 | 85 | 85 |
| 2 | 10+20 | R.68-2 FDD for 10MHz CC<br>R.68 FDD for 20MHz CC | 85 | 85 | 85 |
| 3 | 2x15 | R.68-1 FDD | 85 | 85 | 85 |
| 4 | 15+20 | R.68-1 FDD for 15MHz CC<br>R.68 FDD for 20MHz CC | 85 | 85 | 85 |
| 5 | 2x20 | R.68 FDD | 85 | 85 | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.

Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks , $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes across all the CGs used for DC transmission or reception.

Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes per CG used for DC transmission or reception, separately.

**Table 8.7.6-5: Test points for sustained data rate (FRC DC 256QAM)**

| DC config | Maximum supported Bandwidth combination (MHz) | Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|
| | | DL Cat 11, 12 | | | | | |
| DC with 2CCs | 2x10 | 1 | 1 | | | | |
| | 10+20 | 2 | 2 | | | | |
| | 2x15 | 3 | 3 | | | | |
| | 15+20 | 4 | 4 | | | | |
| | 2x20 | 5 | 5 | | | | |

## 8.7.7 TDD (DC)

The parameters specified in Table 8.7.7-1 are valid for all TDD DC tests unless otherwise stated.

**Table 8.7.7-1: Common Test Parameters (TDD)**

| Parameter | | Unit | Value |
|---|---|---|---|
| Uplink downlink configuration | | | 2 (Note 2) |
| Special subframe configuration | | | 4 |
| Cyclic prefix | | | Normal |
| Cell ID | | | 0 |
| Inter-TTI Distance | | | 1 |
| Number of HARQ processes per component carrier | | Processes | 7 |
| Maximum number of HARQ transmission | | | 4 |
| Redundancy version coding sequence | | | {0,0,1,2} for 64QAM and 256QAM |
| Number of OFDM symbols for PDCCH per component carrier | | OFDM symbols | 1 |
| Cross carrier scheduling | | | Not configured |
| Propagation condition | | | Static propagation condition<br>No external noise sources are applied |
| Transmission mode | | | TM3 |
| Codebook subset restriction | | | 10 |
| Antenna configuration | | | 2x2 |
| $\hat{E}_s$ at antenna port (dBm/15kHz) | | | -85 |
| Symbols for unused PRBs | | | OP.1 TDD |
| ACK/NACK feedback mode | | | Separate ACK/NACK feedbacks with PUCCH format 3 on the MCG and SCG |
| Time offset between MCG CC and SCG CC | | μs | 0 for UE under test supporting synchronous dual connectivity;<br>500 for UE under test supporting both asynchronous and synchrounous dual connectivity (Note 1) |
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 |
| | σ | dB | 0 |
| Note 1: Asynchronous and synchrous dual connectivity are defined in TS36.300 [11].<br>Note 2: If the UE supports both SCG bearer and Split bearer, the Split bearer is configured. | | | |

For UE not supporting 256QAM, the requirements are specified in Table 8.7.7-2, with the addition of the parameters in Table 8.7.7-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.7-3. The TB success rate shall be sustained during at least 300 frames.

For UE supporting 256QAM, the requirements are specified in Table 8.7.7-4, with the addition of the parameters in Table 8.7.7-1 and the downlink physical channel setup according to Annex C.3.2. The test points are applied to UE category and bandwidth combination with maximum aggregated bandwidth as specified inTable 8.7.7-5. The TB success rate shall be sustained during at least 300 frames. For UE supporting 256QAM, the requirements in Table 8.7.7-2 are not applicable.

The applicability of ther requirements are specified in Clause 8.1.2.3A.

**Table 8.7.7-2: Minimum requirement (DC 64QAM)**

| Test number | Bandwidth combination (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value TB success rate across CGs(%) | | |
|---|---|---|---|---|---|---|
| | | | | DRB type of Split bearer (Note 2) | DRB type of SCG bearer (Note 3) | |
| | | | | | MCG | SCG |
| 1 | 2x20 | 75376/0 (Note 4) | R.31-4A TDD | 85 | 85 | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.

Note 2: For the configuration of DRB type of Split bearer,the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes across all the CGs used for DC transmission or reception.

Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes per CG used for DC transmission or reception, separately.

Note 4: 71112 bits for sub-frame 5.

**Table 8.7.7-3: Test points for sustained data rate (FRC DC 64QAM)**

| DC config | Maximum supported Bandwidth combination (MHz) | Cat. 3 | Cat. 4 | Cat. 6, 7 | Cat. 9, 10 | Cat. 11, 12 | |
|---|---|---|---|---|---|---|---|
| DC with 2CCs | 2x20 | - | - | 1 | 1 | - | |

**Table 8.7.7-4: Minimum requirement (DC 256QAM)**

| Test number | Bandwidth combination (MHz) | Measurement channel | Reference value TB success rate (%) | | |
|---|---|---|---|---|---|
| | | | DRB type of Split bearer (Note 2) | DRB type of SCG bearer (Note 3) | |
| | | | | MCG | SCG |
| 1 | 2x20 | R.68-3 TDD | 85 | 85 | 85 |

Note 1: For 2 layer transmissions, 2 transport blocks are received within a TTI.

Note 2: For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes across all the CGs used for DC transmission or reception.

Note 3: For the configuration of DRB type of SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*$N_{DL\_correct\_rx}$/ ($N_{DL\_newtx}$ + $N_{DL\_retx}$), where $N_{DL\_newtx}$ is the number of newly transmitted DL transport blocks, $N_{DL\_retx}$ is the number of retransmitted DL transport blocks, and $N_{DL\_correct\_rx}$ is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blockes per CG used for DC transmission or reception, separately.

**Table 8.7.7-5: Test points for sustained data rate (FRC DC 256QAM)**

| DC config | Maximum supported Bandwidth combination (MHz) | Cat. 11, 12 / DL Cat. 11, 12 | DL Cat. 13 | | | | |
|---|---|---|---|---|---|---|---|
| DC with 2CCs | 2x20 | 1 | 1 | | | | |

# 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 | 2.80 |
| 2 | 10 MHZ | 16 ECCE | R.56 TDD | OP.7 TDD | EVA70 | 2 x 2 Low | 1 | -3.10 |

#### 8.8.1.2.1 Void

**Table 8.8.1.2.1-1: Void**

## 8.8.2 Localized Transmission with TM9

### 8.8.2.1 FDD

The parameters specified in Table 8.8.2.1-1 are valid for all FDD TM9 localized ePDCCH tests unless otherwise stated.

**Table 8.8.2.1-1: Test Parameters for Localized EPDCCH with TM9**

| Parameter | | Unit | Value |
|---|---|---|---|
| Number of PDCCH symbols | | symbols | 1 (Note 1) |
| EPDCCH starting symbol | | symbols | 2 (Note 1) |
| PHICH duration | | | Normal |
| Unused RE-s and PRB-s | | | OCNG |
| Cell ID | | | 0 |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | $\sigma$ | dB | -3 |
| | $\delta$ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15 kHz | -98 |
| Cyclic prefix | | | Normal |
| Subframe Configuration | | | Non-MBSFN |
| Precoder Update Granularity | | PRB | 1 |
| | | ms | 1 |
| Beamforming Pre-Coder | | | Annex B.4.5 |
| Cell Specific Reference Signal | | | Port 0 and 1 |
| CSI-RS Reference Signal | | | Port 15 and 16 |
| CSI-RS reference signal resource configuration | | | 0 |
| CSI reference signal subframe configuration $I_{CSI-RS}$ | | | 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.
Note 2: The starting OFDM symbol for EPDCCH is determined from the higher layer signalling pdsch-Start-r11. And CFI is set to 1.
Note 3: The TP from which PDSCH is transmitted shall be randomly determined independently for each subframe. Probabilities of occurrence of PDSCH transmission from TP 1 and TP 2 are specified.
Note 4: For PQI set 0, PDSCH and EPDCCH are transmitted from TP 2. For PQI set 1, PDSCH and EPDCCH are transmitted from TP1. EPDCCH and PDSCH are transmitted from same TP.

**Table 8.8.3.1-2: 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 |

# 8.9 Demodulation (single receiver antenna)

The SNR deifintion is given in Clause 8.1.1 where the number of receiver antennas $N_{RX}$ assumed for the minimum performance requirement in this clause is 1.

## 8.9.1 PDSCH

### 8.9.1.1 FDD and half-duplex FDD (Fixed Reference Channel)

The parameters specified in Table 8.9.1.1-1 are valid for FDD and half-duplex FDD tests unless otherwise stated.

**Table 8.9.1.1-1: Common Test Parameters (FDD and half-duplex FDD)**

| Parameter | Unit | Value |
|---|---|---|
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 8 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Cyclic Prefix | | Normal |
| Precoder update granularity | | Frequency domain: 1 PRG<br>Time domain: 1 ms for Transmission mode 9 |

### 8.9.1.1.1 Transmit diversity performance (Cell-Specific Reference Symbols)

#### 8.9.1.1.1.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.1.1.1-2, with the addition of the parameters in Table 8.9.1.1.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.9.1.1.1.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode | | | 2 |
| Note 1: $P_B = 1$. | | | |

**Table 8.9.1.1.1.1-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Band-width and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.62 FDD | OP.1 FDD | EPA5 | 2x1 Low | 70 | 9.0 | 0 |

### 8.9.1.1.2 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

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

The requirements are specified in Table 8.9.1.1.2.1-2, with the addition of the parameters in Table 8.9.1.1.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.1.2.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 |
| PMI delay (Note 2) | | ms | 8 |
| Reporting interval | | ms | 8 |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 001111 |
| PDSCH transmission mode | | | 4 |
| Note 1: $P_B = 1$.<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 8.9.1.1.2.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Band-width and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 64QAM 1/2 | R.63 FDD | OP.1 FDD | EPA5 | 2x1 Low | 70 | 13.2 | 0 |

### 8.9.1.1.3 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

#### 8.9.1.1.3.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.9.1.1.3.1-2 with the addition of the parameters in Table 8.9.1.1.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.9.1.1.3.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | -3 |
| Beamforming model | | | Annex B.4.1 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 2 |
| CSI reference signal configuration | | | 0 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 3 / 0001000000000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) |
| Number of allocated resource blocks (Note 2) | | PRB | 6 |
| PDSCH transmission mode | | | 9 |

Note 1: $P_B = 1$.
Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.
Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.9.1.1.3.1-2: Minimum performance for CDM-multiplexed DM RS (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.64 FDD | OP.1 FDD | EPA5 | 2x1 Low | 70 | 4.7 | 0 |

## 8.9.1.2 TDD (Fixed Reference Channel)

The parameters specified in Table 8.9.1.2-1 are valid for all TDD tests unless otherwise stated.

**Table 8.9.1.2-1: Common Test Parameters (TDD)**

| Parameter | Unit | Value |
|---|---|---|
| Uplink downlink configuration (Note 1) | | 1 |
| Special subframe configuration (Note 2) | | 4 |
| Cyclic prefix | | Normal |
| Cell ID | | 0 |
| Inter-TTI Distance | | 1 |
| Number of HARQ processes per component carrier | Processes | 7 |
| Maximum number of HARQ transmission | | 4 |
| Redundancy version coding sequence | | {0,1,2,3} for QPSK and 16QAM<br>{0,0,1,2} for 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | OFDM symbols | 4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths,<br>2 for 10 MHz, 15 MHz and 20 MHz bandwidths |
| Precoder update granularity | | Frequency domain: 1 PRG<br>Time domain: 1 ms for Transmission mode 9 |
| ACK/NACK feedback mode | | Multiplexing |
| Note 1: as specified in Table 4.2-2 in TS 36.211 [4].<br>Note 2: as specified in Table 4.2-1 in TS 36.211 [4]. | | |

### 8.9.1.2.1 Transmit diversity performance (Cell-Specific Reference Symbols)

#### 8.9.1.2.1.1 Minimum Requirement 2 Tx Antenna Port

The requirements are specified in Table 8.9.1.2.1.1-2, with the addition of the parameters in Table 8.9.1.2.1.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of transmit diversity (SFBC) with 2 transmitter antennas.

**Table 8.9.1.2.1.1-1: Test Parameters for Transmit diversity Performance (FRC)**

| Parameter | | Unit | Test 1-2 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | 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 8.9.1.2.1.1-2: Minimum performance Transmit Diversity (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 16QAM 1/2 | R.62 TDD | OP.1 TDD | EPA5 | 2x1 Low | 70 | 8.8 | 0 |

### 8.9.1.2.2 Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)

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

The requirements are specified in Table 8.9.1.2.2.1-2, with the addition of the parameters in Table 8.9.1.2.2.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the closed loop rank-one performance with frequency selective precoding.

**Table 8.9.1.2.2.1-1: Test Parameters for Single-Layer Spatial Multiplexing (FRC)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | -3 |
| | $\rho_B$ | dB | -3 (Note 1) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Precoding granularity | | PRB | 6 |
| PMI delay (Note 2) | | ms | 10 or 11 |
| Reporting interval | | ms | 1 or 4 (Note 3) |
| Reporting mode | | | PUSCH 1-2 |
| CodeBookSubsetRestriction bitmap | | | 001111 |
| ACK/NACK feedback mode | | | Multiplexing |
| PDSCH transmission mode | | | 4 |

Note 1: $P_B = 1$.
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.

**Table8.9.1.2.2.1-2: Minimum performance Single-Layer Spatial Multiplexing (FRC)**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz 64QAM 1/2 | R.63 TDD | OP.1 TDD | EPA5 | 2x1 Low | 70 | 13.1 | 0 |

### 8.9.1.2.3 Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)

#### 8.9.1.2.3.1 Single-layer Spatial Multiplexing

For single-layer transmission on antenna ports 7 or 8 upon detection of a PDCCH with DCI format 2C, the requirements are specified in Table 8.9.1.2.3.1-2 with the addition of the parameters in Table 8.9.1.2.3.1-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify rank-1 performance on one of the antenna ports 7 or 8, and to verify rate matching with multiple CSI reference symbol configurations with non-zero and zero transmission power.

**Table 8.9.1.2.3.1-1: Test Parameters for Testing CDM-multiplexed DM RS (single layer) with multiple CSI-RS configurations**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 (Note 1) |
| | σ | dB | -3 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| Beamforming model | | | Annex B.4.1 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | Subframes | 5 / 4 |
| CSI reference signal configuration | | | 1 |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | 4 / 0010000100000000 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Symbols for unused PRBs | | | OCNG (Note 4) |
| Number of allocated resource blocks (Note 2) | | PRB | 6 |
| Simultaneous transmission | | | No |
| PDSCH transmission mode | | | 9 |

Note 1: $P_B = 1$.
Note 2: The modulation symbols of the signal under test are mapped onto antenna port 7 or 8.
Note 3: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.

**Table 8.9.1.2.3.1-2: Minimum performance for CDM-multiplexed DM RS without simultaneous transmission (FRC) with multiple CSI-RS configurations**

| Test number | Bandwidth and MCS | Reference Channel | OCNG Pattern | Propagation Condition | Correlation Matrix and Antenna Configuration | Reference value | | UE DL category |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Fraction of Maximum Throughput (%) | SNR (dB) | |
| 1 | 10 MHz QPSK 1/3 | R.64 TDD | OP.1 TDD | EPA5 | 2x1 Low | 70 | 4.5 | 0 |

## 8.9.2 PHICH

### 8.9.2.1 FDD and half-duplex FDD

#### 8.9.2.1.1 Transmit diversity performance

For the parameters specified in Table 8.5.1-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.9.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.2.1.1-1: Minimum performance PHICH**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pm-an (%) | SNR (dB) |
| 1 | 10 MHz | R.19 | OP.1 FDD | EPA5 | 2 x 1 Low | 0.1 | 8.6 |

### 8.9.2.2 TDD

#### 8.9.2.2.1 Transmit diversity performance

For the parameters specified in Table 8.5.2-1 the average probability of a miss-detecting ACK for NACK (Pm-an) shall be below the specified value in Table 8.9.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.2.2.1-1: Minimum performance PHICH**

| 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 | EPA5 | 2 x 1 Low | 0.1 | 8.6 |

## 8.9.3 PBCH

### 8.9.3.1 FDD and half-duplex FDD

#### 8.9.3.1.1 Transmit diversity performance

For the parameters specified in Table 8.6.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.9.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.3.1.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Pm-bch (%) | SNR (dB) |
| 1 | 1.4 MHz | R.22 | EPA5 | 2 x 1 Low | 1 | -1.3 |

#### 8.9.3.2 TDD

##### 8.9.3.2.1 Transmit diversity performance

For the parameters specified in Table 8.6.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified value in Table 8.9.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.2.

**Table 8.9.3.2.1-1: Minimum performance PBCH**

| Test number | Bandwidth | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|---|---|---|---|---|---|---|
| | | | | | Pm-bch (%) | SNR (dB) |
| 1 | 1.4 MHz | R.22 | EPA5 | 2 x 1 Low | 1 | -1.7 |

# 9 Reporting of Channel State Information

## 9.1 General

This section includes requirements for the reporting of channel state information (CSI). For all test cases in this section, the definition of SNR and SINR are in accordance with the one given in clause 8.1.1.

For the performance requirements specified in this clause, it is assumed that $N_{RX}$=2 unless otherwise stated.

Unless otherwise stated, 4-bit CQI Table in Table 7.2.3-1 in TS 36.213 [6], and Modulation and TBS index table in Table 7.1.7.1-1 for PDSCH in TS 36.213 [6] are applied in all the CSI requirements.

### 9.1.1 Applicability of requirements

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

In Clause 9 the test cases may be defined with different channel bandwidth to verify the same CSI requirement.

Test cases defined for 5MHz channel bandwidth that reference this clause are applicable to UEs that support only Band 31.

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

The performance requirement for CA CQI tests in Clause 9 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL CCs in Table 9.1.1.2-1 and 3 DL CCs in Table 9.1.1.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 9.1.1.2-1: Applicability and test rules for CA UE CQI tests with 2 DL CCs**

| Tests | CA capability where the tests apply | CA configuration from the selected CA 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, 5+5 MHz, and 10MHz+5MHz. |
| 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 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

**Table 9.1.1.2-2: Applicability and test rules for CA UE CQI tests with 3 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 3CCs in Clause 9.6.1.1 | Any of one of the supported CA capabilities with largest aggregated CA bandwidth combination | Any one of the supported FDD CA configurations with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs 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 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

#### 9.1.1.2A Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets

The performance requirement for TDD-FDD CA CQI tests in Clause 9 are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.6A.1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined for the tests for 2 DL TDD-FDD CA in Table 9.1.1.2A-1 and for 3 DL TDD-FDD CA in Table 9.1.1.2A-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

**Table 9.1.1.2A-1: Applicability and test rules for CA UE CQI tests for TDD-FDD CA with 2 DL CCs**

| Tests | CA capability where the tests apply | CA configuration from the selected CA capbility where the tests apply | CA Bandwidth combination to be tested in priority order |
|---|---|---|---|
| CA tests with 2CCs in Clause 9.6.1.3 | Any of one of the supported CA capabilities | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 2CCs in Clause 9.6.1.4 | Any of one of the supported CA capabilities | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

**Table 9.1.1.2A-2: Applicability and test rules for CA UE CQI tests for TDD-FDD CA with 3 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 3CCs in Clause 9.6.1.3 | Any of one of the supported CA capabilities | Any one of the supported TDD-FDD CA configurations with FDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| CA tests with 3CCs in Clause 9.6.1.4 | Any of one of the supported CA capabilities | Any one of the supported TDD-FDD CA configurations with TDD PCell with largest aggregated CA bandwidth combination | Largest aggregated CA bandwidth combination |
| Note 1: The applicability and test rules are specified in this table, unless otherwise stated.<br>Note 2: Number of the supported bandwidth combinations to be tested from each selected CA configuration is 1.<br>Note 3: A single Uplink CC is configured for all tests | | | |

### 9.1.1.3 Test coverage for different number of componenet carriers

For FDD CA tests specified in 9.6.1.1, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD CA tests specified in 9.6.1.2, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

For TDD FDD CA tests specified in 9.6.1.3 and 9.6.1.4, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the TDD FDD CA tests with less than the largest number of CCs supported by the UE.

## 9.2 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 Table 9.2.1.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1 FDD / RC.14 FDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

The applicability of the requirement with 5MHz bandwidth as specificed in Table 9.2.1.1-2 is defined in 9.1.1.1.

**Table 9.2.1.1-1: PUCCH 1-0 static test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | | |
| SNR (Note 2) | | dB | 0 | 1 | 6 | 7 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -92 | -91 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 6 | | | |
| Note 1: Reference measurement channel RC.1 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.4 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2.<br>Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. | | | | | | |

**Table 9.2.1.1-2: PUCCH 1-0 static test (FDD 5MHz)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 5 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | | |
| SNR (Note 2) | | dB | [0] | [1] | [6] | [7] |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | [-98] | [-97] | [-92] | [-91] |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 6 | | | |
| Note 1: Reference measurement channel RC.14 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1, except for category 1 UE use RC.15 FDD with two sided dynamic OCNG Pattern OP.2 FDD as described in Annex A.5.1.2.<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. | | | | | | |

### 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)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | | |
| SNR (Note 2) | | dB | 0 | 1 | 6 | 7 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -92 | -91 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 3) | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |
| Note 1: Reference measurement channel RC.1 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1, 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. | | | | | | |

### 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 (FDDD)**

| Parameter | | Unit | Test 1 | | | Test 2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | | Cell 2 | Cell 1 | | Cell 2 |
| Bandwidth | | MHz | 10 | | | 10 | | |
| PDSCH transmission mode | | | 2 | | Note 10 | 2 | | Note 10 |
| 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 | 6 | 4 | 5 | -12 |
| $N_{oc}^{(j)}$ at antenna port | $N_{oc1}^{(j)}$ | dBm/15kHz | -102 (Note 7) | | N/A | -98(Note 7) | | N/A |
| | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8) | | N/A | -98(Note 8) | | N/A |
| | $N_{oc3}^{(j)}$ | dBm/15kHz | -94.8 (Note 9) | | N/A | -98(Note 9) | | N/A |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -92 | -94 | -93 | -110 |
| Subframe Configuration | | | Non-MBSFN | | Non-MBSFN | Non-MBSFN | | Non-MBSFN |
| Cell Id | | | 0 | | 1 | 0 | | 1 |
| Time Offset between Cells | | µs | 2.5 (synchronous cells) | | | 2.5 (synchronous cells) | | |
| ABS pattern (Note 2) | | | N/A | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |
| RLM/RRM Measurement Subframe Pattern (Note 4) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | | N/A | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | | N/A |
| CSI Subframe Sets (Note 3) | $C_{CSI,0}$ | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | | N/A | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | | N/A |
| | $C_{CSI,1}$ | | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | | N/A | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | | N/A |
| Number of control OFDM symbols | | | 3 | | | 3 | | |
| Max number of HARQ transmissions | | | 1 | | | 1 | | |
| Physical channel for $C_{CSI,0}$ CQI reporting | | | PUCCH Format 2 | | | PUCCH Format 2 | | |
| Physical channel for $C_{CSI,1}$ CQI reporting | | | PUSCH (Note 12) | | | PUSCH (Note 12) | | |
| PUCCH Report Type | | | 4 | | | 4 | | |
| Reporting periodicity | | Ms | $N_{pd}$ = 5 | | | $N_{pd}$ = 5 | | |
| *cqi-pmi-ConfigurationIndex* $C_{CSI,0}$ (Note 13) | | | 6 | | N/A | 6 | | N/A |
| *cqi-pmi-ConfigurationIndex2* $C_{CSI,1}$ (Note 14) | | | 5 | | N/A | 5 | | N/A |

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 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)**

| Parameter | | Unit | Test 1 | | | Test 2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | | Cell 2 | Cell 1 | | Cell 2 |
| Bandwidth | | MHz | 10 | | | 10 | | |
| PDSCH transmission mode | | | 2 | | Note 10 | 2 | | Note 10 |
| Uplink downlink configuration | | | 1 | | | 1 | | |
| Special subframe configuration | | | 4 | | | 4 | | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | | -3 | | |
| | $\rho_B$ | dB | -3 | | | -3 | | |
| | 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 | 6 | 4 | 5 | -12 |
| $N_{oc}^{(j)}$ at antenna port | $N_{oc1}^{(j)}$ | dBm/15kHz | -102 (Note 7) | | N/A | -98 (Note 7) | | N/A |
| | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8) | | N/A | -98 (Note 8) | | N/A |
| | $N_{oc3}^{(j)}$ | dBm/15kHz | -94.8 (Note 9) | | N/A | -98 (Note 9) | | N/A |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -92 | -94 | -93 | -110 |
| Subframe Configuration | | | Non-MBSFN | | Non-MBSFN | Non-MBSFN | | Non-MBSFN |
| Cell Id | | | 0 | | 1 | 0 | | 1 |
| Time Offset between Cells | | μs | 2.5 (synchronous cells) | | | 2.5 (synchronous cells) | | |
| ABS pattern (Note 2) | | | N/A | | 0100010001 0100010001 | N/A | | 0100010001 0100010001 |
| RLM/RRM Measurement Subframe Pattern (Note 4) | | | 0000000001 0000000001 | | N/A | 0000000001 0000000001 | | N/A |
| CSI Subframe Sets (Note 3) | $C_{CSI,0}$ | | 0100010001 0100010001 | | N/A | 0100010001 0100010001 | | N.A |
| | $C_{CSI,1}$ | | 1000101000 1000101000 | | N/A | 1000101000 1000101000 | | N/A |
| Number of control OFDM symbols | | | 3 | | | 3 | | |
| Max number of HARQ transmissions | | | 1 | | | 1 | | |
| Physical channel for $C_{CSI,0}$ CQI reporting | | | PUCCH Format 2 | | | PUCCH Format 2 | | |
| Physical channel for $C_{CSI,1}$ CQI reporting | | | PUSCH (Note 12) | | | PUSCH | | |
| PUCCH Report Type | | | 4 | | | 4 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | $N_{pd}$ = 5 | | |
| *cqi-pmi-ConfigurationIndex* $C_{CSI,0}$ (Note 13) | | | 3 | | N/A | 3 | | N/A |
| *cqi-pmi-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 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)**

| Parameter | | Unit | Test 1 | | | Test 2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Cell 1 | | Cell 2 and 3 | Cell 1 | | Cell 2 and 3 |
| Bandwidth | | MHz | 10 | | | 10 | | |
| PDSCH transmission mode | | | 2 | | Note 10 | 2 | | Note 10 |
| Downlink power allocation | $\rho_A$ | 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 | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | N/A | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 |
| RLM/RRM Measurement Subframe Pattern (Note 4) | | | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | | N/A | 00000100<br>00000100<br>00000100<br>00000100<br>00000100 | | N/A |
| CSI Subframe Sets (Note 3) | $C_{CSI,0}$ | | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | | N/A | 01010101<br>01010101<br>01010101<br>01010101<br>01010101 | | N/A |
| | $C_{CSI,1}$ | | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | | N/A | 10101010<br>10101010<br>10101010<br>10101010<br>10101010 | | N/A |
| Number of control OFDM symbols | | | 3 | | | 3 | | |
| Max number of HARQ transmissions | | | 1 | | | 1 | | |
| Physical channel for $C_{CSI,0}$ CQI reporting | | | PUCCH Format 2 | | | PUCCH Format 2 | | |
| Physical channel for $C_{CSI,1}$ CQI reporting | | | PUSCH (Note 12) | | | PUSCH (Note 12) | | |
| PUCCH Report Type | | | 4 | | | 4 | | |
| Reporting periodicity | | Ms | $N_{pd}$ = 5 | | | $N_{pd}$ = 5 | | |
| *cqi-pmi-ConfigurationIndex* $C_{CSI,0}$ (Note 13) | | | 6 | | N/A | 6 | | N/A |
| *cqi-pmi-ConfigurationIndex2* $C_{CSI,1}$ (Note 14) | | | 5 | | N/A | 5 | | N/A |

| | |
|---|---|
| Note 1: | For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level. |
| Note 2: | ABS pattern as defined in [9]. |
| Note 3: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 4: | As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7] |
| Note 5: | Time-domain measurement resource restriction pattern for PCell measurements as defined in [7] |
| Note 6: | Cell 1 is the serving cell. Cell 2 and Cell 3 are the aggressor cells. The number of the CRS ports in Cell1, Cell2, and Cell3 are the same. |
| Note 7: | This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS. |
| Note 8: | This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. |
| Note 9: | This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS. |
| Note 10: | Downlink physical channel setup in Cell 2 and Cell 3 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.1.5 |
| Note 11: | Reference measurement channel in Cell 1 RC.2 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. |
| Note 12: | To avoid collisions between HARQ-ACK and wideband CQI it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#4 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. |
| Note 13: | *cqi-pmi-ConfigurationIndex* is applied for $C_{CSI,0}$. |
| Note 14: | *cqi-pmi-ConfigurationIndex2* is applied for $C_{CSI,1}$. |

### 9.2.1.6 TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)

The following requirements apply to UE Category ≥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 $C_{CSI,1}$. |

### 9.2.1.7 FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

The following requirements apply to UE Category 11-12 and DL Category ≥11. For the parameters specified in Table 9.2.1.7-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1A FDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.2.1.7-1: PUCCH 1-0 static test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | | |
| SNR (Note 2) | | dB | -1 | 0 | 20 | 21 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -99 | -98 | -78 | -77 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 6 | | | |
| Note 1: Reference measurement channel RC.1A FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.<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. | | | | | | |

#### 9.2.1.8 TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

The following requirements apply to UE Category 11-12 and UE DL Category ≥11. For the parameters specified in Table 9.2.1.8-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.1A TDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.2.1.8-1: PUCCH 1-0 static test (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 20 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | | |
| SNR (Note 2) | | dB | -1 | 0 | 20 | 21 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -99 | -98 | -78 | -77 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 3) | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

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

### 9.2.2 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.<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: 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 FDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.<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/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 $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 3 | | | |
| CSI reference signal configuration | | | 0 | | | |
| Propagation condition and antenna configuration | | | Clause B.1 (8 x 2) | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0020 0000 0000 0001 0000 | | | |
| SNR (Note 2) | | dB | 4 | 5 | 10 | 11 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -94 | -93 | -88 | -87 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | | | |
| PUCCH Report Type for CQI/second PMI | | | 2b | | | |
| Physical channel for RI reporting | | | PUSCH | | | |
| PUCCH Report Type for RI/ first PMI | | | 5 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| *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: N/A.
Note 5: To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#0 and #5.

#### 9.2.4.2 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 |
| | 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,…,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: | N/A. |
| Note 5: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2. |
| Note 6: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |

### 9.2.5 Minimum requirement PUCCH 1-1 (when *csi-SubframeSet –r12* and *EIMTA-MainConfigServCell-r12* are configured)

The following requirements apply to UE Category ≥2 which supports eIMTA TDD UL-DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI and Rel-12 CSI subframe sets. For the parameters specified in table 9.2.5-1, and using the downlink physical channels specified in Tables C.3.2-1 and C.3.2-2, for each CSI subframe set, the reported CQI value shall be in the range of ±1 of the reported median more than 90% of the time. For each CSI subframe set, if the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1. The difference of the median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ and the median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ shall be larger than or equal to 3.

**Table 9.2.5 -1: PUCCH 1-1 static test (TDD)**

| Parameter | | Unit | Test | |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 | |
| PDSCH transmission mode | | | 9 | |
| Uplink downlink configuration in SIB1 | | | 0 | |
| Downlink HARQ reference configuration (eimta-HarqReferenceConfig-r12) (Note 4) | | | 2 | |
| Set of dynamic TDD UL-DL configurations (Notes 4,5) | | | {0, 2} | |
| Periodicity of monitoring the L1 reconfiguration DCI (eimta-CommandPeriodicity-r12) | | ms | 10 | |
| Set of subframes to monitor the L1 reconfiguration DCI (eimta-CommandSubframeSet-r12) | | | SF#5 | |
| CSI-MeasSubframeSet-r12 | | | 0001100011 | |
| Special subframe configuration | | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| | $P_c$ | dB | 0 | |
| | σ | dB | -3 | |
| CRS reference signals | | | Antenna ports 0, 1 | |
| CSI reference signals | | | Antenna ports 15,16 | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/4 | |
| CSI reference signal configuration | | | 4 | |
| Zero-Power CSI-RS configuration 0 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 0 / 0000010000000000 | |
| Zero-Power CSI-RS configuration 1 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 4 / 0100000000000000 | |
| Propagation condition and antenna configuration | | | Clause B.1 (2 x 2) | |
| Beamforming Model | | | As specified in Section B.4.3 | |
| CodeBookSubsetRestriction bitmap | | | '000001' | |
| SNR in CSI subframe set 0 | | dB | 0 | 1 |
| SNR in CSI subframe set 1 | | dB | 10 | 11 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 |
| $N_{oc1}^{(j)}$ for CSI subframe set 0 | | dB[mW/15kHz] | -98 | -98 |
| $N_{oc2}^{(j)}$ for CSI subframe set 1 | | dB[mW/15kHz] | -108 | -108 |
| PDSCH scheduled subframes for CSI subframe set 0 | | | 0,5 | |
| PDSCH scheduled subframes for CSI subframe set 1 | | | 3,4,8,9 | |
| Max number of HARQ transmissions | | | 1 | |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 6) | |
| PUCCH Report Type for CQI/second PMI | | | 2b | |
| Physical channel for RI reporting | | | PUSCH | |
| PUCCH Report Type for RI/ first PMI | | | 5 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 for each Rel-12 CSI subframe set | |
| CQI delay | | ms | 14 for CSI subframe set 0<br>12 for CSI subframe set 1 | |
| *cqi-pmi-ConfigurationIndex* | | | 8 for set 0<br>13 for set 1 | |
| *ri-ConfigIndex* | | | 805 for both set 0 and set 1 (Note 7) | |
| ACK/NACK feedback mode | | | Multiplexing | |

| | |
|---|---|
| Note 1: | Reference measurement channel RC.19 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD and dynamic OCNG Pattern with multiple non-contiguous blocks OP.7 TDD as described in Annex A.5.2.1/7 for CSI subframe set 0. |
| Note 2: | Reference measurement channel RC.20 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 for CSI subframe set 1. |
| Note 3: | In the test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level for each CSI subframe set separately. |
| Note 4: | As specified in Table 4.2-2 in TS 36.211. |
| Note 5: | UL/DL configuration in PDCCH with eIMTA-RNTI is cyclically selected from the given set on a per-DCI basis. |
| Note 6: | To avoid collisions between CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/PMI to multiplex with the HARQ-ACK on PUSCH in uplink SF#7 and #2. CQI/PMI reports for CSI subframe set 0 is transmitted in SF#2 and CQI/PMI reports for CSI subframe set 1 is transmitted in SF#7. |
| Note 7: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification. |

# 9.3 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)<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. | | | | | | |

**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 $\geq \gamma$;

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

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| SNR (Note 3) | | dB | 9 | 10 | 14 | 15 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -89 | -88 | -84 | -83 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, $a$ = 1, $f_D = 5$ Hz | | | |
| Antenna configuration | | | 1 x 2 | | | |
| Reporting interval | | ms | 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| Reporting mode | | | PUSCH 3-0 | | | |
| 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)**

<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 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>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">CQI delay</td><td>ms</td><td colspan="6">8</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>
</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 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)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 and 3 | Cell 1 | Cell 2 and 3 |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 1 | Note 10 | 1 | Note 10 |
| Uplink downlink configuration | | | 1 | | 1 | |
| Special subframe configuration | | | 4 | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | 0 | |
| | $\rho_B$ | dB | 0 | | 0 | |
| | 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, 5 | Cell 2: 12<br>Cell 3: 10 | 14, 15 | Cell 2: 12<br>Cell 3: 10 |
| $N_{oc}^{(j)}$ at antenna port | $N_{oc1}^{(j)}$ | dBm/15kHz | -98 (Note 7) | N/A | -98 (Note 7) | N/A |
| | $N_{oc2}^{(j)}$ | dBm/15kHz | -98 (Note 8) | N/A | -98 (Note 8) | N/A |
| | $N_{oc3}^{(j)}$ | dBm/15kHz | -93 (Note 9) | N/A | -93 (Note 9) | N/A |
| Subframe Configuration | | | Non-MBSFN | Non-MBSFN | Non-MBSFN | Non-MBSFN |
| Cell Id | | | 0 | Cell 2: 6<br>Cell 3: 1 | 0 | Cell 2: 6<br>Cell 3: 1 |
| Time Offset between Cells | | 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 | |
| CQI delay | | ms | 10 | | | |
| Reporting interval (Note 13) | | ms | 10 | | | |
| Reporting mode | | | PUSCH 3-0 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| ACK/NACK feedback mode | | | Multiplexing | | Multiplexing | |

| | |
|---|---|
| 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 |

### 9.3.1.1.5 TDD (when *csi-SubframeSet –r12* is configured)

The following requirements apply to UE Category ≥1 which supports Rel-12 CSI subframe sets. For the parameters specified in Table 9.3.1.1.5-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.1.5-2 and by the following

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

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 for each CSI subframe set;

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 and less than 0.60 for each CSI subframe set.

d) the difference of the wide-band median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ and the wide-band median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ shall be larger than or equal to 3.

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

**Table 9.3.1.1.5-1: Sub-band test for TDD**

| Parameter | | Unit | Test | |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 | |
| Transmission mode | | | 2 | |
| Uplink downlink configuration | | | 2 | |
| Special subframe configuration | | | 4 | |
| CSI-MeasSubframeSet-r12 | | | 0001100000 | |
| Downlink power allocation | $\rho_A$ | dB | -3 | |
| | $\rho_B$ | dB | -3 | |
| | σ | dB | 0 | |
| SNR in CSI subframe set 0 | | dB | 0 | 1 |
| SNR in CSI subframe set 1 | | dB | 10 | 11 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 |
| $N_{oc1}^{(j)}$ for CSI subframe set 0 | | dB[mW/15kHz] | -98 | -98 |
| $N_{oc2}^{(j)}$ for CSI subframe set 1 | | dB[mW/15kHz] | -108 | -108 |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | |
| Antenna configuration | | | 2x2 | |
| CRS reference signals | | | Antenna port 0 and 1 | |
| Zero-Power CSI-RS configuration 0 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0000010000000000 | |
| Zero-Power CSI-RS configuration 1 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 4 / 0100000000000000 | |
| PDSCH scheduled subframes for CSI subframe set 0 | | | 8,9 | |
| PDSCH scheduled subframes for CSI subframe set 1 | | | 3,4 | |
| Reporting interval (Note 4) | | ms | 10 per subframe set | |
| CQI delay | | ms | 15 for CSI subframe set 0<br>15 for CSI subframe set 1 | |
| Reporting mode | | | PUSCH 3-0 | |
| Sub-band size | | RB | 6 (full size) | |
| Max number of HARQ transmissions | | | 1 | |
| ACK/NACK feedback mode | | | Multiplexing | |
| Number of EPDCCH Sets Configured | | | 2 (Note 5,6) | |
| Number of PRB per EPDCCH Set | | | 4 | |
| EPDCCH Subframe Monitoring | | | NA | |
| EPDCCH Aggregation level | | | 8ECCE | |
| EPDCCH beamforming model | | | Annex B.4.4 | |

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

Note 2: Reference measurement channel RC.17 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.

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

Note 4: For CSI subframe set 0, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF #7. For CSI subframe set 1, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2.

Note 5: In case UE supports EPDCCH, the PDSCH scheduling grants are transmitted via EPDCCH, otherwise PDCCH is used.

Note 6: The two sets are distributed EPDCCH sets and non-overlapping with PRB = {0, 3, 6, 9} for the first set and PRB = {40, 43, 46, 49} for the second set. EPDCCH set is selected after scheduling decision for PDSCH to avoid collision between PDSCH and EPDCCH PRBs, respectively. EPDCCH is only transmitted from one set. The starting symbol for EPDCCH is derived from the PCFICH. RRC signalling epdcch-StartSymbol-r11is not configured

**Table 9.3.1.1.5-2: Minimum requirement (TDD)**

| | Test |
|---|---|
| $\alpha$ [%] | 2 |
| $\beta$ [%] | 55 |
| $\gamma$ | 1.1 |
| UE Category | ≥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 $\geq \gamma$;

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

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

**Table 9.3.1.2.1-1 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 |

### 9.3.1.2.3 FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

For the parameters specified in Table 9.3.1.2.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.3-2 and by the following

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

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

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

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

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.3.1.2.3-1 Sub-band test for FDD**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="2">10 MHz</td></tr>
<tr><td colspan="2">Transmission mode</td><td></td><td colspan="2">9</td></tr>
<tr><td rowspan="4">Downlink power allocation</td><td>$\rho_A$</td><td>dB</td><td colspan="2">0</td></tr>
<tr><td>$\rho_B$</td><td>dB</td><td colspan="2">0</td></tr>
<tr><td>$P_c$</td><td>dB</td><td colspan="2">0</td></tr>
<tr><td>σ</td><td>dB</td><td colspan="2">0</td></tr>
<tr><td colspan="2">SNR (Note 3)</td><td>dB</td><td>16</td><td>17</td></tr>
<tr><td colspan="2">$\hat{I}_{or}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-82</td><td>-81</td></tr>
<tr><td colspan="2">$N_{oc}^{(j)}$</td><td>dB[mW/15kHz]</td><td>-98</td><td>-98</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="2">Clause B.2.4 with $\tau_d = 0.45\,\mu$s, $a$ = 1, $f_D = 5$ Hz</td></tr>
<tr><td colspan="2">Antenna configuration</td><td></td><td colspan="2">2x2</td></tr>
<tr><td colspan="2">Beamforming Model</td><td></td><td colspan="2">As specified in Section B.4.3</td></tr>
<tr><td colspan="2">CRS reference signals</td><td></td><td colspan="2">Antenna ports 0</td></tr>
<tr><td colspan="2">CSI reference signals</td><td></td><td colspan="2">Antenna ports 15, 16</td></tr>
<tr><td colspan="2">CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$</td><td></td><td colspan="2">5/ 1</td></tr>
<tr><td colspan="2">CSI-RS reference signal configuration</td><td></td><td colspan="2">4</td></tr>
<tr><td colspan="2">CodeBookSubsetRestriction bitmap</td><td></td><td colspan="2">000001</td></tr>
<tr><td colspan="2">Reporting interval (Note 4)</td><td>ms</td><td colspan="2">5</td></tr>
<tr><td colspan="2">CQI delay</td><td>ms</td><td colspan="2">8</td></tr>
<tr><td colspan="2">Reporting mode</td><td></td><td colspan="2">PUSCH 3-1</td></tr>
<tr><td colspan="2">Sub-band size</td><td>RB</td><td colspan="2">6 (full size)</td></tr>
<tr><td colspan="2">Max number of HARQ transmissions</td><td></td><td colspan="2">1</td></tr>
<tr><td colspan="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.8A FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.<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: 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.</td></tr>
</table>

**Table 9.3.1.2.3-2 Minimum requirement (FDD)**

| | Test 1 |
|---|---|
| $\alpha$ [%] | 2 |
| $\beta$ [%] | 40 |
| $\gamma$ | 1.1 |
| UE Category | 11-12 |
| UE DL Category | $\geq$11 |

### 9.3.1.2.4 TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)

For the parameters specified in Table 9.3.1.2.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.4-2 and by the following

a) 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.

In this test, 4-bit CQI Table 2 in Table 7.2.3-2 in TS 36.213 [6], and Modulation and TBS index table 2 in Table 7.1.7.1-1A for PDSCH in TS 36.213 [6] are applied.

**Table 9.3.1.2.4-1 Sub-band test for TDD**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 20 MHz |
| Transmission mode | | | 9 |
| Uplink downlink configuration | | | 2 |
| Special subframe configuration | | | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 |
| | $\rho_B$ | dB | 0 |
| | $P_C$ | dB | 0 |
| | σ | dB | 0 |

| | | | |
|---|---|---|---|
| SNR (Note 3) | dB | 16 | 17 |
| $\hat{I}_{or}^{(j)}$ | dB[mW/15kHz] | -82 | -81 |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | -98 |
| Propagation channel | | Clause B.2.4 with $\tau_d = 0.45\,\mu$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 | 8 (full size) | |
| Max number of HARQ transmissions | | 1 | |
| ACK/NACK feedback mode | | Multiplexing | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.8A TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 and #8 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF#2 and #7.

**Table 9.3.1.2.4-2 Minimum requirement (TDD)**

| | **Test 1** |
|---|---|
| $\alpha$ [%] | 2 |
| $\beta$ [%] | 40 |
| $\gamma$ | 1.1 |
| UE Category | 11-12 |
| UE DL Category | $\geq$11 |

### 9.3.1.2.5 Void

### 9.3.1.2.6 TDD (when *csi-SubframeSet –r12* is configured with one CSI process)

The following requirements apply to UE Category ≥1 which supports Rel-12 CSI subframe sets and TM10. For the parameters specified in Table 9.3.1.2.6-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.1.2.6-2 and by the following

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

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 for each CSI subframe set;

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 0.01 for each CSI subframe set.

d) The difference of the wide-band median CQI obtained by reports in CSI subframe sets $C_{CSI,0}$ and the wide-band median CQI obtained by reports in CSI subframe sets $C_{CSI,1}$ shall be larger than or equal to 3.

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

**Table 9.3.1.2.6-1: Sub-band test for TDD**

| Parameter | | Unit | Test | |
|---|---|---|---|---|
| Bandwidth | | MHz | 10 | |
| Transmission mode | | | 10 | |
| Uplink downlink configuration | | | 2 | |
| Special subframe configuration | | | 4 | |
| CSI-MeasSubframeSet-r12 | | | 0001100000 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| | $P_c$ | dB | -3 | |
| | σ | dB | -3 | |
| SNR in CSI subframe set 0 | | dB | 0 | 1 |
| SNR in CSI subframe set 1 | | dB | 10 | 11 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 |
| $N_{oc1}^{(j)}$ for CSI subframe set 0 | | dB[mW/15kHz] | -98 | -98 |
| $N_{oc2}^{(j)}$ for CSI subframe set 1 | | dB[mW/15kHz] | -108 | -108 |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | |
| Antenna configuration | | | 2x2 | |
| Beamforming Model | | | As specified in Section B.4.3 | |
| CRS reference signals | | | Antenna port 0 and 1 | |
| CSI reference signals | | | Antenna port 15,16 | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 0 | |
| CSI-RS reference signal configuration | | | 0 | |
| Zero-Power CSI-RS configuration 0 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0000010000000000 | |
| Zero-Power CSI-RS configuration 1 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 4 / 0100000000000000 | |
| CSI-IM configuration 0 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0000010000000000 | |
| CSI-IM configuration 1 $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 4 / 0100000000000000 | |
| CSI process configuration Signal/Interference/Reporting mode for CSI subframe set 0 | | | CSI-RS/CSI-IM 0/PUSCH 3-1 | |
| CSI process configuration Signal/Interference/Reporting mode for CSI subframe set 1 | | | CSI-RS/CSI-IM 1/PUSCH 3-1 | |
| CodeBookSubsetRestriction bitmap | | | 000001 | |
| Reporting interval (Note 4) | | ms | 10 per subframe set | |
| CQI delay | | ms | 15 for CSI subframe set 0<br>15 for CSI subframe set 1 | |
| Sub-band size | | RB | 6 (full size) | |
| PDSCH scheduled subframes for CSI subframe set 0 | | | 8,9 | |
| PDSCH scheduled subframes for CSI subframe set 1 | | | 3,4 | |
| Max number of HARQ transmissions | | | 1 | |
| ACK/NACK feedback mode | | | Multiplexing | |

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.18 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.

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

Note 4: For CSI subframe set 0, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#3 to allow aperiodic CQI/PMI/RI to be transmitted on uplink SF #7. For CSI subframe set 1, PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#8 to allow aperiodic CQI/PMI/RI to be transmitted

| |
|---|
| on uplink SF#2. |

**Table 9.3.1.2.6-2: Minimum requirement (TDD)**

| | Test |
|---|---|
| $\alpha$ [%] | 2 |
| $\beta$ [%] | 55 |
| $\gamma$ | 1.02 |
| UE Category | ≥1 |

## 9.3.2 Frequency non-selective scheduling mode

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

### 9.3.2.1 Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)

#### 9.3.2.1.1 FDD

For the parameters specified in Table 9.3.2.1.1-1 and Table 9.3.2.1.1-3, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.2.1.1-2 and Table 9.3.2.1.1-4 and by the following

a) 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

The applicability of the requirement with 5MHz bandwidth as specificed in Table 9.3.2.1.1-3 and Table 9.3.2.1.1-4 is defined in 9.1.1.1.

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 6 | 7 | 12 | 13 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -92 | -91 | -86 | -85 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA5 | | | |
| Correlation and antenna configuration | | | High (1 x 2) | | | |
| Reporting mode | | | PUCCH 1-0 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 2 | | | |
| CQI delay | | ms | 8 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type | | | 4 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |

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

Note 2: Reference measurement channel RC.1 FDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.4 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.

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

Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.

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

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

**Table 9.3.2.1.1-3 Fading test for single antenna (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 5 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 6 | 7 | 12 | 13 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -92 | -91 | -86 | -85 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA5 | | | |
| Correlation and antenna configuration | | | High (1 x 2) | | | |
| Reporting mode | | | PUCCH 1-0 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 2 | | | |
| CQI delay | | ms | 8 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type | | | 4 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 2: Reference measurement channel RC.14 FDD according to Table A.4-1 for Category ≥ 2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and RC.15 FDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.<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. | | | | | | |

**Table 9.3.2.1.1-4 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)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| SNR (Note 3) | | dB | 6 | 7 | 12 | 13 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -92 | -91 | -86 | -85 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA5 | | | |
| Correlation and antenna configuration | | | High (1 x 2) | | | |
| Reporting mode | | | PUCCH 1-0 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type | | | 4 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

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

Note 2: Reference measurement channel RC.1 TDD according to Table A.4-1 for Category 2-8 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1 and RC.4 TDD according to Table A.4-1 for Category 1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.

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

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

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

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

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

**Table 9.3.2.2.1-1 Fading test for FDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 9 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | -3 | | | |
| | 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**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 9 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | $P_c$ | dB | -6 | | | |
| | σ | dB | -3 | | | |
| SNR (Note 3) | | dB | 1 | 2 | 7 | 8 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -97 | -96 | -91 | -90 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | EPA5 | | | |
| Correlation and antenna configuration | | | XP High (8 x 2) | | | |
| Beamforming Model | | | As specified in Section B.4.3 | | | |
| CRS reference signals | | | Antenna ports 0, 1 | | | |
| CSI reference signals | | | Antenna ports 15,…,22 | | | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 3 | | | |
| CSI-RS reference signal configuration | | | 2 | | | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 0020 0000 0000 0001 | | | |
| Reporting mode | | | PUCCH 1-1 (Sub-mode: 2) | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| CQI delay | | ms | 10 | | | |
| Physical channel for CQI/ PMI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type for CQI/ PMI | | | 2c | | | |
| Physical channel for RI reporting | | | PUCCH Format 2 | | | |
| PUCCH report type for RI | | | 3 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| *ri-ConfigIndex* | | | 805 (Note 5) | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

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

Note 2: Reference measurement channel RC.7 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

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

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

Note 5: RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available.

**Table 9.3.2.2.2-2 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 $N_{\text{PRB}}$ entry in Table 7.1.7.2.1-1 of TS 36.213 [6] that corresponds to the subband size.

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 9 | 10 | 14 | 15 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -89 | -88 | -84 | -83 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | | | |
| Reporting interval | | ms | 5 | | | |
| CQI delay | | ms | 8 | | | |
| Reporting mode | | | PUSCH 2-0 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size (*k*) | | RBs | 3 (full size) | | | |
| Number of preferred subbands (*M*) | | | 5 | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<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 ≥ γ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{\mathrm{PRB}}$ 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)
Note 2: Reference measurement channel RC.5 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.

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

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma$ | 1.2 | 1.2 |
| UE Category | ≥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 ≥ γ;

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

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

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 8 | 9 | 13 | 14 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -90 | -89 | -85 | -84 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | | | |
| Reporting periodicity | | ms | $N_P$ = 2 | | | |
| CQI delay | | ms | 8 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 4) | | | |
| PUCCH Report Type for wideband CQI | | | 4 | | | |
| PUCCH Report Type for subband CQI | | | 1 | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| Subband size (*k*) | | RBs | 6 (full size) | | | |
| Number of bandwidth parts (*J*) | | | 3 | | | |
| K | | | 1 | | | |
| *cqi-pmi-ConfigIndex* | | | 1 | | | |

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

Note 2: Reference measurement channel RC.3 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.

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

Note 4: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1, #3, #7 and #9 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#5, #7, #1 and #3.

Note 5: CQI reports for the short subband (having 2RBs in the last bandwidth part) are to be disregarded and data scheduling according to the most recent subband CQI report for bandwidth part with j=1.

Note 6: In the case where wideband CQI is reported, data is to be scheduled according to the most recently used subband CQI report.

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

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma$ | 1.15 | 1.15 |
| UE Category | ≥1 | ≥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 ≥ γ;

The requirements only apply for subbands of full size and the random scheduling across the subbands is done by selecting a new subband in each available downlink transmission instance for TDD. The transport block size TBS (wideband CQI median) is that resulting from the code rate which is closest to that indicated by the wideband CQI median and the $N_{\mathrm{PRB}}$ 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 | R.2 FDD |
| Reporting mode | | PUCCH 1-0 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 2 | N/A |
| CQI delay | ms | 8 | N/A |
| Physical channel for CQI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type | | 4 | N/A |
| *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.

**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 | R.2A TDD |
| Reporting mode | | PUCCH 1-0 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 5 | N/A |
| CQI delay | ms | 10 or 11 | N/A |
| Physical channel for CQI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type | | 4 | N/A |
| *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.

**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 two antennas (FDD)**

| Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|
| Bandwidth | MHz | 10 MHz | |
| Transmission mode | | 9 | |
| Cyclic Prefix | | Normal | Normal |
| Cell ID | | 0 | 1 |
| SINR (Note 8) | dB | -2 | N/A |
| $N_{oc}^{(j)}$ | dB[mW/15kHz] | -98 | N/A |
| Propagation channel | | EPA5 | Static (Note 7) |
| Correlation and antenna configuration | | Low (2 x 2) | (1 x 2) |
| Beamforming Model | | As specified in Section B.4.3 (Note 10, 11) | N/A |
| DIP (Note 4) | dB | N/A | -0.41 |
| Cell-specific reference signals | | Antenna ports 0,1 | Antenna port 0 |
| CSI reference signals | | Antenna ports 15,16 | N/A |
| CSI-RS periodicity and subframe offset | | 5/1 | N/A |
| CSI-RS reference signal configuration | | 2 | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | Subframes / bitmap | N/A | 1 / 0010000000000000 |
| CodeBookSubsetRestriction bitmap | | 001111 | N/A |
| Reference measurement channel | | Note 2 | R.2 FDD |
| Reporting mode | | PUCCH 1-1 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 5 | N/A |
| CQI delay | ms | 8 | N/A |
| Physical channel for CQI/PMI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type for CQI/PMI | | 2 | N/A |
| PUCCH channel for RI reporting | | PUCCH Format 2 | N/A |
| PUCCH Report Type for RI | | 3 | N/A |
| *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.<br>Note 7: Static channel is used for the interference model. In case for white Gaussian noise model Cell 2 is not present.<br>Note 8: SINR corresponds to $\widehat{E}_s/N_{oc}'$ of Cell 1 as defined in clause 8.1.1.<br>Note 9: N/A<br>Note 10: The precoder in clause B.4.3 follows UE recommended PMI.<br>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 ≥ $\gamma$;

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 | R.2A TDD |
| Reporting mode | | PUCCH 1-1 | N/A |
| Reporting periodicity | ms | $N_{pd}$ = 5 | N/A |
| CQI delay | ms | 10 | N/A |
| Physical channel for CQI/PMI reporting | | PUSCH (Note 3) | N/A |
| PUCCH Report Type for CQI/PMI | | 2 | N/A |
| Physical channel for RI reporting | | PUCCH Format 2 | N/A |
| PUCCH Report Type for RI | | 3 | N/A |
| *cqi-pmi-ConfigurationIndex* | | 3 | N/A |
| *ri-ConfigIndex* | | 805 (Note 9) | N/A |
| Max number of HARQ transmissions | | 1 | N/A |
| ACK/NACK feedback mode | | Multiplexing | N/A |

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

Note 2: Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

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

| | |
|---|---|
| | uplink subframe SF#2 and #7. |
| Note 4: | The respective received power spectral density of each interfering cell relative to $N_{oc}'$ is defined by its associated DIP value as specified in clause B.5.1. |
| Note 5: | Two cells are considered in which Cell 1 is the serving cell and Cell 2 is the interfering cell. 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: | N/A. |
| Note 11: | The precoder in clause B.4.3 follows UE recommended PMI. |
| Note 12: | If the UE reports in an available uplink reporting instance at 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 4 and 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 | | |

# 9.3.7 Minimum requirement PUSCH 3-2

## 9.3.7.1 FDD

For the parameters specified in Table 9.3.7.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.7.1-2 and by the following.

a) the ratio of the throughput obtained when transmitting based on UE PUSCH 3-2 reported wideband CQI and subband PMI and that obtained when transmitting based on PUSCH 3-1 reported wideband CQI and wideband PMI shall be $\geq\alpha$;

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 based on UE PUSCH3-2 reported subband CQI and subband PMI and that obtained when transmitting on a randomly selected sub-band in set S based on PUSCH 1-2 reported wideband CQI and subband PMI shall be $\geq\beta$;

The transport block sizes TBS for wideband CQI and subband CQI are selected according to RC.17 FDD for test 1 and according to RC.18 FDD for test 2.

**Table 9.3.7.1-1 Sub-band test for FDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10MHz | | | |
| PDSCH resource allocation | | RB | 50PRB | | a subband, 6PRB | |
| Transmission mode | | | TM6 | | TM9 | |
| Downlink power allocation | $\rho_A$ | dB | -6 | | 0 | |
| | $\rho_B$ | dB | -6 | | 0 | |
| | $P_c$ | dB | - | | -3 | |
| | σ | dB | 3 | | -3 | |
| SNR (Note 3) | | dB | 0 | 1 | 5 | 6 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -93 | -92 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 | -98 |
| Propagation channel | | | EVA5 | | EVA5 | |
| Antenna configuration | | | 4x2 ULA low | | 4x2 XP high (Note 4) | |
| Beamforming Model | | | - | | B.4.3 | |
| CRS reference signals | | | Antenna ports 0, 1, 2, 3 | | Antenna ports 0, 1 | |
| Time offset between TX antenna (Note 5) | | ns | 65 | | - | |
| CSI reference signals | | | | | Antenna ports 15, 16, 17, 18 | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | - | | 5/ 1 | |
| CSI-RS reference signal configuration | | | - | | 4 | |
| alternativeCodebookEnabledFor4TX | | | No | | Yes | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF | | 0x0000 0000 0000 FFFF 0000 FFFF | |
| Reporting interval (Note 6) | | ms | 5 | | 5 | |
| CQI delay | | ms | 8 | | 8 | |
| Reporting mode | | | PUSCH 3-2, PUSCH 3-1 | | PUSCH 3-2, PUSCH 1-2 | |
| Sub-band size | | RB | 6 (full size) | | 6 (full size) | |
| Max number of HARQ transmissions | | | 1 | | 1 | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.17 FDD / RC.18 FDD for Test 1 / 2 according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 FDD as described in Annex A.5.1.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3A.4.
Note 5: The values of time offset are [0ns 65ns 0ns 65ns] for antenna port [0, 1, 2, 3] respectively.
Note 6: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#1 and #6 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#0 and #5.

**Table 9.3.7.1-2 Minimum requirement (FDD)**

| | Test 1 | Test 2 |
|---|---|---|
| α | 1.05 | - |
| β | - | 1.15 |
| UE Category | ≥2 | ≥2 |

## 9.3.7.2 TDD

For the parameters specified in Table 9.3.7.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.3.7.2-2 and by the following.

a) the ratio of the throughput obtained when transmitting based on UE PUSCH 3-2 reported wideband CQI and subband PMI and that obtained when transmitting based on PUSCH 3-1 reported wideband CQI and wideband PMI shall be $\geq \alpha$;

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 based on UE PUSCH3-2 reported subband CQI and subband PMI and that obtained when transmitting on a randomly selected sub-band in set S based on PUSCH 1-2 reported wideband CQI and subband PMI shall be $\geq\beta$;

The transport block sizes TBS for wideband CQI and subband CQI are selected according to RC.17 TDD for test 1 and RC.18 TDD for test 2.

**Table 9.3.7.2-1 Sub-band test for TDD**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10MHz | | | |
| PDSCH resource allocation | | RB | 50PRB | | a subband, 6PRB | |
| Transmission mode | | | TM6 | | TM9 | |
| Uplink downlink configuration | | | 1 | | 1 | |
| Special subframe configuration | | | 4 | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | -6 | | 0 | |
| | $\rho_B$ | dB | -6 | | 0 | |
| | $P_c$ | dB | - | | -3 | |
| | σ | dB | 3 | | -3 | |
| SNR (Note 3) | | dB | 0 | 1 | 5 | 6 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -93 | -92 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 | -98 |
| Propagation channel | | | EVA5 | | EVA5 | |
| Antenna configuration | | | 4x2 ULA low | | 4x2 XP high (Note 4) | |
| Beamforming Model | | | - | | B.4.3 | |
| CRS reference signals | | | Antenna ports 0, 1, 2, 3 | | Antenna ports 0, 1 | |
| Time offset between TX antenna (Note 5) | | ns | 65 | | - | |
| CSI reference signals | | | | | Antenna ports 15, 16, 17, 18 | |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | - | | 5/ 4 | |
| CSI-RS reference signal configuration | | | - | | 4 | |
| alternativeCodebookEnabledFor4TX | | | No | | Yes | |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF | | 0x0000 0000 0000 FFFF 0000 FFFF | |
| Reporting interval (Note 6) | | ms | 5 | | 5 | |
| CQI delay | | ms | 8 | | 8 | |
| Reporting mode | | | PUSCH 3-2, PUSCH 3-1 | | PUSCH 3-2, PUSCH 1-2 | |
| Sub-band size | | RB | 6 (full size) | | 6 (full size) | |
| Max number of HARQ transmissions | | | 1 | | 1 | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.17 TDD / RC.18 TDD for Test 1 / 2 according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.
Note 3: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 4: Randomization of the principle beam direction shall be used as specified in B.2.3A.4.
Note 5: The values of time offset are [0ns 65ns 0ns 65ns] for antenna port [0, 1, 2, 3] respectively.
Note 6: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic CQI/PMI/RI to be transmitted in uplink SF#3 and #8.

**Table 9.3.7.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| α | 1.05 | - |
| β | - | 1.15 |
| UE Category | ≥2 | ≥2 |

### 9.3.8 Additional requirements for enhanced receiver Type B

The purpose of the test is to verify that the reporting of the channel quality based on the receiver of the enhanced Type B meets a minimum performance. Performance requirements are specified in terms of the relative throughput obtained when the transport format is that indicated by the reported CQI with NeighCellsInfo-r12 configured compared to the case without NeighCellsInfo-r12 configured. Cell 1 is the serving cell, and Cell 2 and Cell 3 are the interference cells.

#### 9.3.8.1 Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols)

##### 9.3.8.1.1 FDD

For the parameters specified in Table 9.3.8.1.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.1.1-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be $\geq \gamma$;

**Table 9.3.8.1.1-1 Fading test for FDD**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 4 | | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | |
| | $\rho_B$ | dB | -3 | | |
| | σ | dB | 0 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\hat{E}_s/N_{oc}$ | | | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB [mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| Interference model | | | N/A | As specified in clause B.6.3 | As specified in clause B.6.3 |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | N/A |
| Physical channel for CQI/PMI reporting | | | PUCCH Format 2 | N/A | N/A |
| PUCCH Report Type for CQI/PMI | | | 2 | N/A | N/A |
| PUCCH Report Type for RI | | | 3 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex* | | | 6 | N/A | N/A |
| *ri-ConfigurationIndex* | | | 1 | N/A | N/A |
| *CodeBookSubsetRestriction bitmap* | | | 000001 | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| NeighCellsInfo-r12 (Note 4) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList -r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<br>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.<br>Note 3: All cells are time-synchronous.<br>Note 4: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 9.3.8.1.1-2 Minimum requirement (FDD)**

| | Test |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

### 9.3.8.1.2 TDD

For the parameters specified in Table 9.3.8.1.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.8.1.2-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be $\geq \gamma$;

**Table 9.3.8.1.2-1 Fading test for TDD**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 4 | | |
| Uplink downlink configuration | | | 2 | | |
| Special subframe configuration | | | 4 | | |
| Downlink power allocation | $\rho_A$ | dB | -3 | | |
| | $\rho_B$ | dB | -3 | | |
| | σ | dB | 0 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\hat{E}_s/N_{oc}$ | | | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB [mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| Interference model | | | N/A | As specified in clause B.6.3 | As specified in clause B.6.3 |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | N/A |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | N/A | N/A |
| PUCCH Report Type | | | 2 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex* | | | 3 | N/A | N/A |
| *ri-ConfigIndex* | | | 805 (Note 5) | N/A | N/A |
| *CodeBookSubsetRestriction bitmap* | | | 000001 | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| NeighCellsInfo-r12 (Note 6) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| Note 1: 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.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: 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.<br>Note 4: All cells are time-synchronous.<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.<br>Note 6: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. | | | | | |

**Table 9.3.8.1.2-2 Minimum requirement (TDD)**

| | Test |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

### 9.3.8.2 Minimum requirement PUCCH 1-1 (CSI Reference Symbols)

#### 9.3.8.2.1 FDD

For the parameters specified in Table 9.3.8.2.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.2.1-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be $\geq \gamma$;

**Table 9.3.8.2.1-1 Fading test for FDD**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 9 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\widehat{E}_s/N_{oc}$ | | | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB [mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset | | | 5/1 | N/A | N/A |
| CSI-RS reference signal configuration | | | 2 | N/A | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | N/A | 1 / 0001000000000000 | 1 / 0001000000000000 |
| CodeBookSubsetRestriction bitmap | | | 000001 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | N/A |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | N/A | N/A |
| PUCCH Report Type for CQI/PMI | | | 2 | N/A | N/A |
| PUCCH channel for RI reporting | | | PUCCH Format 2 | N/A | N/A |
| PUCCH Report Type for RI | | | 3 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex* | | | 2 | N/A | N/A |
| *ri-ConfigIndex* | | | 1 | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| NeighCellsInfo-r12 (Note 5) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmission ModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.11 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: All cells are time-synchronous.
Note 5: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 9.3.8.2.1-2 Minimum requirement (FDD)**

| | Test |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

#### 9.3.8.2.2 TDD

For the parameters specified in Table 9.3.8.2.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in 9.3.8.2.2-2 and by the following

a) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with NeighCellsInfo-r12 configured and that obtained when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources without NeighCellsInfo-r12 configured shall be $\geq \gamma$;

**Table 9.3.8.2.2-1 Fading test for TDD**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 9 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Uplink downlink configuration | | | 2 | | |
| Special subframe configuration | | | 4 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\hat{E}_s/N_{oc}$ | | | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB [mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna ports 0,1 | Antenna ports 0,1 |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset | | | 5/3 | N/A | N/A |
| CSI-RS reference signal configuration | | | 2 | N/A | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | N/A | 3 / 0001000000000000 | 3 / 0001000000000000 |
| CodeBookSubsetRestriction bitmap | | | 000001 | N/A | N/A |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | N/A | N/A |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) | N/A | N/A |
| PUCCH Report Type for CQI/PMI | | | 2 | N/A | N/A |
| Physical channel for RI reporting | | | PUCCH Format 2 | N/A | N/A |
| PUCCH Report Type for RI | | | 3 | N/A | N/A |
| *cqi-pmi-ConfigurationIndex* | | | 3 | N/A | N/A |
| *ri-ConfigIndex* | | | 805 (Note 5) | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| NeighCellsInfo -r12 (Note 6) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmission ModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |

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

Note 2: Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1.

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

Note 4: All cells are time-synchronous.

| | |
|---|---|
| Note 5: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 6: | NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. |

**Table 9.3.8.2.2-2 Minimum requirement (TDD)**

| | **Test** |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

## 9.3.8.3 Minimum requirement with CSI process

### 9.3.8.3.1 FDD

For the parameters specified in Table 9.3.8.3.1-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.3.1-2 and by the following

a) the ratio of the throughput obtained for the Type B receiver with NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with specified $\hat{E}_s/N_{oc}$ and that obtained for the Type B receiver without NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with the same specified $\hat{E}_s/N_{oc}$ shall be $\geq \gamma$;

**Table 9.3.8.3.1-1 Fading test for single antenna (FDD)**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 10 | 9 | 9 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB[mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna port 0, 1 | Antenna port 0, 1 |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset | | | 5/1 | N/A | N/A |
| CSI-RS reference signal configuration | | | 2 | N/A | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | N/A | 1 / 0001000000000000 | 1 / 0001000000000000 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI process | CSI-RS | | CSI-RS | N/A | N/A |
| | CSI-IM | | CSI-IM | N/A | N/A |
| | Reporting mode | | PUCCH 1-1 | N/A | N/A |
| | CodeBookSubsetRestriction bitmap | | 000001 | N/A | N/A |
| | Reporting periodicity | ms | $N_{pd}$ = 5 | N/A | N/A |
| | CQI delay | ms | 8 | N/A | N/A |
| | Physical channel for CQI/ PMI reporting | | PUSCH (Note 3) | N/A | N/A |
| | PUCCH Report Type for CQI/PMI | | 2 | N/A | N/A |
| | PUCCH channel for RI reporting | | PUCCH Format 2 | N/A | N/A |
| | PUCCH report type for RI | | 3 | N/A | N/A |
| | *cqi-pmi-ConfigurationIndex* | | 2 | N/A | N/A |
| | *ri-ConfigIndex* | | 1 | N/A | N/A |
| CSI-IM periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | N/A | N/A |
| CSI-IM configuration | | | 6 | N/A | N/A |
| CSI process for PDSCH scheduling | | | CSI process | N/A | N/A |
| Quasi-co-located CSI-RS | | | CSI-RS | N/A | N/A |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | N/A | N/A |
| Reference measurement channel | | | Note 2 | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| NeighCellsInfo-r12 (Note 5) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| 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 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: All cells are time-synchronous.
Note 5: NeighCellsInfo-r12 is described in subclause 6.3.2 of [7].

**Table 9.3.8.3.1-2 Minimum requirement (FDD)**

| | **Test** |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

### 9.3.8.3.2 TDD

For the parameters specified in Table 9.3.8.3.2-1, and using the downlink physical channels specified in Annex C, the minimum requirements are specified in Table 9.3.8.3.2-2 and by the following

a) the ratio of the throughput obtained obtained for the Type B receiver with NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with specified $\hat{E}_s/N_{oc}$ and that obtained for the Type B receiver without NAICS assistance information when transmitting the transport format indicated by each reported wideband CQI index subject to interference sources with the same specified $\hat{E}_s/N_{oc}$ shall be $\geq \gamma$;

**Table 9.3.8.3.2-1 Fading test for single antenna (TDD)**

| Parameter | | Unit | Cell 1 | Cell 2 | Cell 3 |
|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | |
| Transmission mode | | | 10 | 9 | 9 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| | Pc | dB | 0 | | |
| | σ | dB | 0 | | |
| Uplink downlink configuration | | | 2 | | |
| Special subframe configuration | | | 4 | | |
| Cyclic Prefix | | | Normal | Normal | Normal |
| Cell ID | | | 0 | 1 | 6 |
| SNR | | dB | 8.34 | N/A | N/A |
| $\hat{E}_s/N_{oc}$ | | dB | N/A | 3.28 | 0.74 |
| $\hat{I}_{or}^{(j)}$ | | dB [mW/15kHz] | -89.66 | -94.72 | -97.26 |
| $N_{oc}$ | | dB[mW/15kHz] | -98 | | |
| Propagation channel | | | EPA5 | EPA5 | EPA5 |
| Correlation and antenna configuration | | | Low 2 x 2 | Low 2 x 2 | Low 2 x 2 |
| Cell-specific reference signals | | | Antenna ports 0,1 | Antenna port 0,1 | Antenna port 0,1 |
| Beamforming Model | | | As specified in Section B.4.3 | | |
| CSI reference signals | | | Antenna ports 15,16 | N/A | N/A |
| CSI-RS periodicity and subframe offset | | | 5/3 | N/A | N/A |
| CSI-RS reference signal configuration | | | 2 | N/A | N/A |
| Zero-power CSI-RS configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | Subframes / bitmap | N/A | 3 / 0001000000000000 | 3 / 0001000000000000 |
| Interference model | | | N/A | As specified in clause B.6.4 | As specified in clause B.6.4 |
| CSI process | CSI-RS | | CSI-RS | N/A | N/A |
| | CSI-IM | | CSI-IM | N/A | N/A |
| | Reporting mode | | PUCCH 1-1 | N/A | N/A |
| | CodeBookSubsetRestriction bitmap | | 000001 | N/A | N/A |
| | Reporting periodicity | ms | $N_{pd}$ = 5 | N/A | N/A |
| | CQI delay | ms | 8 | N/A | N/A |
| | Physical channel for CQI/ PMI reporting | | PUSCH (Note 3) | N/A | N/A |
| | PUCCH Report Type for CQI/PMI | | 2 | N/A | N/A |
| | PUCCH channel for RI reporting | | PUCCH Format 2 | N/A | N/A |
| | PUCCH report type for RI | | 3 | N/A | N/A |
| | *cqi-pmi-ConfigurationIndex* | | 3 | N/A | N/A |
| | *ri-ConfigIndex* | | 805 (Note 5) | N/A | N/A |
| CSI-IM periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/1 | N/A | N/A |
| CSI-IM configuration | | | 6 | N/A | N/A |
| CSI process for PDSCH scheduling | | | CSI process | N/A | N/A |
| Quasi-co-located CSI-RS | | | CSI-RS | N/A | N/A |
| Quasi-co-located CRS | | | Same Cell ID as Cell 1 | N/A | N/A |
| Reference measurement channel | | | Note 2 | N/A | N/A |
| Max number of HARQ transmissions | | | 1 | N/A | N/A |
| ACK/NACK feedback mode | | | Multiplexing | N/A | N/A |
| NeighCellsInfo-r12 (Note 6) | p-aList-r12 | | N/A | {dB-6, dB-3, dB0} | {dB-6, dB-3, dB0} |
| | transmissionModeList-r12 | | N/A | {2,3,4,8,9} | {2,3,4,8,9} |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a | | | | | |

| | |
|---|---|
| | downlink SF not later than SF#(n-4), this reported wideband CQI cannot be applied at the eNB downlink before SF#(n+4) |
| Note 2: | Reference measurement channel RC.11 TDD according to Table A.4-1 with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. |
| Note 3: | To avoid collisions between CQI/ PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#1 and #6 to allow periodic CQI/ PMI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#0 and #5. |
| Note 4: | All cells are time-synchronous. |
| Note 5: | RI reporting interval is set to the maximum allowable length of 160ms to minimise collisions between RI, CQI/PMI and HARQ-ACK reports. In the case when all three reports collide, it is expected that CQI/PMI reports will be dropped, while RI and HARQ-ACK will be multiplexed. At eNB, CQI report collection shall be skipped every 160ms during performance verification and the reported CQI in subframe SF#7 of the previous frame is applied in downlink subframes until a new CQI (after CQI/PMI dropping) is available. |
| Note 6: | NeighCellsInfo-r12 is described in subclause 6.3.2 of [7]. |

**Table 9.3.8.3.2-2 Minimum requirement (TDD)**

| | Test |
|---|---|
| $\gamma$ | 0.925 |
| UE Category | ≥2 |

## 9.4 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 6 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 and transmission mode 9 with 4TX enhanced codebook 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, PUCCH 1-1 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 |

### 9.4.1.4 Minimum requirement PUCCH 1-1 (CSI Reference Symbol)

#### 9.4.1.4.1 FDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.1.4.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.1-2.

**Table 9.4.1.4.1-1 PMI test for single-layer (FDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Propagation channel | | | EPA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | High XP 4 x 2 |
| Beamforming model | | | Annex B.4.3 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 1 |
| CSI-RS reference signal configuration | | | 6 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF 0000 00FF |
| 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 | | | PUCCH 1-1 submode1 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 10 |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) |
| PUCCH Report Type for CQI/second PMI | | | 2b |
| Physical channel for RI reporting | | | PUSCH |
| PUCCH Report Type for RI/ first PMI | | | 5 |
| *cqi-pmi-ConfigurationIndex* | | | 4 |
| *ri-ConfigIndex* | | | 1 |
| Measurement channel | | | R.60 FDD |
| OCNG Pattern | | | OP.1 FDD |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| alternativeCodeBookEnabledFor4TX-r12 | | | True |

Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)
Note 2: If the UE reports in an available uplink reporting instance at 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 CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.
Note 4: PDSCH _RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.
Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4

**Table 9.4.1.4.1-2 Minimum requirement (FDD)**

| Parameter | Test 1 |
| --- | --- |
| $\gamma$ | 1.8 |
| UE Category | ≥1 |

### 9.4.1.4.2 TDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.1.4.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.4.1.4.2-2.

**Table 9.4.1.4.2-1 PMI test for single-layer (TDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EPA5 |
| Precoding granularity | | PRB | 50 |
| Correlation and antenna configuration | | | High XP 4 x 2 |
| Beamforming model | | | Annex B.4.3 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/ 4 |
| CSI-RS reference signal configuration | | | 6 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 0000 FFFF 0000 00FF |
| 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 | | | PUCCH 1-1 submode1 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 15 |
| Physical channel for CQI/PMI reporting | | | PUSCH (Note 3) |
| PUCCH Report Type for CQI/second PMI | | | 2b |
| Physical channel for RI reporting | | | PUSCH |
| PUCCH Report Type for RI/ first PMI | | | 5 |
| *cqi-pmi-ConfigurationIndex* | | | 4 |
| *ri-ConfigIndex* | | | 1 |
| Measurement channel | | | R.60 TDD |
| OCNG Pattern | | | OP.1 TDD |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| alternativeCodeBookEnabledFor4TX-r12 | | | True |

Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)
Note 2: If the UE reports in an available uplink reporting instance at 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 CQI/PMI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH.
Note 4: PDCCH DCI format 0 with a trigger for aperiodic CQI shall be transmitted in downlink SF#4 and #9 to allow aperiodic

| | |
|---|---|
| Note 5: | CQI/PMI/RI to be transmitted on uplink SF#3 and #8.<br>Randomization of the principle beam direction shall be used as specified in B.2.3A.4. |

**Table 9.4.1.4.2-2 Minimum requirement (TDD)**

| Parameter | Test 1 |
|---|---|
| $\gamma$ | 1.8 |
| 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 |
| | $\sigma$ | dB | -3 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 |
| Reporting mode | | | PUSCH 1-2 |
| Reporting interval | | ms | 5 (Note 4) |
| PMI delay | | ms | 10 |
| Measurement channel | | | R.45-1 TDD for UE Category 1, R.45 TDD for UE Category ≥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).
Note 2: If the UE reports in an available uplink reporting instance at subrame SF#n based on PMI estimation at a downlink SF not later than SF#(n-4), this reported PMI cannot be applied at the eNB downlink before SF#(n+4).
Note 3: One/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2 shall be

| | |
|---|---|
| | used. |
| 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 |

### 9.4.2.3.3 FDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.2.3.3-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.3-2.

**Table 9.4.2.3.3-1 PMI test for dual-layer (FDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Propagation channel | | | EVA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Correlation and antenna configuration | | | High XP 4 x 2 |
| Beamforming model | | | Annex B.4.3 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| CSI-RS periodicity and subframe offset $T_{CSI-RS}$ / $I_{CSI-RS}$ | | | 5/ 1 |
| CSI-RS reference signal configuration | | | 8 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 FFFF 0000 FFFF 0000 |
| 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 | | | PUSCH1-2 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 8 |
| Measurement channel | | | R.45-1 FDD for UE Category 1, R.45 FDD for UE Category ≥2 |
| Rank Number of PDSCH | | | 2 |
| OCNG Pattern | | | OP.7 FDD for UE Category 1<br>OP.1 FDD for UE Category ≥2 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| alternativeCodeBookEnabledFor4TX-r12 | | | True |

Note 1: For random precoder selection, the precoder shall be updated in each TTI (1 ms granularity)
Note 2: If the UE reports in an available uplink reporting instance at 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: Void.
Note 4: PDSCH _RA= 0 dB, PDSCH_RB= 0 dB in order to have the same PDSCH and OCNG power per subcarrier at the receiver.
Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4

**Table 9.4.2.3.3-2 Minimum requirement (FDD)**

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

#### 9.4.2.3.4 TDD (with 4Tx enhanced codebook)

For the parameters specified in Table 9.4.2.3.4-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in 9.4.2.3.4-2.

**Table 9.4.2.3.4-1 PMI test for dual-layer (TDD)**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Bandwidth | | MHz | 10 |
| Transmission mode | | | 9 |
| Uplink downlink configuration | | | 1 |
| Special subframe configuration | | | 4 |
| Propagation channel | | | EVA5 |
| Precoding granularity (only for reporting and following PMI) | | PRB | 6 |
| Correlation and antenna configuration | | | XP High 4 x 2 |
| Beamforming model | | | Annex B.4.3 |
| Cell-specific reference signals | | | Antenna ports 0,1 |
| CSI reference signals | | | Antenna ports 15,…,18 |
| CSI-RS periodicity and subframe offset **$T_{CSI-RS}$ / $I_{CSI-RS}$** | | | 5/ 4 |
| CSI-RS reference signal configuration | | | 4 |
| CodeBookSubsetRestriction bitmap | | | 0x0000 0000 FFFF 0000 FFFF 0000 |
| 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 | | | PUSCH1-2 |
| Reporting interval | | ms | 5 |
| PMI delay (Note 2) | | ms | 10 |
| Measurement channel | | | R.61-1 TDD for UE Category 1, R.61 TDD for UE Category ≥2 |
| Rank Number of PDSCH | | | 2 |
| OCNG Pattern | | | OP.7 FDD for UE Category 1<br>OP.1 FDD for UE Category ≥2 |
| Max number of HARQ transmissions | | | 4 |
| Redundancy version coding sequence | | | {0,1,2,3} |
| ACK/NACK feedback mode | | | Multiplexing |
| alternativeCodeBookEnabledFor4TX-r12 | | | True |
| 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>Note3: 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.<br>Note 5: Randomization of the principle beam direction shall be used as specified in B.2.3A.4. | | | |

**Table 9.4.2.3.4-2 Minimum requirement (TDD)**

| Parameter | Test 1 |
|---|---|
| $\gamma$ | 1.2 |
| UE Category | ≥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 and 9.5.2, the RI and PMI reporting is restricted to select the union of these precoders. Channels with low and high correlation are used to ensure that RI reporting reflects the channel condition.

For fixed rank 1 transmission in section 9.5.3, the RI reporting is restricted to single-layer, for fixed rank 2 transmission in section 9.5.3, the RI reporting is restricted to two-layers. For follow RI transmission in section 9.5.3, the RI reporting is either one or two layers.

### 9.5.1 Minimum requirement (Cell-Specific Reference Symbols)

#### 9.5.1.1 FDD

The minimum performance requirement in Table 9.5.1.1-2 is defined as

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 | | |
| | $\sigma$ | dB | 0 | | |
| Propagation condition and antenna configuration | | | 2 x 2 EPA5 | | |
| CodeBookSubsetRestriction bitmap | | | 000011 for fixed RI = 1<br>010000 for fixed RI = 2<br>010011 for UE reported RI | | |
| Antenna correlation | | | Low | Low | High |
| RI configuration | | | Fixed RI=2 and follow RI | Fixed RI=1 and follow RI | Fixed RI=1 and follow RI |
| SNR | | dB | 0 | 20 | 20 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -78 | -78 |
| Maximum number of HARQ transmissions | | | 1 | | |
| Reporting mode | | | PUCCH 1-1 (Note 4) | | |
| Physical channel for CQI/PMI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type for CQI/PMI | | | 2 | | |
| Physical channel for RI reporting | | | PUSCH (Note 3) | | |
| PUCCH Report Type for RI | | | 3 | | |
| Reporting periodicity | | ms | $N_{pd}$= 5 | | |
| PMI and CQI delay | | ms | 8 | | |
| *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 $\geq \gamma_1$

For the parameters specified in Table 9.5.3.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.5.3.1-2.

**Table 9.5.3.1-1: RI Test (FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| | | | Cell 1 | Cell 2 | Cell 1 | Cell 2 |
| Bandwidth | | MHz | 10 | | 10 | |
| PDSCH transmission mode | | | 3 | Note 10 | 3 | Note 10 |
| Downlink power allocation | $\rho_A$ | dB | -3 | | -3 | |
| | $\rho_B$ | dB | -3 | | -3 | |
| | 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 |
| $N_{oc}^{(j)}$ | $N_{oc1}^{(j)}$ | 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].
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#4 and #9 to allow periodic RI/CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#8 and #3. | | | | | |
| Note 4: This noise is applied in OFDM symbols #1, #2, #3, #5, #6, #8, #9, #10,#12, #13 of a subframe overlapping with the aggressor ABS | | | | | |
| Note 5: This noise is applied in OFDM symbols #0, #4, #7, #11 of a subframe overlapping with the aggressor ABS. | | | | | |
| Note 6: This noise is applied in all OFDM symbols of a subframe overlapping with aggressor non-ABS | | | | | |
| Note 7: ABS pattern as defined in [9]. | | | | | |
| Note 8: Time-domain measurement resource restriction pattern for PCell measurements as defined in [7]. | | | | | |
| Note 9: As configured according to the time-domain measurement resource restriction pattern for CSI measurements defined in [7]. | | | | | |
| Note 10: Cell 1 is the serving cell. Cell 2 is the aggressor cell. The number of the CRS ports in Cell 1 and Cell 2 is the same. | | | | | |
| Note 11: Downlink physical channel setup in Cell 2 in accordance with Annex C.3.3 applying OCNG pattern as defined in Annex A.5.2.5. | | | | | |

**Table 9.5.3.2-2: Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\gamma_1$ | 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** |
|---|---|---|---|
| $\widehat{E}_s / N_{oc2}$ 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 |

### 9.5.4.2 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 |
|---|---|---|---|
| $\hat{E}_s/N_{oc2}$ 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 |

## 9.5.5 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 / 1000001000000000 | N/A | 1] / 1000001000000000 |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 1 / 0011000000000000 | N/A | 1 / 0011000000000000 | 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 010011 for UE reported RI | 100000 | 000011 for fixed RI = 1 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)<br>Note 2: 3 symbols allocated to PDCCH<br>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.<br>Note 4: TM10 OCNG as specified in A.5.1.8 is transmitted on subframe 1 and 6 from TP1.<br>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.<br>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.<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: 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.<br>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 $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | N/A | 5/3 | N/A |
| CSI-RS 0 configuration | | | 0 | N/A | 0 | N/A |
| CSI-RS signal 1 | | | N/A | Antenna ports 15,16 | N/A | Antenna ports 15,16 |
| CSI-RS 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | 5/3 | N/A | 5/3 |
| CSI-RS 1 configuration | | | N/A | 3 | N/A | 3 |
| Zero-power CSI-RS 0 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | N/A | 3 / 1000001000000000 | N/A | 3 / 1000001000000000 |
| Zero-power CSI-RS 1 configuration $I_{CSI-RS}$ / *ZeroPowerCSI-RS* bitmap | | | 3 / 0011000000000000 | N/A | 3 / 0011000000000000 | N/A |
| CSI-IM 0 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | 5/3 | N/A | 5/3 | N/A |
| CSI-IM 0 configuration | | | 2 | N/A | 2 | N/A |
| CSI-IM 1 periodicity and subframe offset $T_{CSI-RS}$ / $\Delta_{CSI-RS}$ | | | N/A | 5/3 | N/A | 5/3 |
| CSI-IM 1 configuration | | | N/A | 6 | N/A | 6 |
| RI configuration | | | Fixed RI=2 and follow RI | N/A | Fixed RI=1 and follow RI | N/A |
| CSI process 0 (Note 6, 7) | CSI-RS | | CSI-RS 0 | 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 CA with 2 DL CC, for the parameters specified in Table 9.6.1.1-1 and Table 9.6.1.1-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband } CQI_{Pcell} - \text{wideband } CQI_{Scell} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-1: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 2 DL CA)**

| Parameter | | Unit | Pcell | Scell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | |
| SNR | | dB | 10 | 4 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -94 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | |
| PUCCH Report Type | | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 | |
| *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, 2 DL CA)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 10MHz for both cells |
| 2 | 20MHz for both cells |
| 3 | 5MHz for both cells |
| 4 | 5MHz for PCell and 10MHz for SCell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.<br>Note 2: Mapping of PCell and Scell to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. | |

The following requirements apply to UE Category ≥5. For CA with 3 DL CC, for the parameters specified in Table 9.6.1.1-3 and Table 9.6.1.1-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell1} \geq 2$$

$$\text{wideband CQI}_{SCell1} - \text{wideband CQI}_{SCell2} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.1-3: Parameters for PUCCH 1-0 static test on multiple cells (FDD, 3 DL CA)**

| Parameter | | Unit | Pcell | Scell1 | Scell2 |
|---|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | |
| SNR | | dB | 12 | 6 | 0 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -86 | -92 | -98 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type | | | 4 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 20 | | |
| *cqi-pmi-ConfigurationIndex* | | | 21 | 26 (shift of 5 ms relative to Pcell) | 31 (shift of 10 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 9.6.1.1-4: PUCCH 1-0 static test (FDD, 3 DL CA)**

| Test number | Bandwidth combination (MHz) |
|---|---|
| 1 | 3x20 |
| 2 | 20+20+15 |
| 3 | 20+20+10 |
| 4 | 20+15+15 |
| 5 | 20+15+10 |
| 6 | 20+10+10 |
| 7 | 15+15+10 |
| 8 | 20+10+5 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.<br>Note 2: If more than one cell can be configured as PCell, choose one with the smallest bandwidth as PCell. Mapping of PCell and Scells to the CCs shall be constant for all the iterations during the test. Each execution of the test shall use the same mapping. | |

### 9.6.1.2 TDD

The following requirements apply to UE Category ≥3. For CA with 2 DL CC, for the parameters specified in Table 9.6.1.2-1 and Table 9.6.1.2-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of Pcell and Scell reported shall be such that

$$\text{wideband CQI}_{Pcell} - \text{wideband CQI}_{Scell} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-1: PUCCH 1-0 static test on multiple cells (TDD, 2 DL CA)**

| Parameter | | Unit | Pcell | Scell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Uplink downlink configuration | | | 2 | |
| Special subframe configuration | | | 4 | |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | |
| SNR | | dB | 10 | 4 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -94 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | |
| PUCCH Report Type | | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 | |
| *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, 2 DL CA)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 20MHz for both cells |
| 2 | 15MHz for PCell and 20MHz for SCell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3. | |

The following requirements apply to UE Category ≥5. For CA with 3 DL CC, for the parameters specified in Table 9.6.1.2-3 and Table 9.6.1.2-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell 1 and SCell2 reported shall be such that

$$\text{wideband } CQI_{PCell} - \text{wideband } CQI_{SCell1} \geq 2$$

$$\text{wideband } CQI_{SCell1} - \text{wideband } CQI_{SCell2} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.2-3: PUCCH 1-0 static test on multiple cells (TDD, 3 DL CA)**

| Parameter | | Unit | Pcell | Scell1 | Scell2 |
|---|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | | |
| Uplink downlink configuration | | | 2 | | |
| Special subframe configuration | | | 4 | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | |
| SNR | | dB | 12 | 6 | 0 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -86 | -92 | -98 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type | | | 4 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 20 | | |
| *cqi-pmi-ConfigurationIndex* | | | 18 | 23 (shift of 5 ms relative to Pcell) | 28 (shift of 10 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 9.6.1.2-4: PUCCH 1-0 static test (TDD, 3 DL CA)**

| Test number | Bandwidth combination (MHz) |
|---|---|
| 1 | 3x20 |
| 2 | 20+20+15 |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2. The test coverage for different number of component carriers is defined in 9.1.1.3.<br>Note 2: If more than one cell can be configured as PCell, choose one of the cells with the smallest bandwidth as PCell. | |

### 9.6.1.3 TDD-FDD CA with FDD PCell

The following requirements apply to UE Category ≥5. For TDD-FDD CA with FDD PCell with 2 DL CC, for the parameters specified in Table 9.6.1.3-1 and Table 9.6.1.3-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{PCell} - \text{wideband CQI}_{SCell} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-1: Parameters for PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 2 DL CA)**

| Parameter | | Unit | PCell | SCell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Uplink downlink configuration | | | N/A | 2 |
| Special subframe configuration | | | N/A | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | |
| | $\rho_B$ | dB | 0 | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | |
| SNR | | dB | 10 | 4 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -88 | -94 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | |
| PUCCH Report Type | | | 4 | |
| Reporting periodicity | | ms | $N_{pd}$ = 10 | |
| *cqi-pmi-ConfigurationIndex* | | | 9 | 14 (shift of 5 ms relative to Pcell) |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 TDD as described in Annex A.5.2.1. | | | | |

**Table 9.6.1.3-2: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 2 DL CA)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 20MHz for FDD cell and 20MHz for TDD cell |
| 2 | 10MHz for FDD cell and 20MHz for TDD cell |
| 3 | 15MHz for FDD cell and 20MHz for TDD cell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. | |

The following requirements apply to UE Category ≥5. For TDD-FDD CA with FDD PCell with 3 DL CC, for the parameters specified in Table 9.6.1.3-3 and Table 9.6.1.3-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2 reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.3-3: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with FDD PCell, 3 DL CA)**

| Parameter | | Unit | PCell | SCell1 | SCell2 |
|---|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | | |
| Uplink downlink configuration | | | N/A | 2 if Scell1 is TDD Cell<br>N/A if Scell1 is FDD Cell | 2 |
| Special subframe configuration | | | N/A | 4 if Scell1 is TDD Cell<br>N/A if Scell1 is FDD Cell | 4 |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | |
| SNR | | dB | 12 | 6 | 0 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -86 | -92 | -98 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type | | | 4 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 20 | | |
| *cqi-pmi-ConfigurationIndex* | | | 19 | 24 (shift of 5 ms relative to Pcell) | 29 (shift of 10 ms relative to Pcell) |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. | | | | | |

**Table 9.6.1.4-4: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 3 DL CA)**

| Test number | Bandwidth combination (MHz) |
|---|---|
| 1 | 20MHz for FDD cell and 2x20MHz for TDD cell |
| 2 | 15MHz for FDD cell and 2x20MHz for TDD cell |
| 3 | 10MHz for FDD cell and 2x20MHz for TDD cell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. | |

### 9.6.1.4 TDD-FDD CA with TDD PCell

The following requirements apply to UE Category ≥5. For TDD-FDD CA with TDD PCell with 2 DL CC, for the parameters specified in Table 9.6.1.4-1 and Table 9.6.1.4-2, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell}} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-1: Parameters for PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 2 DL CA)**

| Parameter | | Unit | PCell | SCell |
|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | |
| Uplink downlink configuration | | | 2 | N/A |
| Special subframe configuration | | | 4 | N/A |
| 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 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. | | | | |

**Table 9.6.1.4-2: PUCCH 1-0 static test (TDD-FDD CA with TDD PCell, 2 DL CA)**

| Test number | Bandwidth combination |
|---|---|
| 1 | 20MHz for TDD cell and 20MHz for FDD cell |
| 2 | 20MHz for TDD cell and 10MHz for FDD cell |
| 3 | 20MHz for TDD cell and 15MHz for FDD cell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. | |

The following requirements apply to UE Category ≥5. For TDD-FDD CA with TDD PCell with 3 DL CC, for the parameters specified in Table 9.6.1.4-3 and Table 9.6.1.4-4, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2 reported shall be such that

$$\text{wideband } CQI_{PCell} - \text{wideband } CQI_{SCell1} \geq 2$$

$$\text{wideband } CQI_{SCell1} - \text{wideband } CQI_{SCell2} \geq 2$$

for more than 90% of the time.

**Table 9.6.1.4-3: PUCCH 1-0 static test on multiple cells (TDD-FDD CA with TDD PCell, 3 DL CA)**

| Parameter | | Unit | PCell | SCell1 | SCell2 |
|---|---|---|---|---|---|
| PDSCH transmission mode | | | 1 | | |
| Uplink downlink configuration | | | 2 | 2 if Scell1 is TDD Cell<br>N/A if Scell1 is FDD Cell | N/A |
| Special subframe configuration | | | 4 | 4 if Scell1 is TDD Cell<br>N/A if Scell1 is FDD Cell | N/A |
| Downlink power allocation | $\rho_A$ | dB | 0 | | |
| | $\rho_B$ | dB | 0 | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 2) | | |
| SNR | | dB | 12 | 6 | 0 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -86 | -92 | -98 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | -98 | -98 |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | |
| PUCCH Report Type | | | 4 | | |
| Reporting periodicity | | ms | $N_{pd}$ = 20 | | |
| *cqi-pmi-ConfigurationIndex* | | | 18 | 23 (shift of 5 ms relative to Pcell) | 28 (shift of 10 ms relative to Pcell) |
| Note 1: 3 symbols are allocated to PDCCH. No PDSCH for user data is scheduled for the UE with one sided dynamic OCNG Pattern OP.1 FDD and OP.1 TDD as described in Annex A.5.1.1 and A.5.2.1. | | | | | |

**Table 9.6.1.3-4: PUCCH 1-0 static test (TDD-FDD CA with FDD PCell, 3 DL CA)**

| Test number | Bandwidth combination (MHz) |
|---|---|
| 1 | 2x20MHz for TDD cell and 20MHz for FDD cell |
| 2 | 2x20MHz for TDD cell and 15MHz for FDD cell |
| 3 | 2x20MHz for TDD cell and 10MHz for FDD cell |
| Note 1: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 9.1.1.2A. The test coverage for different number of component carriers is defined in 9.1.1.3. | |

# 9.7 CSI reporting (Single receiver antenna)

The number of receiver antennas $N_{RX}$ assumed for the minimum performance requirement in this clause is 1.

## 9.7.1 CQI reporting definition under AWGN conditions

### 9.7.1.1 FDD and half-duplex FDD

The following requirements apply to UE DL Category 0. For the parameters specified in Table 9.7.1.1-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.16 FDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.7.1.1-1: PUCCH 1-0 static test (FDD and half-duplex FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 1) | | | |
| SNR (Note 2) | | dB | 0 | 1 | 6 | 7 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -92 | -91 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUCCH Format 2 | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 40 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 41 | | | |
| Note 1: Reference measurement channel RC.16 FDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/OP.2 FDD as described in Annex A.5.1.1/A.5.1.2.<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. | | | | | | |

## 9.7.1.2 TDD

The following requirements apply to UE DL Category 0. For the parameters specified in Table 9.7.1.2-1, and using the downlink physical channels specified in tables C.3.2-1 and C.3.2-2, the reported CQI value according to RC.16 TDD in Table A.4-1 shall be in the range of ±1 of the reported median more than 90% of the time. If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI – 1) shall be less than or equal to 0.1.

**Table 9.7.1.2-1: PUCCH 1-0 static test (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 | | | |
| PDSCH transmission mode | | | 1 | | | |
| Uplink downlink configuration | | | 2 | | | |
| Special subframe configuration | | | 4 | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| Propagation condition and antenna configuration | | | AWGN (1 x 1) | | | |
| SNR (Note 2) | | dB | 0 | 1 | 6 | 7 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -98 | -97 | -92 | -91 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Max number of HARQ transmissions | | | 1 | | | |
| Physical channel for CQI reporting | | | PUSCH (Note 3) | | | |
| PUCCH Report Type | | | 4 | | | |
| Reporting periodicity | | ms | $N_{pd}$ = 5 | | | |
| *cqi-pmi-ConfigurationIndex* | | | 3 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |

Note 1: Reference measurement channel RC.16 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/OP.2 TDD as described in Annex A.5.2.1/A.5.2.2.
Note 2: For each test, the minimum requirements shall be fulfilled for at least one of the two SNR(s) and the respective wanted signal input level.
Note 3: To avoid collisions between CQI reports and HARQ-ACK it is necessary to report both on PUSCH instead of PUCCH. PDCCH DCI format 0 shall be transmitted in downlink SF#3 and #8 to allow periodic CQI to multiplex with the HARQ-ACK on PUSCH in uplink subframe SF#7 and #2.

## 9.7.2 CQI reporting under fading conditions

### 9.7.2.1 FDD and half-duplex FDD

For the parameters specified in Table 9.7.2.1-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.1-2 and by the following

a) 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 and in each available downlink transmission instance for half-duplex FDD.

**Table 9.7.2.1-1 Sub-band test for single antenna transmission (FDD and half-duplex FDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | σ | dB | 0 | | | |
| SNR (Note 3) | | dB | 8 | 9 | 13 | 14 |
| $\hat{I}_{or}^{(j)}$ | | dB[mW/15kHz] | -90 | -89 | -85 | -84 |
| $N_{oc}^{(j)}$ | | dB[mW/15kHz] | -98 | | -98 | |
| Propagation channel | | | Clause B.2.4 with $\tau_d = 0.45\,\mu$s, *a* = 1, $f_D = 5$ Hz | | | |
| Antenna configuration | | | 1 x 1 | | | |
| Reporting interval | | ms | 8 | | | |
| CQI delay | | ms | 8 | | | |
| Reporting mode | | | PUSCH 3-0 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |

Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)
Note 2: Reference measurement channel RC.16 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 9.7.2.1-2 Minimum requirement (FDD and half-duplex FDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| UE DL Category | 0 | 0 |

## 9.7.2.2 TDD

For the parameters specified in Table 9.7.2.2-1, and using the downlink physical channels specified in Annex C.3.2, the minimum requirements are specified in Table 9.7.2.2-2 and by the following

a) 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 available downlink transmission instance for TDD.

**Table 9.7.2.2-1 Sub-band test for single antenna transmission (TDD)**

| Parameter | | Unit | Test 1 | | Test 2 | |
|---|---|---|---|---|---|---|
| Bandwidth | | MHz | 10 MHz | | | |
| Transmission mode | | | 1 (port 0) | | | |
| Downlink power allocation | $\rho_A$ | dB | 0 | | | |
| | $\rho_B$ | dB | 0 | | | |
| | 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 | | | |
| Antenna configuration | | | 1 x 1 | | | |
| Reporting interval | | ms | 5 | | | |
| CQI delay | | ms | 10 or 11 | | | |
| Reporting mode | | | PUSCH 3-0 | | | |
| Sub-band size | | RB | 6 (full size) | | | |
| Max number of HARQ transmissions | | | 1 | | | |
| ACK/NACK feedback mode | | | Multiplexing | | | |
| Note 1: If the UE reports in an available uplink reporting instance at subframe SF#n based on CQI estimation at a downlink subframe not later than SF#(n-4), this reported subband or wideband CQI cannot be applied at the eNB downlink before SF#(n+4)<br>Note 2: Reference measurement channel RC.16 TDD according to Table A.4-1 with one/two sided dynamic OCNG Pattern OP.1/2 TDD as described in Annex A.5.2.1/2.<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 9.7.2.2-2 Minimum requirement (TDD)**

| | Test 1 | Test 2 |
|---|---|---|
| $\alpha$ [%] | 2 | 2 |
| $\beta$ [%] | 55 | 55 |
| $\gamma$ | 1.1 | 1.1 |
| UE DL Category | 0 | 0 |

# 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) |
| | σ | dB | 0 |
| $N_{oc}$ at antenna port | | dBm/15kHz | -98 |
| Note 1: $P_B = 0$. | | | |

**Table 10.2.1-2: Minimum performance**

| Test number | Bandwidth | Reference Channel | OCNG Pattern | Propagation condition | Correlation Matrix and antenna | Reference value | | 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 |

# 11 Performance requirement (ProSe Direct Discovery)

This clause contains the performance requirements for the Sidelink physical channels specified for ProSe Direct Discovery.

## 11.1 General

### 11.1.1 Applicability of requirements

The requirements in this clause are applicable to UEs that support ProSe Direct Discovery. Some of the tests defined in this clause are applicable only to UEs that additionally support transmission and reception of Sidelink synchronization signal (indicated using *disc-SLSS*). The test case applicability is in according to table 11.1.1-1 depending on UE capability.

**Table 11.1.1-1: ProSe Direct Discovery test applicability**

| | ProSe Direct Discovery without support of SLSS | ProSe Direct Discovery with support of SLSS |
|---|---|---|
| **FDD** | 11.2.1, 11.3.1, 11.5.1 | 11.3.1, 11.4.1, 11.5.1 |
| **TDD** | 11.2.2, 11.3.2, 11.5.2 | 11.2.2, 11.3.2, 11.5.2 |

For maximum Sidelink Processes test specified in clause 11.5, the UE is required to only meet the test for the maximum channel bandwidth over the ProSe operating bands supported by the UE.

### 11.1.2 Reference DRX configuration

**Table 11.1.2-1: Reference DRX configuration**

| Parameter | Value | Comments |
|---|---|---|
| onDurationTimer | psf1 | |
| drx-InactivityTimer | psf1 | |
| drx-RetransmissionTimer | psf1 | |
| longDRX-CycleStartOffset | sf2560, 0 | |
| shortDRX | disabled | |
| NOTE: For further information see clause 6.3.2 in TS 36.331. | | |

## 11.2 Demodulation of PSDCH (single link performance)

The purpose of the requirements in this subclause is to verify the PSDCH demodulation performance with a single active PSDCH link under different operating scenarios and channel conditions.

The active cell(s), when present, are specified in the test parameters specific to the test.

### 11.2.1 FDD

The minimum requirements are specified in Table 11.2.1-2 with the test parameters specified in Table 11.2.1-1. The receiver UE under test is associated with Cell 1.

**Table 11.2.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.1-1 (Configuration #1-FDD) |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 3) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern (NOTE 2) | | | OP.1 FDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1 |
| Sidelink UE 1 | Sidelink Transmissions | | | PSDCH |
| | PSDCH RB allocation | | | PRB pairs {2i, 2i+1), where i is chosen randomly uniformly from [0,11] in each discovery period. |
| | Time offset (NOTE 4) | | µs | +1 |
| | Frequency offset (NOTE 5) | | Hz | +200 |
| | Propagation Channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |
| NOTE 1: $P_B = 0$.<br>NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.<br>NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.<br>NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.<br>NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency. | | | | |

**Table 11.2.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | BLER of PSDCH (%) | SNR (dB) |
| 1 | 1 | 5 MHz | D.1 FDD | 30 | 4.6 |

## 11.2.2 TDD

The minimum requirements are specified in Table 11.2.2-2 with the test parameters specified in Table 11.2.2-1. The receiver UE under test is associated with Cell 1.

**Table 11.2.2-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.2-1 (Configuration #1-TDD) |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 5) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Uplink downlink configuration (NOTE 3) | | | 0 |
| | Special subframe configuration (NOTE 4) | | | 4 |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern NOTE 2 | | | OP.1 TDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1 |
| Sidelink UE 1 | Sidelink Transmissions | | | PSDCH |
| | RB allocation | | | PRB pairs {2i, 2i+1), where i is chosen randomly uniformly from [0,11] in each discovery period. |
| | Time offset (NOTE 6) | | µs | +1 |
| | Frequency offset (NOTE 7) | | Hz | +200 |
| | Propagation Channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].
NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].
NOTE 5: Applicable to both DL subframes and UL subframes configured for ProSe Direct Discovery.
NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 11.2.2-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | BLER of PSDCH (%) | SNR (dB) |
| 1 | 1 | 5 MHz | D.1 TDD | 30 | 4.6 |

# 11.3 Power imbalance performance with two links

The purpose of this test is to check the demodulation performance when receiving PSDCH transmissions from two Sidelink UEs with power imbalance in one subframe.

## 11.3.1 FDD

The minimum requirements are specified in Table 11.3.1-2 with the test parameters specified in Table 11.3.1-1. The receiver UE under test is associated with Cell 1. The Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSDCH on adjacent RBs.

**Table 11.3.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.1-1 (Configuration #1-FDD) |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 3) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern (NOTE 2) | | | OP.1 FDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1, Sidelink UE 2 |
| Sidelink UE 1 | Sidelink Transmissions | | | PSDCH |
| | PSDCH RB allocation | | | PRB pairs {4, 5) |
| | Time offset (NOTE 3) | | µs | 0 |
| | Frequency offset (NOTE 4) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |
| Sidelink UE 2 | Sidelink Transmissions | | | PSDCH |
| | PSDCH RB allocation | | | PRB pairs {6, 7) |
| | Time offset (w.r.t. Cell 1 DL) | | µs | 0 |
| | Frequency offset (w.r.t. Cell 1 UL) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |
| Applicability to UEs supporting | | | | Discovery |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.
NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 11.3.1-2: Minimum performance**

| Test num. | Band-width | Sidelink UE | Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | BLER of PSDCH (%) | SNR (dB) |
| 1 | 5 MHz | 1 | D.1 FDD | (NOTE 1) | 24.3 |
| | | 2 | D.1 FDD | 30 | 6.9 |

NOTE 1: There is no BLER requirement for Sidelink UE 1.

## 11.3.2 TDD

The minimum requirements are specified in Table 11.3.2-2 with the test parameters specified in Table 11.3.2-1. The receiver UE under test is associated with Cell 1. The Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSDCH on adjacent RBs.

**Table 11.3.2-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.2-1 (Configuration #1-TDD) |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 5) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Uplink downlink configuration (NOTE 3) | | | 0 |
| | Special subframe configuration (NOTE 4) | | | 4 |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern NOTE 2 | | | OP.1 TDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1, Sidelink UE 2 |
| Sidelink UE 1 | Sidelink Transmissions | | | PSDCH |
| | PSDCH RB allocation | | | PRB pairs {4, 5) |
| | Time offset (NOTE 6) | | µs | 0 |
| | Frequency offset (NOTE 7) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |
| Sidelink UE 2 | Sidelink Transmissions | | | PSDCH |
| | RB allocation | | | PRB pairs {6, 7) |
| | Time offset (NOTE 6) | | µs | 0 |
| | Frequency offset (NOTE 7) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |
| NOTE 1: $P_B = 0$.<br>NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.<br>NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].<br>NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].<br>NOTE 5: Applicable to both DL subframes and UL subframes configured for ProSe Direct Discovery.<br>NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.<br>NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency. | | | | |

**Table 11.3.2-2: Minimum performance**

| Test num. | Band-width | Sidelink UE | Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | BLER of PSDCH (%) | SNR (dB) |
| 1 | 5 MHz | 1 | D.1 TDD | (NOTE 1) | 24.3 |
| | | 2 | D.1 TDD | 30 | 6.9 |
| NOTE 1: There is no BLER requirement for Sidelink UE 1. | | | | | |

# 11.4 Multiple timing reference test

The purpose of this test is to check the demodulation performance when receiving from two Sidelink UEs that follow different timing references and transmitting on different resources (non-overlapping in time).

### 11.4.1 FDD

The test parameters are specified in Table 11.4.1-1. Sidelink UE 2 and the receiver UE under test are associated with Cell 1. Sidelink UE 1 and 3 are associated with another cell and use a different timing, and UE 1 acts as a synchronization reference. The minimum requirements are specified in Table 11.4.1-2.

**Table 11.4.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.1-2 (Configuration #2-FDD) |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 3) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern NOTE 2 | | | OP.1 FDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UEs 1, 2, 3 |
| Sidelink UE 1 | Sidelink Transmissions | | | SLSS |
| | networkControlledSyncTx | | | ON |
| | slssid | | | 30 |
| | Time offset (NOTE 4) | | µs | 3511 |
| | Frequency offset (NOTE 5) | | Hz | -100 |
| | Propagation channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |
| | $\widehat{E}_s$ of SLSS at antenna port | | dBm/15kHz | -82 |
| Sidelink UE 2 | Sidelink Transmissions | | | PSDCH |
| | Resource pool used for transmissions | | | *discRxPool(0)* |
| | RB allocation | | | PRB pairs {2i, 2i+1), where i is chosen randomly uniformly from [0,11] in each discovery period. |
| | Time offset (NOTE 4) | | µs | +1 |
| | Frequency offset (NOTE 5) | | Hz | +200 |
| | Propagation Channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |
| Sidelink UE 3 | Sidelink Transmissions | | | PSDCH |
| | Resource pool used for transmissions | | | *discRxPool(1)* |
| | RB allocation | | | PRB pairs {2i, 2i+1), where i is chosen randomly uniformly from [0,11] in each discovery period. |
| | Time offset (NOTE 4) | | µs | 3511 |
| | Frequency offset (NOTE 5) | | Hz | +300 |
| | Propagation Channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: Applicable to both DL channel and ProSe Direct Discovery Subframes on UL.
NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 11.4.1-2: Minimum performance**

| Test num. | Band-width | Sidelink UE | Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | BLER of PSDCH (%)NOTE 1 | SNR (dB) |
| 1 | 5 MHz | 2 | D.1 FDD | 30 | 4.6 |
| | | 3 | D.1 FDD | 30 | 4.6 |
| NOTE 1: The BLER is measured after 5 D2D Discovery periods (1600 frames) of lead time during which the test UE detects and synchronizes to Sidelink UE 1 SLSS. | | | | | |

## 11.5 Maximum Sidelink processes test

The purpose of this test is to verify the maximum number of Sidelink processes supported by the UE as reported using UE capability signalling (*discSupportedProc*).

The UE is required to meet only the test for the maximum channel bandwidth over the ProSe operating bands supported by the UE.

### 11.5.1 FDD

The test parameters are specified in Table 11.5.1-1. Multiple discovery resource pools are interleaved. Each Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 11.5.1-2.

**Table 11.5.1-1: Test Parameters**

| Parameter | | | Unit | Test 1-7 |
|---|---|---|---|---|
| Discovery resource pool configuration | | | | As specified in Table A.7.1.1-3 (Configuration #3-FDD) with parameters $BW_{Channel}$, NPools = Number of configured resource pools (as specified in Table 11.5.1-2), and N = discSupportedProc |
| DRX configuration | | | | As specified in Table 11.1.2-1 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern NOTE 2 | | | OP.1 FDD |
| | Propagation channel | | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -85 |
| Active Sidelink UE(s) | | | | Sidelink UE i, i = 0, …, discSupportedProc-1 |
| Sidelink UE i | Sidelink Transmissions | | | PSDCH (D.1 FDD) |
| | Resource pool index (NOTE 3) | | | $\left\lfloor \frac{i}{N_{MAX\_SF}} \right\rfloor$ |
| | PSDCH RB allocation (NOTE 3) | | | PRB pairs {2*(i % $N_{MAX\_SF}$), 2*(i % $N_{MAX\_SF}$)+1} |
| | Time offset (NOTE 4) | | µs | 0 |
| | Frequency offset (NOTE 5) | | Hz | 0 |
| | Propagation Channel | | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs..
NOTE 3: $N_{MAX\_SF}$ represents the maximum number of Sidelink UEs transmitting in one subframe. $N_{MAX\_SF}$ = 12 (5 MHz), 25 (10MHz), 37 (15MHz), 50 (10MHz).
NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 11.5.1-2: Minimum performance**

| Test num. | Bandwidth | discSupportedProc | Number of configured resource pools | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value for Sidelink UE i=0…discSupportedProc-1 |
|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) |
| 1 | 5 MHz | 50 | 5 | -85 | 95 |
| 2 | 10 MHz | 50 | 2 | -85 | 95 |
| 3 | 15 MHz | 50 | 2 | -85 | 95 |
| 4 | 20 MHz | 50 | 1 | -85 | 95 |
| 5 | 10 MHz | 400 | 16 | -85 | 95 |
| 6 | 15 MHz | 400 | 11 | -85 | 95 |
| 7 | 20 MHz | 400 | 8 | -85 | 95 |

## 11.5.2 TDD

The test parameters are specified in Table 11.5.2-1. Multiple discovery resource pools are interleaved. Each Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 11.5.2-2.

**Table 11.5.2-1: Test Parameters**

| Parameter | | Unit | Test 1-7 |
|---|---|---|---|
| Discovery resource pool configuration | | | As specified in Table A.7.1.2-2 (Configuration #2-TDD) with parameters $BW_{Channel}$, NPools = Number of configured resource pools (as specified in Table 11.5.2-2), and N = discSupportedProc |
| DRX configuration | | | As specified in Table 11.1.2-1 |
| Active cell(s) | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | Normal |
| Cell 1 | Uplink downlink configuration (NOTE 3) | | 0 |
| Cell 1 | Special subframe configuration (NOTE 4) | | 4 |
| Cell 1 | Cell ID | | 0 |
| Cell 1 | Downlink power allocation $\rho_A$ | dB | 0 |
| Cell 1 | Downlink power allocation $\rho_B$ | dB | 0 (NOTE 1) |
| Cell 1 | Downlink power allocation σ | dB | 0 |
| Cell 1 | OCNG Pattern NOTE 2 | | OP.1 TDD |
| Cell 1 | Propagation channel | | Static propagation condition<br>No external noise sources are applied |
| Cell 1 | Antenna configuration | | 1x2 |
| Cell 1 | RSRP | dBm/15kHz | -85 |
| Active Sidelink UE(s) | | | Sidelink UE i, i = 0, …, discSupportedProc-1 |
| Sidelink UE i | Sidelink Transmissions | | PSDCH (D.1 TDD) |
| Sidelink UE i | PSDCH Resource pool (NOTE 5) | | $\left\lfloor \frac{i}{N_{MAX\_SF}} \right\rfloor$ |
| Sidelink UE i | PSDCH RB allocation (NOTE 5) | | PRB pairs {2*(i % $N_{MAX\_SF}$), 2*(i % $N_{MAX\_SF}$)+1} |
| Sidelink UE i | Time offset (NOTE 6) | µs | 0 |
| Sidelink UE i | Frequency offset (NOTE 7) | Hz | 0 |
| Sidelink UE i | Propagation Channel | | Static propagation condition<br>No external noise sources are applied |
| Sidelink UE i | Antenna configuration | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: As specified in Table 4.2-2 in TS 36.211 [4].
NOTE 4: As specified in Table 4.2-1 in TS 36.211 [4].
NOTE 5: $N_{MAX\_SF}$ represents the maximum number of Sidelink UEs transmitting in one subframe. $N_{MAX\_SF}$ = 12 (5 MHz), 25 (10MHz), 37 (15MHz), 50 (10MHz).
NOTE 6: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 7: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 11.5.2-2: Minimum performance**

| Test num. | Bandwidth | discSupportedProc | Number of configured resource pools | $\hat{E}_s$ at antenna port (dBm/15kHz | Reference value |
|---|---|---|---|---|---|
| | | | | | Fraction of maximum throughput (%) for Sidelink UE i=0…discSupportedProc-1 |
| 1 | 5 MHz | 50 | 5 | -85 | 95 |
| 2 | 10 MHz | 50 | 2 | -85 | 95 |
| 3 | 15 MHz | 50 | 2 | -85 | 95 |
| 4 | 20 MHz | 50 | 1 | -85 | 95 |
| 5 | 10 MHz | 400 | 16 | -85 | 95 |
| 6 | 15 MHz | 400 | 11 | -85 | 95 |
| 7 | 20 MHz | 400 | 8 | -85 | 95 |

# 12 Performance requirement (ProSe Direct Communication)

This clause contains the performance requirements for the Sidelink physical channels specified for ProSe Direct Communication in TS 36.211 [4].

## 12.1 General

### 12.1.1 Applicability of requirements

The requirements in this clause are applicable to UEs that support ProSe Direct Communication. Test cases defined for 5MHz channel bandwidth are applicable to UEs that support ProSe Direct Communication on only Band 31.

### 12.1.2 Reference DRX configuration

**Table 12.1.2-1: Reference DRX configuration**

| Parameter | Value | Comments |
|---|---|---|
| onDurationTimer | psf1 | |
| drx-InactivityTimer | psf1 | |
| drx-RetransmissionTimer | psf1 | |
| longDRX-CycleStartOffset | sf2560, 0 | |
| shortDRX | disabled | |
| NOTE: For further information see clause 6.3.2 in TS 36.331. | | |

## 12.2 Demodulation of PSSCH

The purpose of the requirements in this subclause is to verify the PSSCH demodulation performance with a single active PSSCH link.

### 12.2.1 FDD

The minimum requirements are specified in Table 12.2.1-2 with the test parameters specified in Table 12.2.1-1. This test specifies an out-of-coverge scenario where Sidelink UE 1 is the synchronization reference only and Sidelink UE 2 transmits PSCCH and PSSCH.

**Table 12.2.1-1: Test Parameters**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Communication resource pool configuration | | | As specified in Table A.7.2.1-1 (Configuration #1-FDD) |
| DRX configuration | | | As specified in Table 12.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 1) | | dBm/15 kHz | -98 |
| Active cell(s) | | | None |
| Sidelink UE 1 | Sidelink Transmissions | | SLSS + PSBCH |
| | networkControlledSyncTx | | ON |
| | slssid | | 30 |
| | inCoverage (in MIB-SL) | | TRUE |
| | syncOffsetIndicator | | Set same as syncOffsetIndicator1 in Configuration #1-FDD |
| | Propagation channel | | EPA5 |
| | Antenna configuration | | 1x2 Low |
| | $\hat{E}_s$ at antenna port | dBm/15 kHz | -85 |
| Sidelink UE 2 | Sidelink Transmissions | | PSCCH + PSSCH |
| | PSCCH RMC | | 5MHz: CC.3 FDD<br>10 MHz: CC.4 FDD |
| | PSCCH subframe allocation | | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH\_RP}/2 \rfloor L_{PSCCH} - 1]$ every sc-period |
| | PSCCH RB allocation | | |
| | $\hat{E}_s$ of PSCCH at antenna port | dBm/15 kHz | -85 |
| | PSSCH RMC | | As specificied in Table 12.2.1-2 |
| | PSSCH subframe allocation | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
| | Time offset (NOTE 2) | µs | +1 |
| | Frequency offset (NOTE 3) | Hz | +200 |
| | Propagation Channel | | EVA70 |
| | Antenna configuration | | 1x2 Low |
| NOTE 1: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.<br>NOTE 2: Time offset of Sidelink UE 2 receive signal timing with respect to Sidelink UE 1 receive signal timing at the tested UE.<br>NOTE 3: Frequency offset of Sidelink UE 2 with respect to Sidelink UE 1 transmit frequency. | | | |

**Table 12.2.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | PSSCH Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | Fraction of maximum throughput (%) (NOTE 1) | SNR (dB) of PSSCH |
| 1 | 2 | 10 MHz | CD.1 FDD | 70 | -3.4 |
| | | 5 MHz | | 70 | -3.3 |
| NOTE 1: The throughput is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1. | | | | | |

# 12.3 Demodulation of PSCCH

The purpose of the requirements in this subclause is to verify the PSCCH demodulation performance with a single active PSSCH link.

### 12.3.1 FDD

The minimum requirements are specified in Table 12.3.1-2 with the test parameters specified in Table 12.3.1-1. This test specifies an out-of-coverage scenario where Sidelink UE 1 is the synchronization reference only and Sidelink UE 2 transmits PSCCH and PSSCH..

**Table 12.3.1-1: Test Parameters**

| Parameter | | Unit | Test 1 |
|---|---|---|---|
| Communication resource pool configuration | | | As specified in Table A.7.2.1-1 (Configuration #1-FDD) |
| DRX configuration | | | As specified in Table 12.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 1) | | dBm/15 kHz | -98 |
| Active cell(s) | | | None |
| Sidelink UE 1 | Sidelink Transmissions | | SLSS + PSBCH |
| | networkControlledSyncTx | | ON |
| | slssid | | 30 |
| | inCoverage (in MIB-SL) | | TRUE |
| | syncOffsetIndicator | | Set same as syncOffsetIndicator1 in Configuration #1-FDD |
| | Propagation channel | | EPA5 |
| | Antenna configuration | | 1x2 Low |
| | $\hat{E}_s$ at antenna port | dBm/15 kHz | -85 |
| Sidelink UE 2 | Sidelink Transmissions | | PSCCH + PSSCH |
| | PSCCH RMC | | As specified in Table 12.3.1-2 |
| | PSCCH subframe allocation | | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH\_RP} / 2 \rfloor L_{PSCCH} - 1]$ every sc-period |
| | PSCCH RB allocation | | |
| | PSSCH RMC | | CD.1 FDD |
| | PSSCH subframe allocation | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
| | Time offset (NOTE 2) | µs | +1 |
| | Frequency offset (NOTE 3) | Hz | +200 |
| | Propagation Channel | | EVA70 |
| | Antenna configuration | | 1x2 Low |
| NOTE 1: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.<br>NOTE 2: Time offset of Sidelink UE 2 receive signal timing with respect to Sidelink UE 1 receive signal timing at the tested UE.<br>NOTE 3: Frequency offset of Sidelink UE 2 with respect to Sidelink UE 1 transmit frequency. | | | |

**Table 12.3.1-2: Minimum performance**

| Test num. | Sidelink UE | Band-width | PSCCH Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | Probability of missed PSCCH (%) (NOTE 1) | SNR (dB) of PSCCH |
| 1 | 2 | 10 MHz | CC.4 FDD | 1 | 4.7 |
| | | 5 MHz | CC.3 FDD | 1 | 4.8 |
| NOTE 1: The probability is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1. | | | | | |

## 12.4 Demodulation of PSBCH

The purpose of the requirements in this subclause is to verify the PSBCH demodulation performance with a single active link.

### 12.4.1 FDD

The minimum requirements are specified in Table 12.4.1-2 with the test parameters specified in Table 12.4.1-1.

**Table 12.4.1-1: Test Parameters**

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th>Test 1</th></tr>
<tr><td colspan="2">Communication resource pool configuration</td><td></td><td>As specified in Table A.7.2.1-1 (Configuration #1-FDD)</td></tr>
<tr><td colspan="2">DRX configuration</td><td></td><td>As specified in Table 12.1.2-1</td></tr>
<tr><td colspan="2">$N_{oc}$ at antenna port</td><td>dBm/15kHz</td><td>-98</td></tr>
<tr><td colspan="2">Active cell(s)</td><td></td><td>None</td></tr>
<tr><td rowspan="7">Sidelink UE 1</td><td>Sidelink Transmissions</td><td></td><td>SLSS + PSBCH (CP.1 FDD)</td></tr>
<tr><td>networkControlledSyncTx</td><td></td><td>ON</td></tr>
<tr><td>slssid</td><td></td><td>30</td></tr>
<tr><td>inCoverage (in MIB-SL)</td><td></td><td>TRUE</td></tr>
<tr><td>syncOffsetIndicator</td><td></td><td>Set same as syncOffsetIndicator1 in Configuration #1-FDD</td></tr>
<tr><td>Propagation channel</td><td></td><td>EPA5</td></tr>
<tr><td>Antenna configuration</td><td></td><td>1x2 Low</td></tr>
</table>

**Table 12.4.1-2: Minimum performance**

<table>
<tr><th rowspan="2">Test num.</th><th rowspan="2">Sidelink UE</th><th rowspan="2">Band-width</th><th rowspan="2">Reference channel</th><th colspan="2">Reference value</th></tr>
<tr><th>Probability of missed PSBCH (%) (NOTE 1)</th><th>SNR (dB)</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1</td><td>10 MHz</td><td rowspan="2">PSBCH (CP.1 FDD)</td><td rowspan="2">1</td><td rowspan="2">4.4</td></tr>
<tr><td>5 MHz</td></tr>
<tr><td colspan="6">NOTE 1: The probability is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1.</td></tr>
</table>

## 12.5 Power imbalance performance with two links

The purpose of this test is to check the demodulation performance when receiving PSSCH transmissions from two Sidelink UEs with power imbalance in one subframe.

### 12.5.1 FDD

The test parameters in Table 12.5.1-1 specifies an in-coverage scenario where Sidelink UE 1 and 2 are synchronized to Cell 1 and transmit PSSCH on adjacent RBs. The minimum requirements are specified in Table 12.5.1-2.

**Table 12.5.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Communication resource pool configuration | | | | As specified in Table A.7.2.1-2 (Configuration #2-FDD) |
| DRX configuration | | | | As specified in Table 12.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 3) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern (NOTE 2) | | | OP.1 FDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1, Sidelink UE 2 |
| Sidelink UE 1 | Sidelink Transmissions | | | PSCCH + PSSCH |
| | PSCCH RMC | | | 5 MHz: CC.1 FDD<br>10 MHz: CC.2 FDD |
| | PSCCH subframe allocation | | | $n_{PSCCH} = 0$ (as defined in TS 36.213) |
| | PSCCH RB allocation | | | |
| | $\hat{E}_s$ of PSCCH at antenna port | | dBm/15kHz | -85 |
| | PSSCH RMC | | | As specified in Table 12.5.1-2 |
| | PSSCH subframe allocation | | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | | PRB pairs {4, 5} |
| | Time offset (NOTE 4) | | µs | 0 |
| | Frequency offset (NOTE 5) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |
| Sidelink UE 2 | Sidelink Transmissions | | | PSCCH + PSSCH |
| | PSCCH RMC | | | 5 MHz: CC.1 FDD<br>10 MHz: CC.2 FDD |
| | PSCCH subframe allocation | | | $n_{PSCCH} = 2$ (as defined in TS 36.213) |
| | PSCCH RB allocation | | | |
| | $\hat{E}_s$ of PSCCH at antenna port | | dBm/15kHz | -85 |
| | PSSCH RMC | | | As specified in Table 12.5.1-2 |
| | PSSCH subframe allocation | | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | | PRB pairs {6, 7} |
| | Time offset (NOTE 4) | | µs | 0 |
| | Frequency offset (NOTE 5) | | Hz | 0 |
| | Propagation Channel | | | AWGN |
| | Antenna configuration | | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.

NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 12.5.1-2: Minimum performance**

| Test num. | Band-width | Sidelink UE | PSSCH Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | Fraction of maximum throughput (%) | SNR (dB) of PSSCH |
| 1 | 5 / 10 MHz | 1 | CD.5 FDD | (NOTE 1) | 24.35 |
| | | 2 | CD.5 FDD | 70 | 2.4 |
| NOTE 1: There is no throughput requirement for Sidelink UE 1. | | | | | |

# 12.6 Multiple timing reference test

The puporse of this test is to check the PSSCH demodulation performance when receiving from two Sidelink UEs that follow different timing references and transmitting on different resources (non-overalapping in time).

## 12.6.1 FDD

The test parameters are specified in Table 12.6.1-1. Sidelink UE 2 and the receiver UE under test are associated with Cell 1. Sidelink UE 1 and Sidelink UE 3 are associated with another cell and use a different timing, and Sidelink UE 1 acts as a synchronization reference only. The minimum requirements are specified in Table 12.6.1-2.

**Table 12.6.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Communication resource pool configuration | | | | As specified in Table A.7.2.1-3 (Configuration #3-FDD) |
| DRX configuration | | | | As specified in Table 12.1.2-1 |
| $N_{oc}$ at antenna port (NOTE 3) | | | dBm/15kHz | -98 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern NOTE 2 | | | OP.1 FDD |
| | Propagation channel | | | AWGN |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -92 |
| Active Sidelink UE(s) | | | | Sidelink UE 1, Sidelink UE 2, Sidelink UE 3 |
| Sidelink UE 1 | Sidelink Transmissions | | | SLSS + PSBCH |
| | networkControlledSyncTx | | | ON |
| | slssid | | | 30 |
| | inCoverage (in MIB-SL) | | | TRUE |
| | syncOffsetIndicator | | | Set same as syncOffsetIndicator in Configuration #3-FDD |
| | Time offset (NOTE 5) | | ms | +12.51 |
| | Frequency offset (NOTE 6) | | Hz | -100 |
| | Propagation channel | | | EPA5 |
| | Antenna configuration | | | 1x2 Low |
| | $\hat{E}_s$ at antenna port | | dBm/15kHz | -85 |
| Sidelink UE 2 | Sidelink Transmissions | | | PSCCH + PSSCH |
| | Resource pool | | | *commRxPool(0)* |
| | PSCCH RMC | | | 5MHz: CC.1 FDD<br>10 MHz: CC.2 FDD<br>(NOTE 5) |
| | PSCCH subframe allocation | | | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH\_RP}/2 \rfloor L_{PSCCH} - 1]$ every sc-period |
| | PSCCH RB allocation | | | |
| | $\hat{E}_s$ of PSCCH at antenna port | | dBm/15kHz | -85 |
| | PSSCH RMC | | | As specified in Table 12.6.1-2 |
| | PSSCH subframe allocation | | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
| | Time offset (NOTE 4, 5) | | | PSCCH: +1µs PSSCH: +1µs – 288$T_s$ |
| | Frequency offset (NOTE 6) | | Hz | +200 |
| | Propagation Channel | | | EVA70 |
| | Antenna configuration | | | 1x2 Low |
| Sidelink UE 3 | Sidelink Transmissions | | | PSCCH + PSSCH |
| | Resource pool | | | *commRxPool(1)* |
| | PSCCH RMC | | | 5MHz: CC.5 FDD<br>10 MHz: CC.6 FDD |
| | PSCCH subframe allocation | | | As defined by TS 36.213 with $n_{PSCCH}$ chosen randomly (uniformly) in $[0, \lfloor M_{RB}^{PSCCH\_RP}/2 \rfloor L_{PSCCH} - 1]$ every sc-period |
| | PSCCH RB allocation | | | |
| | $\hat{E}_s$ of PSCCH at antenna port | | dBm/15kHz | -85 |
| | PSSCH RMC | | | As specified in Table 12.6.1-2 |

| | | | |
|---|---|---|---|
| | PSSCH subframe allocation | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | First transmission: Chosen randomly (uniformly) among the allowed RBs as per TS36.213<br>HARQ retransmission: As per frequency hopping indicated in PSCCH and specified in TS36.213 |
| | Time offset (NOTE 5) | ms | +12.509 |
| | Frequency offset (NOTE 6) | Hz | +300 |
| | Propagation Channel | | EVA70 |
| | Antenna configuration | | 1x2 Low |
| NOTE 1: $P_B = 0$.<br>NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.<br>NOTE 3: Applicable to both DL channel and ProSe Direct Communication Subframes on UL.<br>NOTE 4: Timing advance indication in PSSCH is set as 18 (=288$T_s$) in this test. PSSCH timing is advanced with respect to PSCCH timing by the quantity (i.e., PSSCH timing shall be +1µs – 288$T_s$ in this test).<br>NOTE 5: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.<br>NOTE 6: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency. | | | |

**Table 12.6.1-2: Minimum performance**

| Test num. | Band-width | Sidelink UE | PSSCH Reference channel | Reference value | |
|---|---|---|---|---|---|
| | | | | Fraction of maximum throughput (%) (NOTE 1) | SNR (dB) |
| 1 | 10 MHz | 2 | CD.4 FDD | 70 | 3.0 |
| | | 3 | CD.2 FDD | 70 | 2.8 |
| | 5 MHz | 2 | CD.3 FDD | 70 | 2.9 |
| | | 3 | CD.2 FDD | 70 | 2.8 |
| NOTE 1: The throughput is measured after 40 radio frames of lead time during which the test UE detects and synchronizes to Sidelink UE 1. | | | | | |

# 12.7 Maximum Sidelink processes test

The purpose of this test is to verify the maximum number of Sidelink processes and the maximum number of bits per TTI supported by the UE.

## 12.7.1 FDD

The test parameters are specified in Table 12.7.1-1. Multiple communication resource pools are interleaved. Each active Sidelink UE transmits in one of the resource pools with 3 retransmissions. The minimum requirements are specified in Table 12.7.1-2.

**Table 12.7.1-1: Test Parameters**

| Parameter | | | Unit | Test 1 |
|---|---|---|---|---|
| Communication resource pool configuration | | | | As specified in Table A.7.2.1-4<br>(Configuration #4-FDD) |
| DRX configuration | | | | As specified in Table 12.1.2-1 |
| Active cell(s) | | | | Cell 1 (Serving cell) |
| Cell 1 | Cyclic prefix | | | Normal |
| | Cell ID | | | 0 |
| | Downlink power allocation | $\rho_A$ | dB | 0 |
| | | $\rho_B$ | dB | 0 (NOTE 1) |
| | | σ | dB | 0 |
| | OCNG Pattern (NOTE 2) | | | OP.1 FDD |
| | Propagation channel | | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | | 1x2 |
| | RSRP | | dBm/15kHz | -85 |
| Active Sidelink UE(s) | | | | Sidelink UE i, 0 ≤ i ≤ 15 |
| Sidelink UE i,<br>0 ≤ i ≤ 15 | Sidelink Transmissions | | | PSCCH + PSSCH |
| | Resource pool | | | *commRxPool(* $\left\lfloor \frac{i}{8} \right\rfloor$ *)* |
| | PSCCH RMC | | | 5MHz: CC.1 FDD with $I_{TRP}$=i%8 (NOTE 3)<br>10 MHz: CC.2 FDD with $I_{TRP}$= i%8 (NOTE 3) |
| | PSCCH subframe allocation | | | As defined by TS 36.213 with $n_{PSCCH}$ = i |
| | PSCCH RB allocation | | | |
| | PSSCH RMC | | | As specified in Table 12.7.1-2 |
| | PSSCH subframe allocation | | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | | Fully allocated |
| | Time offset (NOTE 4) | | µs | 0 |
| | Frequency offset (NOTE 5) | | Hz | 0 |
| | Propagation Channel | | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | | 1x2 Low |

NOTE 1: $P_B = 0$.
NOTE 2: OCNG is used to fully allocate the available resource blocks to virtual UEs.
NOTE 3: For $N_{TRP}$ = 8 (FDD) and *trpt-Subset* = 001, $I_{TRP}$ = 0 corresponds to a time repetition pattern of (1,0,0,0,0,0,0,0), $I_{TRP}$ = 1 corresponds to a time repetition pattern of (0,1,0,0,0,0,0,0), etc.
NOTE 4: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 5: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 12.7.1-2: Minimum performance**

| Test num. | Bandwidth | PSCCH Reference channel | $\hat{E}_s$ at antenna port (dBm/15kHz) | Reference value for Sidelink UE i=0…15 |
|---|---|---|---|---|
| | | | | Fraction of maximum throughput (%) |
| 1 | 10 MHz | CD.7 FDD | -85 | 95 |
| | 5 MHz | CD.6 FDD | -85 | 95 |

# 12.8 Sustained downlink data rate with active Sidelink

The purpose of this test is to verify the downlink data rate is not impacted when Sidelink resource are also configured. The test parameters are in Table 12.8.1-1. Cell 1 is the serving cell and UE 1 and UE 2 are transmitters of Prose Direct Communication. The test UE is expected to receive all PDSCH transmissions, and prioritize the transmission of ACK/NACK over the reception of UE 2's PSSCH.

The test cases apply to UE categories and bandwidth combinations with maximum aggregated bandwidth as specified in Table 12.8.1-2. The minimum requirements are specified in Table 12.8.1-3. The TB success rate in the cellular link shall be sustained during at least 300 frames.

**Table 12.8.1-1: Test parameters for sustained downlink data rate (FDD 64QAM) with active Sidelink**

| Parameter | | Unit | Test 1, 2, 3A |
|---|---|---|---|
| Communication resource pool configuration | | | As specified in Table A.7.2.1-5 (Configuration #5-FDD) |
| Active cell(s) | | | Cell 1 (Serving cell) |
| Cell 1 | Test parameters | | As specified in clause 8.7.1: Table 8.7.1-1 and Test 1, 2, 3A in Table 8.7.1-2 |
| Active Sidelink UE(s) | | | Sidelink UE 1, Sidelink UE 2 |
| Sidelink UE 1 | Sidelink Transmissions | | PSCCH + PSSCH |
| | PSCCH RMC | | 10 MHz: CC.2 FDD with $I_{TRP}$=0 (NOTE 1) |
| | PSCCH subframe allocation | | As defined by TS 36.213 with $n_{PSCCH}$ = 0 |
| | PSCCH RB allocation | | |
| | PSSCH RMC | | 10 MHz: CD.7 FDD |
| | PSSCH subframe allocation | | As per time repetition pattern specified in PSCCH |
| | PSSCH RB allocation | | Fully allocated |
| | Time offset (NOTE 3) | µs | 0 |
| | Frequency offset (NOTE 4) | Hz | 0 |
| | Propagation Channel | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | 1x2 Low |
| | $\hat{E}_s$ at antenna port | dBm/15kHz | -85 |
| Sidelink UE 2 | Sidelink Transmissions | | PSCCH (NOTE 2) |
| | PSCCH RMC | | 10 MHz: CC.2 FDD with $I_{TRP}$=1 (NOTE 1) |
| | PSCCH subframe allocation | | As defined by TS 36.213 with $n_{PSCCH}$ = 1 |
| | PSCCH RB allocation | | |
| | Time offset (NOTE 3) | µs | 0 |
| | Frequency offset (NOTE 4) | Hz | 0 |
| | Propagation Channel | | Static propagation condition<br>No external noise sources are applied |
| | Antenna configuration | | 1x2 Low |
| | $\hat{E}_s$ at antenna port | dBm/15kHz | -85 |

NOTE 1: For $N_{TRP}$ = 8 (FDD) and *trpt-Subset* = 001, $I_{TRP}$ = 0 corresponds to a time repetition pattern of (1,0,0,0,0,0,0,0), $I_{TRP}$ = 1 corresponds to a time repetition pattern of (0,1,0,0,0,0,0,0).
NOTE 2: Sidelink UE 2 transmits PSCCH but not PSSCH.
NOTE 3: Time offset of Sidelink UE receive signal with respect to Cell 1 downlink timing at the tested UE.
NOTE 4: Frequency offset of Sidelink UE with respect to Cell 1 uplink frequency.

**Table 12.8.1-2: Test cases for sustained data rate**

| CA config | Maximum supported Bandwidth/ Bandwidth combination (MHz) | Cat. 1 | Cat. 2 | Cat. 3 | Cat. 4 | Cat. 6,7 | Cat. 9,10 | Cat 11, 12 |
|---|---|---|---|---|---|---|---|---|
| Single carrier | 10 | 1 | 2 | 3A | 3A | 3A | 3A | 3A |

**Table 12.8.1-3: Minimum requirements (FDD 64QAM) with active Sidelink**

| Test | Bandwidth (MHz) | Number of bits of a DL-SCH transport block received within a TTI | Measurement channel | Reference value<br>PDSCH TB success rate (%) |
|---|---|---|---|---|
| 1 | 10 | 10296 | R.31-1 FDD (NOTE 2) | 95 |
| 2 | 10 | 25456 | R.31-2 FDD (NOTE 2) | 95 |
| 3A | 10 | 36696 (NOTE 1) | R.31-3A FDD (NOTE 2) | 85 |

NOTE 1: 35160 bits for sub-frame 5.
NOTE 2: PDSCH scheduling pattern is changed as per the following bitmap that repeats every 40ms. PDSCH scheduling subframe bitmap = {01110111 11110111 11110111 11110111 11111110}.

# 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 $N_{RB}$ 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 / HD-FDD | Table A.2.2.1.1-1a | | 1.4 | QPSK | 1/3 | 6 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.1-1a | | 3 | QPSK | 1/5 | 15 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.1-1a | | 5 | QPSK | 1/8 | 25 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.1-1a | | 10 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.1-1a | | 15 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.1-1a | | 20 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| **FDD, 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 / HD-FDD | Table A.2.2.1.2-1a | | 1.4 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.2-1a | | 3 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.2-1a | | 5 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.2-1a | | 10 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.2-1a | | 15 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.1.2-1a | | 20 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| **FDD, 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 / HD-FDD | Table A.2.2.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 1 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 2 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 3 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 4 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 5 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 3-20 | QPSK | 1/3 | 6 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 3-20 | QPSK | 1/3 | 8 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 3-20 | QPSK | 1/3 | 9 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 3-20 | QPSK | 1/3 | 10 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 3-20 | QPSK | 1/4 | 12 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 5-20 | QPSK | 1/5 | 15 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 5-20 | QPSK | 1/5 | 16 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 5-20 | QPSK | 1/6 | 18 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 5-20 | QPSK | 1/6 | 20 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 5-20 | QPSK | 1/8 | 24 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 10-20 | QPSK | 1/8 | 25 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 10-20 | QPSK | 1/8 | 27 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.1-1a | | 10-20 | QPSK | 1/10 | 30 | | - | UE UL Category 0 |
| **FDD, 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 | |
| FDD / HD-FDD | Table A.2.2.2.2-1a | | 1.4 - 20 | 16QAM | 3/4 | 1 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.2-1a | | 1.4 - 20 | 16QAM | 3/4 | 2 | | - | UE UL Category 0 |
| FDD / HD-FDD | Table A.2.2.2.2-1a | | 1.4 - 20 | 16QAM | 2/5 | 4 | | - | UE UL Category 0 |
| **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 | Table A.2.3.1.1-1a | | 1.4 | QPSK | 1/3 | 6 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.1-1a | | 3 | QPSK | 1/5 | 15 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.1-1a | | 5 | QPSK | 1/8 | 25 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.1-1a | | 10 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.1-1a | | 15 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.1-1a | | 20 | QPSK | 1/10 | 36 | | - | UE UL Category 0 |
| **TDD, 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 | Table A.2.3.1.2-1a | | 1.4 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.2-1a | | 3 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.2-1a | | 5 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.2-1a | | 10 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.2-1a | | 15 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.1.2-1a | | 20 | 16QAM | 1/3 | 5 | | - | UE UL Category 0 |
| **TDD, 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 | Table A.2.3.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 1 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 2 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 3 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 4 | | - | UE UL Category 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TDD | Table A.2.3.2.1-1a | | 1.4 - 20 | QPSK | 1/3 | 5 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 3-20 | QPSK | 1/3 | 6 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 3-20 | QPSK | 1/3 | 8 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 3-20 | QPSK | 1/3 | 9 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 3-20 | QPSK | 1/3 | 10 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 3-20 | QPSK | 1/4 | 12 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 5-20 | QPSK | 1/5 | 15 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 5-20 | QPSK | 1/5 | 16 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 5-20 | QPSK | 1/6 | 18 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 5-20 | QPSK | 1/6 | 20 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 5-20 | QPSK | 1/8 | 24 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 10-20 | QPSK | 1/8 | 25 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 10-20 | QPSK | 1/8 | 27 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.1-1a | | 10-20 | QPSK | 1/10 | 30 | | - | UE UL Category 0 |
| **TDD, 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 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TDD | Table A.2.3.2.2-1a | | 1.4 - 20 | 16QAM | 3/4 | 1 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.2-1a | | 1.4 - 20 | 16QAM | 3/4 | 2 | | - | UE UL Category 0 |
| TDD | Table A.2.3.2.2-1a | | 1.4 - 20 | 16QAM | 2/5 | 4 | | - | UE UL Category 0 |

# A.2.2 Reference measurement channels for FDD

## A.2.2.1 Full RB allocation

### A.2.2.1.1 QPSK

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

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

**Table A.2.2.1.1-1a Reference Channels for QPSK with full/maximum RB allocation for UE UL category 0**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 25 | 36 | 36 | 36 |
| DFT-OFDM Symbols per Sub-Frame | | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate | | 1/3 | 1/5 | 1/8 | 1/10 | 1/10 | 1/10 |
| Payload size | Bits | 600 | 872 | 904 | 1000 | 1000 | 1000 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks per Sub-Frame (NOTE 1) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Total number of bits per Sub-Frame | Bits | 1728 | 4320 | 7200 | 10368 | 10368 | 10368 |
| Total symbols per Sub-Frame | | 864 | 2160 | 3600 | 5184 | 5184 | 5184 |
| UE UL Category | | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled. | | | | | | | |

#### A.2.2.1.2 16-QAM

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

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

**Table A.2.2.1.2-1a Reference Channels for 16-QAM with maximum RB allocation for UE UL category 0**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 5 | 5 | 5 | 5 | 5 | 5 |
| DFT-OFDM Symbols per Sub-Frame | | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size | Bits | 872 | 872 | 872 | 872 | 872 | 872 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks per Sub-Frame | | 1 | 1 | 1 | 1 | 1 | 1 |
| Total number of bits per Sub-Frame | Bits | 2880 | 2880 | 2880 | 2880 | 2880 | 2880 |
| Total symbols per Sub-Frame | | 720 | 720 | 720 | 720 | 720 | 720 |
| UE UL Category | | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled. | | | | | | | |

#### 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) | | | | | | | | | | |

**Table A.2.2.2.1-1a Reference Channels for QPSK with partial RB allocation for UE UL category 0**

| Parameter | Ch BW | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Trans-port block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE UL Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | MHz | | | | | Bits | Bits | | Bits | | |
| | 1.4 - 20 | 1 | 12 | QPSK | 1/3 | 72 | 24 | 1 | 288 | 144 | 0 |
| | 1.4 - 20 | 2 | 12 | QPSK | 1/3 | 176 | 24 | 1 | 576 | 288 | 0 |
| | 1.4 - 20 | 3 | 12 | QPSK | 1/3 | 256 | 24 | 1 | 864 | 432 | 0 |
| | 1.4 - 20 | 4 | 12 | QPSK | 1/3 | 392 | 24 | 1 | 1152 | 576 | 0 |
| | 1.4 - 20 | 5 | 12 | QPSK | 1/3 | 424 | 24 | 1 | 1440 | 720 | 0 |
| | 3-20 | 6 | 12 | QPSK | 1/3 | 600 | 24 | 1 | 1728 | 864 | 0 |
| | 3-20 | 8 | 12 | QPSK | 1/3 | 808 | 24 | 1 | 2304 | 1152 | 0 |
| | 3-20 | 9 | 12 | QPSK | 1/3 | 776 | 24 | 1 | 2592 | 1296 | 0 |
| | 3-20 | 10 | 12 | QPSK | 1/3 | 872 | 24 | 1 | 2880 | 1440 | 0 |
| | 3-20 | 12 | 12 | QPSK | 1/4 | 840 | 24 | 1 | 3456 | 1728 | 0 |
| | 5-20 | 15 | 12 | QPSK | 1/5 | 872 | 24 | 1 | 4320 | 2160 | 0 |
| | 5-20 | 16 | 12 | QPSK | 1/5 | 904 | 24 | 1 | 4608 | 2304 | 0 |
| | 5-20 | 18 | 12 | QPSK | 1/6 | 776 | 24 | 1 | 5184 | 2592 | 0 |
| | 5-20 | 20 | 12 | QPSK | 1/6 | 872 | 24 | 1 | 5760 | 2880 | 0 |
| | 5-20 | 24 | 12 | QPSK | 1/8 | 872 | 24 | 1 | 6912 | 3456 | 0 |
| | 10-20 | 25 | 12 | QPSK | 1/8 | 904 | 24 | 1 | 7200 | 3600 | 0 |
| | 10-20 | 27 | 12 | QPSK | 1/8 | 968 | 24 | 1 | 7776 | 3888 | 0 |
| | 10-20 | 30 | 12 | QPSK | 1/10 | 808 | 24 | 1 | 8640 | 4320 | 0 |

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

Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled.

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

**Table A.2.2.2.2-1a Reference Channels for 16-QAM with partial RB allocation for UE UL category 0**

| Parameter | Ch BW | Allocated RBs | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame | Total symbols per Sub-Frame | UE UL Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | MHz | | | | | Bits | Bits | | Bits | | |
| | 1.4 - 20 | 1 | 12 | 16QAM | 3/4 | 408 | 24 | 1 | 576 | 144 | 0 |
| | 1.4 - 20 | 2 | 12 | 16QAM | 3/4 | 840 | 24 | 1 | 1152 | 288 | 0 |
| | 1.4 - 20 | 4 | 12 | 16QAM | 2/5 | 904 | 24 | 1 | 2304 | 576 | 0 |
| Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th, 6th, 12th, 13th, 14th, 20th, 21st, 22nd, 28th, 29th, 30th, 36th, 37th, and 38th subframes every 40ms. Information bit payload is available if uplink subframe is scheduled. | | | | | | | | | | | |

### 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] | | | | | | | |

**Table A.2.3.1.1-1a Reference Channels for QPSK with full/maximum RB allocation for UE UL category 0**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 15 | 25 | 36 | 36 | 36 |
| Uplink-Downlink Configuration (Note 2) | | 1 | 1 | 1 | 1 | 1 | 1 |
| DFT-OFDM Symbols per Sub-Frame | | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding rate | | 1/3 | 1/5 | 1/8 | 1/10 | 1/10 | 1/10 |
| Payload size | | | | | | | |
| For Sub-Frame 2,3,7,8 | Bits | 600 | 872 | 904 | 1000 | 1000 | 1000 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks per Sub-Frame (Note 1) | | | | | | | |
| For Sub-Frame 2,3,7,8 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Total number of bits per Sub-Frame | | | | | | | |
| For Sub-Frame 2,3,7,8 | Bits | 1728 | 4320 | 7200 | [10368 | 10368 | 10368 |
| Total symbols per Sub-Frame | | | | | | | |
| For Sub-Frame 2,3,7,8 | | 864 | 2160 | 3600 | 5184 | 5184 | 5184 |
| UE UL Category | | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<br>NOTE 2: As per Table 4.2-2 in TS 36.211 | | | | | | | |

## A.2.3.1.2 16-QAM

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

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

**Table A.2.3.1.2-1a Reference Channels for 16-QAM with maximum RB allocation for UE UL category 0**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 5 | 5 | 5 | 5 | 5 | 5 |
| Uplink-Downlink Configuration (Note 2) | | 1 | 1 | 1 | 1 | 1 | 1 |
| DFT-OFDM Symbols per Sub-Frame | | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size | | | | | | | |
| For Sub-Frame 2,3,7,8 | Bits | 872 | 872 | 872 | 872 | 872 | 872 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks per Sub-Frame (Note 1) | | | | | | | |
| For Sub-Frame 2,3,7,8 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Total number of bits per Sub-Frame | | | | | | | |
| For Sub-Frame 2,3,7,8 | Bits | 2880 | 2880 | 2880 | 2880 | 2880 | 2880 |
| Total symbols per Sub-Frame | | | | | | | |
| For Sub-Frame 2,3,7,8 | | 720 | 720 | 720 | 720 | 720 | 720 |
| UE UL Category | | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)<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)
Note 2: As per Table 4.2-2 in TS 36.211 [4]

**Table A.2.3.2.1-1a Reference Channels for QPSK with partial RB allocation for UE UL category 0**

| Parameter | Ch BW | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE UL Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Unit** | **MHz** | | | | | | **Bits** | **Bits** | | **Bits** | | |
| | 1.4 - 20 | 1 | 1 | 12 | QPSK | 1/3 | 72 | 24 | 1 | 288 | 144 | 0 |
| | 1.4 - 20 | 2 | 1 | 12 | QPSK | 1/3 | 176 | 24 | 1 | 576 | 288 | 0 |
| | 1.4 - 20 | 3 | 1 | 12 | QPSK | 1/3 | 256 | 24 | 1 | 864 | 432 | 0 |
| | 1.4 - 20 | 4 | 1 | 12 | QPSK | 1/3 | 392 | 24 | 1 | 1152 | 576 | 0 |
| | 1.4 - 20 | 5 | 1 | 12 | QPSK | 1/3 | 424 | 24 | 1 | 1440 | 720 | 0 |
| | 3-20 | 6 | 1 | 12 | QPSK | 1/3 | 600 | 24 | 1 | 1728 | 864 | 0 |
| | 3-20 | 8 | 1 | 12 | QPSK | 1/3 | 808 | 24 | 1 | 2304 | 1152 | 0 |
| | 3-20 | 9 | 1 | 12 | QPSK | 1/3 | 776 | 24 | 1 | 2592 | 1296 | 0 |
| | 3-20 | 10 | 1 | 12 | QPSK | 1/3 | 872 | 24 | 1 | 2880 | 1440 | 0 |
| | 3-20 | 12 | 1 | 12 | QPSK | 1/4 | 840 | 24 | 1 | 3456 | 1728 | 0 |
| | 5-20 | 15 | 1 | 12 | QPSK | 1/5 | 872 | 24 | 1 | 4320 | 2160 | 0 |
| | 5-20 | 16 | 1 | 12 | QPSK | 1/5 | 904 | 24 | 1 | 4608 | 2304 | 0 |
| | 5-20 | 18 | 1 | 12 | QPSK | 1/6 | 776 | 24 | 1 | 5184 | 2592 | 0 |
| | 5-20 | 20 | 1 | 12 | QPSK | 1/6 | 872 | 24 | 1 | 5760 | 2880 | 0 |
| | 5-20 | 24 | 1 | 12 | QPSK | 1/8 | 872 | 24 | 1 | 6912 | 3456 | 0 |
| | 10-20 | 25 | 1 | 12 | QPSK | 1/8 | 904 | 24 | 1 | 7200 | 3600 | 0 |
| | 10-20 | 27 | 1 | 12 | QPSK | 1/8 | 968 | 24 | 1 | 7776 | 3888 | 0 |
| | 10-20 | 30 | 1 | 12 | QPSK | 1/10 | 808 | 24 | 1 | 8640 | 4320 | 0 |
| Note 1: | If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | | | | | | | | | |
| Note 2: | As per Table 4.2-2 in TS 36.211 [4] | | | | | | | | | | | |

### 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]

**Table A.2.3.2.2-1a Reference Channels for 16QAM with partial RB allocation UE UL category 0**

| Parameter | Ch BW | Allocated RBs | UDL Configuration (Note 2) | DFT-OFDM Symbols per Sub-Frame | Mod'n | Target Coding rate | Payload size for Sub-Frame 2, 3, 7, 8 | Transport block CRC | Number of code blocks per Sub-Frame (Note 1) | Total number of bits per Sub-Frame for Sub-Frame 2, 3, 7, 8 | Total symbols per Sub-Frame for Sub-Frame 2, 3, 7, 8 | UE UL Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | MHz | | | | | | Bits | Bits | | Bits | | |
| | 1.4 - 20 | 1 | 1 | 12 | 16QAM | 3/4 | 408 | 24 | 1 | 576 | 144 | 0 |
| | 1.4 - 20 | 2 | | 12 | 16QAM | 3/4 | 840 | 24 | 1 | 1152 | 288 | 0 |
| | 1.4 - 20 | 4 | | 12 | 16QAM | 2/5 | 904 | 24 | 1 | 2304 | 576 | 0 |

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

#### 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 | |
| FDD / HD-FDD | Table A.3.2-1a | | 1.4 | QPSK | 1/3 | 6 | | - | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a | | 3 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a | | 5 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a | | 10 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a | | 15 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| FDD / HD-FDD | Table A.3.2-1a | | 20 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| **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 | |
| TDD | Table A.3.2-2a | | 1.4 | QPSK | 1/3 | 6 | | - | UE DL Category 0 |
| TDD | Table A.3.2-2a | | 3 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| TDD | Table A.3.2-2a | | 5 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| TDD | Table A.3.2-2a | | 10 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| TDD | Table A.3.2-2a | | 15 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| TDD | Table A.3.2-2a | | 20 | QPSK | 1/3 | 14 | | - | UE DL Category 0 |
| **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 | | - | |
| **FDD, Receiver requirements, Maximum input level for UE DL Categories 0** | | | | | | | | | |
| FDD | Table A.3.2-3c | | 1.4 | 64QAM | 3/4 | 2 | | - | |
| FDD | Table A.3.2-3c | | 3 | 64QAM | 3/4 | 2 | | - | |
| FDD | Table A.3.2-3c | | 5 | 64QAM | 3/4 | 2 | | - | |
| FDD | Table A.3.2-3c | | 10 | 64QAM | 3/4 | 2 | | - | |
| FDD | Table A.3.2-3c | | 15 | 64QAM | 3/4 | 2 | | - | |
| FDD | Table A.3.2-3c | | 20 | 64QAM | 3/4 | 2 | | - | |
| **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 | | - | |
| **TDD, Receiver requirements, Maximum input level for UE DL Categories 0** | | | | | | | | | |
| TDD | Table A.3.2-4c | | 1.4 | 64QAM | 3/4 | 2 | | - | |
| TDD | Table A.3.2-4c | | 3 | 64QAM | 3/4 | 2 | | - | |
| TDD | Table A.3.2-4c | | 5 | 64QAM | 3/4 | 2 | | - | |
| TDD | Table A.3.2-4c | | 10 | 64QAM | 3/4 | 2 | | - | |
| TDD | Table A.3.2-4c | | 15 | 64QAM | 3/4 | 2 | | - | |
| TDD | Table A.3.2-4c | | 20 | 64QAM | 3/4 | 2 | | - | |
| **FDD, Receiver requirements, Maximum input level for UE Categories 11/12 and UE DL categories ≥ 11** | | | | | | | | | |
| FDD | Table A.3.2-5 | | 1.4 | 256QAM | 4/5 | 6 | | - | |
| FDD | Table A.3.2-5 | | 3 | 256QAM | 4/5 | 15 | | - | |
| FDD | Table A.3.2-5 | | 5 | 256QAM | 4/5 | 25 | | - | |
| FDD | Table A.3.2-5 | | 10 | 256QAM | 4/5 | 50 | | - | |
| FDD | Table A.3.2-5 | | 15 | 256QAM | 4/5 | 75 | | - | |
| FDD | Table A.3.2-5 | | 20 | 256QAM | 4/5 | 100 | | - | |
| **TDD, Receiver requirements, Maximum input level for UE Categories 11/12 and UE DL categories ≥ 11** | | | | | | | | | |
| TDD | Table A.3.2-6 | | 1.4 | 256QAM | 4/5 | 6 | | - | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TDD | Table A.3.2-6 | | 3 | 256QAM | 4/5 | 15 | | - | |
| TDD | Table A.3.2-6 | | 5 | 256QAM | 4/5 | 25 | | - | |
| TDD | Table A.3.2-6 | | 10 | 256QAM | 4/5 | 50 | | - | |
| TDD | Table A.3.2-6 | | 15 | 256QAM | 4/5 | 75 | | - | |
| TDD | Table A.3.2-6 | | 20 | 256QAM | 4/5 | 100 | | - | |
| **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.42-1 FDD | 3 | QPSK | 1/3 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.1-1 | R.42-2 FDD | 5 | QPSK | 1/3 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.1-1 | R.42-3 FDD | 15 | QPSK | 1/3 | 75 | | ≥ 1 | |
| FDD | Table A.3.3.1-1 | R.2 FDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.1-2 | R.3-1 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.1-2 | R.3 FDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.5 FDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.1-3 | R.6 FDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.7 FDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.8 FDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.1-3 | R.9 FDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| FDD | Table A.3.3.1-3a | R.6-1 FDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.7-1 FDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.8-1 FDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-1 FDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| FDD | Table A.3.3.1-3a | R.9-2 FDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| FDD | Table A.3.3.1-6 | R.41 FDD | 10 | QPSK | 1/10 | 50 | | ≥ 1 | |
| **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 | Table A.3.3.1-7 | R.49-1 FDD | 10 | 64QAM | 0.84-0.87 | 50 | | ≥2 | |
| FDD | Table A.3.3.1-7 | R.49-2 FDD | 5 | 64QAM | 0.84-0.86 | 25 | | ≥2 | |
| **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.3.3.2.1-2 | R.10-2 FDD | 5 | QPSK | 1/3 | 25 | | ≥ 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 | Table A.3.3.2.1-2 | R.11-5 FDD | 1.4 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-2 | R.11-6 FDD | 3 | 16QAM | 1/2 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-2 | R.11-7 FDD | 15 | 16QAM | 1/2 | 75 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-2 | R.11-8 FDD | 10 | QPSK | 3/5 | 50 | | ≥ 2 | |
| FDD | Table A.3.3.2.1-2 | R.11-9 FDD | 10 | QPSK | 0.58 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-2 | R.11-10 FDD | 10 | QPSK | 0.67 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.2.1-2 | R.65 FDD | 10 | 256QAM | 0. 55 | 50 | | 11-15 | |
| FDD | Table A.3.3.2.1-3 | R. 62 FDD | 10 | 16QAM | 1/2 | 3 | | 0 | |
| FDD | Table A.3.3.2.1-3 | R.63 FDD | 10 | 64QAM | 1/2 | 1 | | 0 | |
| **FDD, 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 | Table A.3.3.2.2-1 | R.14-4 FDD | 1.4 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| FDD | Table A.3.3.2.2-1 | R.14-5 FDD | 3 | 16QAM | 1/2 | 15 | | ≥ 1 | |
| FDD | Table A.3.3.2.2-1 | R.14-6 FDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| FDD | Table A.3.3.2.2-1 | R.14-7 FDD | 15 | 16QAM | 1/2 | 75 | | ≥ 2 | |
| **FDD, PDSCH Performance (UE specific RS) without CSI-RS** | | | | | | | | | |
| FDD | Table A.3.3.3.0-1 | R.70 FDD | 10 | QPSK | 0.65 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.3.0-1 | R.71 FDD | 10 | 16QAM | 0.6 | 50 | | ≥ 2 | |
| **FDD, 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 | |
| FDD | Table A.3.3.3.2-2 | R.60 FDD | 10 | QPSK | 1/2 | 50 | | ≥ 1 | |
| FDD | Table A.3.3.3.2-3 | R.64 FDD | 10 | QPSK | 1/3 | 6 | | 0 | |
| FDD | Table A.3.3.3.2-1 | R.66 FDD | 10 | 256QAM | 0.77 | 50 | | 11-15 | |
| FDD | Table A.3.3.3.2-4 | R.69 FDD | 10 | QPSK | 0.74-0.8 | 50 | | ≥ 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.3.4.1-1 | R.2A TDD | 10 | QPSK | 1/3 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.1-1 | R.42-1 TDD | 3 | QPSK | 1/3 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.1-1 | R.42-2 TDD | 5 | QPSK | 1/3 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.1-1 | R.42-3 TDD | 15 | QPSK | 1/3 | 75 | | ≥ 1 | |
| TDD | Table A.3.4.1-2 | R.3-1 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.1-2 | R.3 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.5 TDD | 3 | 64QAM | 3/4 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.1-3 | R.6 TDD | 5 | 64QAM | 3/4 | 25 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.7 TDD | 10 | 64QAM | 3/4 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.8 TDD | 15 | 64QAM | 3/4 | 75 | | ≥ 2 | |
| TDD | Table A.3.4.1-3 | R.9 TDD | 20 | 64QAM | 3/4 | 100 | | ≥ 3 | |
| TDD | Table A.3.4.1-3a | R.6-1 TDD | 5 | 64QAM | 3/4 | 18 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.7-1 TDD | 10 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.8-1 TDD | 15 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-1 TDD | 20 | 64QAM | 3/4 | 17 | | ≥ 1 | |
| TDD | Table A.3.4.1-3a | R.9-2 TDD | 20 | 64QAM | 3/4 | 83 | | ≥ 2 | |
| TDD | Table A.3.4.1-6 | R.41 TDD | 10 | QPSK | 1/10 | 50 | | ≥ 1 | |
| **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 | Table A.3.4.1-7 | R.49-1 TDD | 15 | 64QAM | 0.80-0.86 | 75 | | ≥ 3 | |
| **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 | Table A.3.4.2.1-2 | R.11-5 TDD | 1.4 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-2 | R.11-6 TDD | 3 | 16QAM | 1/2 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-2 | R.11-7 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-2 | R.11-8 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |

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|---|---|---|---|---|---|---|---|---|---|
| TDD | Table A.3.4.2.1-2 | R.11-9 TDD | 15 | 16QAM | 1/2 | 75 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-2 | R.11-10 TDD | 10 | QPSK | 3/5 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.2.1-2 | R.11-11 TDD | 10 | QPSK | 0.48-0.58 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-2 | R.11-12 TDD | 10 | QPSK | 0.54-0.66 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.2.1-3 | R.62 TDD | 10 | 16QAM | 1/2 | 3 | | 0 | |
| TDD | Table A.3.4.2.1-3 | R.63 TDD | 10 | 64QAM | 1/2 | 1 | | 0 | |
| TDD | Table A.3.4.2.1-4 | R.65 TDD | 20 | 256QAM | 0.6 | 100 | | 11-15 | |
| TDD | Table A.3.4.2.1-5 | R.67 TDD | 10 | 16QAM | 0.4 | 50 | | ≥ 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 | Table A.3.4.2.2-1 | R.43-1 TDD | 1.4 | 16QAM | 1/2 | 6 | | ≥ 1 | |
| TDD | Table A.3.4.2.2-1 | R.43-2 TDD | 3 | 16QAM | 1/2 | 15 | | ≥ 1 | |
| TDD | Table A.3.4.2.2-1 | R.43-3 TDD | 5 | 16QAM | 1/2 | 25 | | ≥ 1 | |
| TDD | Table A.3.4.2.2-1 | R.43-4 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.2.2-1 | R.43-5 TDD | 15 | 16QAM | 1/2 | 75 | | ≥ 2 | |
| **TDD, 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 | Table A.3.4.3.2 | R.70 TDD | 10 | QPSK | 0.54-0.65 | 50 | | ≥ 1 | |
| TDD | Table A.3.4.3.2 | R.71 TDD | 10 | 16QAM | 0.5-0.6 | 50 | | ≥ 2 | |
| **TDD, 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 | Table A.3.4.3.4-2 | R.60 TDD | 10 | QPSK | 1/2 | 50 | | ≥ 1 | |

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|---|---|---|---|---|---|---|---|---|---|
| TDD | Table A.3.4.3.4-2 | R.61 TDD | 10 | 16QAM | 1/2 | 50 | | ≥ 2 | |
| TDD | Table A.3.4.3.4-2 | R.61-1 TDD | 10 | 16QAM | 1/2 | 39 | | ≥ 1 | |
| TDD | Table A.3.4.3.4-3 | R.64 TDD | 10 | QPSK | 1/3 | 6 | | 0 | |
| TDD | Table A.3.4.3.4-1 | R.66 TDD | 20 | 256QAM | | 100 | | 11-15 | |
| TDD | Table A.3.4.3.4-4 | R.69 TDD | 10 | QPSK | 0.61-0.8 | 50 | | ≥ 1 | |
| **TDD, 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 | Table A.3.6.1 | R.19-1 | 5 | PHICH | | | | | |
| FDD / TDD | Table A.3.6-1 | R.20 | 5 | PHICH | | | | | |
| FDD / TDD | Table A.3.6-1 | R.24 | 10 | PHICH | | | | | |
| **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- | | | ≥ 2 | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.64 | | | | |
| FDD | Table A.3.9.1-1 | R.31-3 FDD | 20 | 64QAM | 0.59-0.62 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31-3A FDD | 10 | 64QAM | 0.85-0.90 | | | ≥ 2 | |
| FDD | Table A.3.9.1-1 | R.31-3C FDD | 15 | 64QAM | 0.87-0.91 | | | ≥ 3 | |
| FDD | Table A.3.9.1-1 | R.31-4 FDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |
| FDD | Table A.3.9.1-1 | R.31-4B FDD | 15 | 64QAM | 0.85-0.88 | | | ≥ 4 | |
| FDD | Table A.3.9.1-1 | R.31-5 FDD | 15 | 64QAM | 0.85-0.91 | | | ≥ 3 | |
| FDD | Table A.3.9.1-2 | R.31-6 FDD | 5 | 64QAM | 0.83-0.85 | | | ≥ 2 | |
| FDD | Table A.3.9.1-3 | R.68 FDD | 20 | 256QAM | 0.74-0.85 | | | 11-12 | |
| FDD | Table A.3.9.1-3 | R.68-1 FDD | 15 | 256QAM | 0.74-0.88 | | | 11-12 | |
| FDD | Table A.3.9.1-3 | R.68-2 FDD | 10 | 256QAM | 0.74-0.85 | | | 11-12 | |
| FDD | Table A.3.9.1-3 | R.68-3 FDD | 5 | 256QAM | 0.77-0.85 | | | 11-12 | |
| **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 | |
| TDD | Table A.3.9.2-1 | R.31-4A TDD | 20 | 64QAM | 0.87-0.90 | | | ≥ 3 | |
| TDD | Table A.3.9.2-1 | R.31-5 TDD | 15 | 64QAM | 0.85-0.88 | | | ≥ 3 | |
| TDD | Table A.3.9.2-1 | R.31-5A TDD | 15 | 64QAM | 0.85-0.88 | | | ≥ 3 | |
| TDD | Table A.3.9.2-1 | R.31-6 TDD | 10 | 64QAM | 0.85-0.88 | | | ≥ 2 | |
| TDD | Table A.3.9.2-2 | R.68 TDD | 20 | 256QAM | | | | 11-12 | |
| TDD | Table A.3.9.2-2 | R.68-1 TDD | 15 | 256QAM | | | | 11-12 | |
| TDD | Table A.3.9.2-2 | R.68-2 TDD | 10 | 256QAM | | | | 11-12 | |
| TDD | Table A.3.9.2-2 | R.68-3 TDD | 20 | 256QAM | | | | 11-12 | |
| TDD | Table A.3.9.2-2 | R.68-4 TDD | 15 | 256QAM | | | | 11-12 | |
| **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 | | | ≥ 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

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

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

**Table A.3.2-1a Fixed Reference Channel for Receiver Requirements (FDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 14 | 14 | 14 | 14 | 14 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 1000 | 1000 | 1000 | 1000 | 1000 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 (Note 3) | Bits | 152 | 840 | 840 | 904 | 904 | 904 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 1 | 1 | 1 | 1 | 1 | 1 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1368 | 3528 | 3528 | 3864 | 3864 | 3864 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 (Note 3) | Bits | 528 | 2688 | 2688 | 3024 | 3024 | 3024 |
| Max. Throughput averaged over 1 frame | kbps | 341.6 | 884 | 884 | 890.4 | 890.4 | 890.4 |
| UE DL Category | | 0 | 0 | 0 | 0 | 0 | 0 |

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

Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.

Note 3: For Sub-Frame 0, it is assumed the 6PRBs are allocated in the centre of the channel where some REs of the same PRBs are occupied by PBCH and synchronization signals.

Note 4: For HD-FDD UE, the downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled.

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel Bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 6 | 14 | 14 | 14 | 14 | 14 |
| Uplink-Downlink Configuration (Note 5) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmission | | 1 | 1 | 1 | 1 | 1 | 1 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target coding rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Information Bit Payload per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | 408 | 1000 | 1000 | 1000 | 1000 | 1000 |
| For Sub-Frame 1, 6 | | N/A | 872 | 872 | 872 | 872 | 872 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 208 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frame 4, 9 | | 1 | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frame 1, 6 | | N/A | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Binary Channel Bits Per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | 1368 | 3528 | 3528 | 3864 | 3864 | 3864 |
| For Sub-Frame 1, 6 | | N/A | 3048 | 3048 | 3048 | 3048 | 3048 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 672 | 2832 | 2832 | 3168 | 3168 | 3168 |
| Max. Throughput averaged over 1 frame | kbps | 102.4 | 474.4 | 474.4 | 474.4 | 474.4 | 474.4 |
| UE DL Category | | 0 | 0 | 0 | 0 | 0 | 0 |

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

**Table A.3.2-3 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.
Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

**Table A.3.2-3c Fixed Reference Channel for Maximum input level for UE DL Category 0 (FDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 2 | 2 | 2 | 2 | 2 | 2 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Allocated subframes per Radio Frame | | 8 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 (Note 3) | Bits | N/A | 1000 | 1000 | 1000 | 1000 | 1000 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 1 | 1 | 1 | 1 | 1 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1368 | 1512 | 1512 | 1656 | 1656 | 1656 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 (Note 3) | Bits | N/A | 1512 | 1512 | 1656 | 1656 | 1656 |
| Max. Throughput averaged over 1 frame | kbps | 800 | 900 | 900 | 900 | 900 | 900 |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. 3 symbols allocated to PDCCH for 5 MHz and 3 MHz. 4 symbols allocated to PDCCH for 1.4 MHz.
Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211.
Note 3: For Sub-Frame 0, it is assumed that the allocated 2PRBs are scheduled on the RBs other than the center 6PRBs as most of the symbols are occupied by PBCH and synchronization signals.

**Table A.3.2-4 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].

**Table A.3.2-4c Fixed Reference Channel for Maximum input level for UE DL Category 0 (TDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | 2 | 2 | 2 | 2 | 2 | 2 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 | 12 |
| Uplink-Downlink Configuration (Note 5) | | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame | | 2 | 3+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| For Sub-Frames 1,6 | Bits | N/A | 712 | 712 | 712 | 712 | 712 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 1000 | 1000 | 1000 | 1000 | 1000 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frames 1,6 | | N/A | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 1 | 1 | 1 | 1 | 1 |
| Binary Channel Bits per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1368 | 1512 | 1512 | 1656 | 1656 | 1656 |
| For Sub-Frames 1,6 | | N/A | 1224 | 1224 | 1368 | 1368 | 1368 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 1512 | 1512 | 1656 | 1656 | 1656 |
| Max. Throughput averaged over 1 frame | kbps | 200 | 442.4 | 442.4 | 442.4 | 442.4 | 442.4 |

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

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

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

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

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

**Table A.3.2-5 Fixed Reference Channel for Maximum input level for UE Categories 11/12 and UE DL categories ≥ 11 (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 | | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding Rate | | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Number of HARQ Processes | Processes | 8 | 8 | 8 | 8 | 8 | 8 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 4392 | 12216 | 19848 | 42368 | 63776 | 84760 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9912 | 17568 | 40576 | 63776 | 84760 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | 4 | 7 | 11 | 14 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 7 | 11 | 14 |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 5472 | 15120 | 25200 | 55200 | 82800 | 110400 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 12210 | 22290 | 51840 | 79440 | 107040 |
| Max. Throughput averaged over 1 frame | kbps | 3513.6 | 10764 | 17635.2 | 37952 | 57398.4 | 76284 |

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

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

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

**Table A.3.2-6 Fixed Reference Channel for Maximum input level for UE Categories 11/12 and UE DL categories ≥ 11 (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 | | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Target Coding Rate | | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 | 4/5 |
| Number of HARQ Processes | Processes | 7 | 7 | 7 | 7 | 7 | 7 |
| Maximum number of HARQ transmissions | | 1 | 1 | 1 | 1 | 1 | 1 |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 4392 | 12216 | 19848 | 42368 | 63776 | 84760 |
| For Sub-Frames 1,6 | Bits | N/A | 10680 | 17568 | 36696 | 55056 | 75376 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9912 | 17568 | 42368 | 63776 | 84760 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 4 | 7 | 11 | 14 |
| For Sub-Frames 1,6 | | N/A | 2 | 3 | 6 | 9 | 13 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 3 | 7 | 11 | 14 |
| Binary Channel Bits per Sub-Frame | | | | | | | |
| For Sub-Frames 4,9 | Bits | 5472 | 15120 | 25200 | 55200 | 82800 | 110400 |
| For Sub-Frames 1,6 | | N/A | 13104 | 22224 | 45024 | 67824 | 90624 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 12336 | 22416 | 52416 | 80016 | 107616 |
| Max. Throughput averaged over 1 frame | kbps | 878.4 | 5570.4 | 9240 | 20049.6 | 30144 | 40503.2 |

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

# 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.42-1 FDD | R.42-2 FDD | R.42-3 FDD | R.2 FDD |
| Channel bandwidth | MHz | 1.4 | 20 | 3 | 5 | 15 | 10 |
| Allocated resource blocks (Note 4) | | 6 | 100 | 15 | 25 | 75 | 50 |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | 9 | 9 | 9 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Information Bit Payload (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 8760 | 1320 | 2216 | 6712 | 4392 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 152 | 8760 | 1064 | 1800 | 6712 | 4392 |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 1 | 2 | 1 | 1 | 2 | 1 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | 1 | 1 | 2 | 1 |
| Binary Channel Bits (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1368 | 27600 | 3780 | 6300 | 20700 | 13800 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 528 | 26760 | 2940 | 5460 | 19860 | 12960 |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 0.342 | 7.884 | 1.162 | 1.953 | 6.041 | 3.953 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |

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 4) | | 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 3) | | |
| For Sub-Frames 4,9 | | 1 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | | 1 |
| For Sub-Frame 1,2,3,6,7,8 | | 0 (MBSFN) |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 4,9 | Bits | 552 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 552 |
| For Sub-Frame 1,2,3,6,7,8 | Bits | 0 (MBSFN) |
| Max. Throughput averaged over 1 frame | kbps | 76.8 |
| UE Category | | ≥ 1 |
| Note 1: 2 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>Note 4: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation | | |

**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: Fixed Reference Channel for CA demodulation with power imbalance**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.49 FDD | R.49-1 FDD | R.49-2 FDD |
| Channel bandwidth | MHz | 20 | 10 | 5 |
| Allocated resource blocks | | 100 | 50 | 25 |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 |
| Modulation | | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.84 | 0.84 | 0.84 |
| For Sub-Frame 5 | | N/A | N/A | N/A |
| For Sub-Frame 0 | | 0.87 | 0.87 | 0.86 |
| Information Bit Payload | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 63776 | 31704 | 15840 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | | 63776 | 30576 | 14112 |
| Number of Code Blocks per Sub-Frame (Note 3) | | | | |
| For Sub-Frames 0,1,2,3,4,6,7,8,9 | Code Blocks | 11 | 6 | 3 |
| For Sub-Frame 5 | Code Blocks | N/A | N/A | N/A |
| Binary Channel Bits Per Sub-Frame | | | 5 | 3 |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 75600 | | |
| For Sub-Frame 5 | Bits | N/A | 37800 | 18900 |
| For Sub-Frame 0 | Bits | 73080 | N/A | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 57.398 | 35280 | 16380 |
| UE Category | | ≥5 | ≥2 | ≥2 |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | |

## A.3.3.2 Multi-antenna transmission (Common Reference Symbols)

### A.3.3.2.1 Two antenna ports

**Table A.3.3.2.1-1: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| :e channel | | R.46 FDD | R.47 FDD | R.35-4 FDD | R.11-5 FDD | R.11-6 FDD | R.11-7 FDD | R.11-8 FDD | R.11-9 FDD | R.11-10 FDD | R.65 FDD |
| bandwidth | MHz | 10 | 10 | 10 | 1.4 | 3 | 15 | 10 | 10 | 10 | 10 |
| l resource blocks (Note 4) | | 50 | 50 | 50 | 6 | 15 | 75 | 50 | 50 | 50 | 50 |
| l subframes per Radio Frame | | 9 | 9 | 9 | 8 | 9 | 9 | 9 | 8 | 8 | 9 |
| l number of PDCCH symbols | | 2 | 2 | 2 | 4 | 3 | 2 | 2 | 3 | 3 | 2 |
| on | | QPSK | 16QAM | 64QAM | 16QAM | 16QAM | 16QAM | QPSK | QPSK | QPSK | 256QAM |
| oding Rate | | | | 0.47 | 1/2 | 1/2 | 1/2 | 3/5 | 0.58 | 0.67 | 0. 55 |
| on Bit Payload (Note 4) | | | | | | | | | | | |
| )-Frames 1,2,3,4,6,7,8,9 | Bits | 5160 | 8760 | 18336 | 1352 | 3368 | 19080 | 7992 | 6968 | 7992 | 31704 |
| )-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| )-Frame 0 | Bits | 5160 | 8760 | 16416 | N/A | 2664 | 19080 | 6968 | N/A | N/A | N/A |
| of Code Blocks and 4) | | | | | | | | | | | |
| )-Frames 1,2,3,4,6,7,8,9 | Bits | 1 | 2 | 3 | 1 | 1 | 4 | 2 | 2 | 2 | 6 |
| )-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| )-Frame 0 | Bits | 1 | 2 | 3 | 1 | 1 | 4 | 2 | N/A | N/A | N/A |
| hannel Bits (Note 4) | | | | | | | | | | | |
| )-Frames 1,2,3,4,6,7,8,9 | Bits | 13200 | 26400 | 39600 | 2592 | 7200 | 39600 | 13200 | 12000 | 12000 | 57600 |
| )-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| )-Frame 0 | Bits | 12384 | 24768 | 37152 | N/A | 5568 | 37968 | 12384 | N/A | N/A | N/A |
| oughput averaged over 1 ote 4) | Mbps | 4.644 | 7.884 | 16.310 | 1.082 | 2.961 | 17.172 | 7.0904 | 5.5744 | 6.3936 | 25.363 |
| gory | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | 11-12 |
| ategory | | ≥ 6 | ≥ 6 | ≥ 6 | ≥ 6 | ≥ 6 | ≥ 6 | ≥ 6 | | | ≥ 11 |

Void
Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [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)
Given per component carrier per codeword.

**Table A.3.3.2.1-3: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.62 FDD | R.63 FDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks (Note 4) | | 3 | 1 |
| Allocated DL subframes per 4 Radio Frames (Note 3) | | 15 | 15 |
| Modulation | | 16QAM | 64QAM |
| Target Coding Rate | | 1/2 | 1/2 |
| Information Bit Payload | | | |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Bits | 744 | 408 |
| Number of Code Blocks | | | |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Code blocks | 1 | 1 |
| Binary Channel Bits | | | |
| For Sub-Frames 0,1,2,3,4,5,6,7,8,9 | Bits | 1584 | 792 |
| Max. Throughput averaged over 4 frames | Mbps | 0.279 | 0.153 |
| UE DL Category | | 0 | 0 |

Note 1: 2 symbols allocated to PDCCH
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3: The downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled.
Note 4: Allocated PRB positions start from {9, 10, …, 9+N-1}, where N is the number of allocated resource blocks.

#### 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 | R.14-4 FDD | R.14-5 FDD | R.14-6 FDD | R.14-7 FDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 20 | 10 | 1.4 | 3 | 5 | 15 |
| Allocated resource blocks (Note 4) | | 6 | 50 | 50 | 6 | 3 | 100 | 50 | 6 | 15 | 25 | 75 |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | 8 | 8 | 9 | 9 | 8 | 9 | 9 | 9 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 64QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload (Note 4) | | | | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | 25456 | 18336 | 1192 | 3368 | 5736 | 19080 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | n/a | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 152 | 3624 | 11448 | N/A | N/A | 22920 | 18336 | N/A | 2664 | 4968 | 19080 |
| 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 | 1 | 1 | 1 | 4 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | n/a | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 1 | 2 | N/A | N/A | 4 | 3 | N/A | 1 | 1 | 4 |
| Binary Channel Bits (Note 4) | | | | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 51200 | 38400 | 2496 | 6960 | 11600 | 38400 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | n/a | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 480 | 12032 | 24064 | N/A | N/A | 49664 | 36096 | N/A | 5424 | 10064 | 36864 |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 0.342 | 3.876 | 11.513 | 1.235 | 0.595 | 22.656 | 16.502 | 0.954 | 2.961 | 5.086 | 17.172 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 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.<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.3.3.3.0 Two antenna ports (no CSI-RS)

The reference measurement channels in Table A.3.3.3.0-1 apply with two CRS antenna ports and without CSI-RS.

**Table A.3.3.3.0-1: Fixed Reference Channel without CSI-RS**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.70 FDD | R.71 FDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks | | 50 | 50 |
| Allocated subframes per Radio Frame | | 10 | 10 |
| Modulation | | QPSK | 16QAM |
| Target Coding Rate | | 0.65 | 0.6 |
| Information Bit Payload | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 6968 | 12960 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | N/A |
| Number of Code Blocks per Sub-Frame (Note 4) | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | | 2 | 3 |
| For Sub-Frame 5 | | N/A | N/A |
| For Sub-Frame 0 | | N/A | N/A |
| Binary Channel Bits Per Sub-Frame | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 10800 | 21600 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 5.5744 | 10.368 |
| UE Category | | ≥ 1 | ≥ 2 |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) | | | |

## A.3.3.3.1 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 A3.3.3.1-2 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 | R.66 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 |
| Allocated resource blocks | | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) | 50 (Note 3) |
| Allocated subframes per Radio Frame | | 9 | 9 | 9 | 9 |
| Modulation | | QPSK | 64QAM | QPSK | 256QAM |
| Target Coding Rate | | 1/3 | 1/2 | | 0.77 |
| Information Bit Payload | | | | | |
| For Sub-Frames 1,4,6,9 | Bits | 3624 | 18336 | 6200 | 36696 |
| For Sub-Frames 2,3,7,8 | Bits | 3624 | 16416 | 6200 | 35160 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 2984 | 14688 | 4968 | 30576 |
| Number of Code Blocks (Note 4) | | | | | |
| For Sub-Frames 1,4,6,9 | Code blocks | 1 | 3 | 2 | 6 |
| For Sub-Frames 2,3,7,8 | Code blocks | 1 | 3 | 2 | 6 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 1 | 3 | 1 | 5 |
| Binary Channel Bits | | | | | |
| For Sub-Frames 1,4,6,9 | Bits | 12000 | 36000 | 12000 | 48000 |
| For Sub-Frames 2,7 | | 11600 | 34800 | 11600 | 46400 |
| For Sub-Frames 3,8 | | 11600 | 34800 | 12000 | 46400 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 9840 | 29520 | 9840 | 39360 |
| Max. Throughput averaged over 1 frame | Mbps | 3.1976 | 15.3696 | 5.4568 | 31.800 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 | 11-12 |
| UE DL Category | | ≥ 6 | ≥ 6 | ≥ 6 | ≥ 11 |
| 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 | R.60 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 |
| Allocated resource blocks | | 50[3] | 50[3] | 39 | 50[3] |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 |
| Modulation | | QPSK | 16QAM | 16QAM | QPSK |
| Target Coding Rate | | 1/3 | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | | |
| For Sub-Frames (Non CSI-RS subframe) | Bits | 3624 | 11448 | 8760 | 6200 |
| For Sub-Frames (CSI-RS subframe) | Bits | 3624 | 11448 | 8760 | 6200 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 2984 | 9528 | 8760 | N/A |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | |
| For Sub-Frames (Non CSI-RS subframe) | | 1 | 2 | 2 | 2 |
| For Sub-Frames (CSI-RS subframe) | | 1 | 2 | 2 | 2 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | 2 | N/A |
| Binary Channel Bits Per Sub-Frame | | | | | |
| For Sub-Frames (Non CSI-RS subframe) | Bits | 12000 | 24000 | 18720 | 12000 |
| For Sub-Frames (CSI-RS subframe) | Bits | 11600 | 23200 | 18096 | 11600 |
| For Sub-Frames (ZeroPowerCSI-RS subframe) | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 9840 | 19680 | 18720 | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 3.1976 | 10.1112 | 7.884 | 4.96 |
| UE Category | | ≥ 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<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: For R.44, R.45 and R.60, 50 resource blocks are allocated in sub-frames 1,2,3,4,6,7,8,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0. For R.45-1, 39 resource blocks are allocated in all subframes (RB0–RB20 and RB30–RB47).<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.3.3.3.2-3 apply for verifying demodulation performance for UE-specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-3: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.64 FDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks (Note 4) | | 6 |
| Allocated subframes per 4 Radio Frames | | 15 |
| Modulation | | QPSK |
| Target Coding Rate | | 1/3 |
| Information Bit Payload | | |
| For Sub-Frames 0,1,4,5,6,9 (Note 3) | Bits | 504 |
| For Sub-Frames 2,3,7,8 (Note 3) | Bits | 504 |
| Number of Code Blocks | | |
| For Sub-Frames 0,1,4,5,6,9 | Code blocks | 1 |
| For Sub-Frames 2,3,7,8 | Code blocks | 1 |
| Binary Channel Bits | | |
| For Sub-Frames 0,1,4,5,6,9 | Bits | 1440 |
| For Sub-Frames 2,3,7,8 | Bits | 1392 |
| Max. Throughput averaged over 4 frames | Mbps | 0.189 |
| UE DL Category | | 0 |
| Note 1: 2 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: The downlink subframes are scheduled at the 0th, 1st, 2nd, 8th, 9th, 10th, 16th, 17th, 18th, 24th, 25th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is avaialbe if downlink subframe is scheduled.<br>Note 4: Allocated PRB positions start from {9, 10, …, 9+N-1}, where N is the number of allocated resource blocks. | | |

The reference measurement channels in Table A.3.3.3.2-4 apply with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.3.3.2-4: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.69 FDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 50 |
| Allocated subframes per Radio Frame | | 8 |
| Modulation | | QPSK |
| Target Coding Rate | | |
| For Sub-Frames 2,3,4,6,7,8,9 | | 0.74 |
| For Sub-Frame 1 | | 0.8 |
| Information Bit Payload | | |
| For Sub-Frames 2,3,4,6,7,8,9 | Bits | 7992 |
| For Sub-Frame 1 | Bits | 7992 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | N/A |
| Number of Code Blocks per Sub-Frame (Note 4) | | |
| For Sub-Frames 2,3,4,6,7,8,9 | | 2 |
| For Sub-Frame 1 | | 2 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | | N/A |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 2,3,4,6,7,8,9 | Bits | 10800 |
| For Sub-Frame 1 | Bits | 10000 |
| 2 For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 6.3936 |
| UE Category | | ≥ 1 |
| Note 1: 3 symbols allocated to PDCCH.<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.3.4 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.2A TDD | R.2 TDD | R.42-1 TDD | R.42-2 TDD | R.42-3 TDD |
| Channel bandwidth | MHz | 1.4 | 20 | 10 | 10 | 3 | 5 | 15 |
| Allocated resource blocks (Note 6) | | 6 | 100 | 50 | 50 | 15 | 25 | 75 |
| Uplink-Downlink Configuration (Note 4) | | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3 | 3+2 | 5+2 | 3+2 | 3+2 | 3+2 | 3+2 |
| Modulation | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate | | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Information Bit Payload (Note 6) | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 408 | 8760 | 4392 | 4392 | 1320 | 2216 | 6712 |
| For Sub-Frames 1,6 | Bits | N/A | 7736 | 3240 | 3240 | 1128 | 1864 | 5992 |
| For Sub-Frames 3,8 | Bits | N/A | N/A | 4392 | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 208 | 8760 | 4392 | 4392 | 1064 | 1800 | 6712 |
| Number of Code Blocks (Notes 5 and 6) | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| For Sub-Frames 1,6 | | N/A | 2 | 1 | 1 | 1 | 1 | 1 |
| For Sub-Frames 3,8 | | N/A | N/A | 1 | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| Binary Channel Bits (Note 6) | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1368 | 27600 | 13800 | 13800 | 3780 | 6300 | 20700 |
| For Sub-Frames 1,6 | Bits | N/A | 22656 | 11256 | 11256 | 3276 | 5556 | 16956 |
| For Sub-Frames 3,8 | | N/A | N/A | 13800 | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 672 | 26904 | 13104 | 13104 | 3084 | 5604 | 20004 |
| Max. Throughput averaged over 1 frame (Note 6) | Mbps | 0.102 | 4.175 | 2.844 | 1.966 | 0.596 | 0.996 | 3.212 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |
| Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.<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. | | | | | | | | |

**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.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]
Note 3: As per Table 4.2-2 TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

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

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | | R.6-1 TDD | R.7-1 TDD | R.8-1 TDD | R.9-1 TDD | R.9-2 TDD |
| Channel bandwidth | MHz | | 5 | 10 | 15 | 20 | 20 |
| Allocated resource blocks (Note 3) | | | 18 | 17 | 17 | 17 | 83 |
| Uplink-Downlink Configuration (Note 4) | | | 1 | 1 | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | | 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.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4]<br>Note 3: As per Table 4.2-2 in TS 36.211 [4].<br>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | | | | |

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

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.29 TDD (MBSFN) |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 1 |
| MBSFN Configuration (Note 5) | | 010010 |
| Uplink-Downlink Configuration (Note 3) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 1+2 |
| Modulation | | 16QAM |
| Target Coding Rate | | 1/2 |
| Information Bit Payload | | |
| For Sub-Frames 4,9 | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6 | Bits | 208 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 256 |
| Number of Code Blocks per Sub-Frame (Note 4) | | |
| For Sub-Frames 4,9 | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6 | Bits | 1 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 1 |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 4,9 | Bits | 0 (MBSFN) |
| For Sub-Frames 1,6 | Bits | 456 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | 552 |
| Max. Throughput averaged over 1 frame | kbps | 67.2 |
| UE Category | | ≥ 1 |
| Note 1: 2 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: as per Table 4.2-2 in TS 36.211 [4].<br>Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>Note 5: MBSFN Subframe Allocation as defined in [7], one frame with 6 bits is chosen for MBSFN subframe allocation | | |

**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: Fixed Reference Channel for CA demodulation with power imbalance**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.49 TDD | R.49-1 TDD |
| Channel bandwidth | MHz | 20 | 15 |
| Allocated resource blocks | | 100 | 75 |
| Uplink-Downlink Configuration (Note 1) | | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 |
| Modulation | | 64QAM | 64QAM |
| Number of OFDM symbols for PDCCH per component carrier | | | |
| For Sub-Frames 0,4,5,9 | OFDM symbols | 3 | 3 |
| For Sub-Frames 1,6 | OFDM symbols | 2 | 2 |
| Target Coding Rate | | | |
| For Sub-Frames 4,9 | | 0.84 | 0.83 |
| For Sub-Frames 1,6 | | 0.81 | 0.80 |
| For Sub-Frames 5 | | N/A | N/A |
| For Sub-Frames 0 | | 0.87 | 0.86 |
| Information Bit Payload | | | |
| For Sub-Frames 0, 4, 9 | Bits | 63776 | 46888 |
| For Sub-Frame 1,6 | Bits | 55056 | 40576 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| Number of Code Blocks per Sub-Frame (Note 2) | | | |
| For Sub-Frames 0, 4, 9 | Code Blocks | 11 | 8 |
| For Sub-Frame 1,6 | Code Blocks | 9 | 7 |
| For Sub-Frame 5 | Code Blocks | N/A | N/A |
| Binary Channel Bits Per Sub-Frame | | | |
| For Sub-Frames 4,9 | Bits | 75600 | 56700 |
| For Sub-Frame 1,6 | Bits | 67968 | 50868 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | 73512 | 54612 |
| Max. Throughput averaged over 1 frame | Mbps | 30.144 | 22.182 |
| UE Category | | ≥5 | ≥ 3 |
| Note 1: Reference signal, synchronization signals and PBC allocated as per TS 36.211 [4].<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 a 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 | R.11-5 TDD | R.11-6 TDD | R.11-7 TDD | R.11-8 TDD | R.11- TDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 1.4 | 3 | 5 | 10 | 15 |
| Allocated resource blocks (Note 5) | | 50 | 50 | 50 | 6 | 15 | 25 | 50 | 75 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Allocated number of PDCCH symbols in normal subframes | | 2 | 2 | 2 | 4 | 3 | 3 | 2 | 2 |
| Allocated number of PDCCH symbols in special subframes | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 | 2+2 | 2+2 | 2+2 | 2+2 | 2+2 | 2+2 |
| Modulation | | QPSK | 16QAM | 64QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QA |
| Target Coding Rate | | | | 0.47 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| For Sub-Frames 4,9 | | | | | | | | | |
| For Sub-Frames 1,6 | | | | | | | | | |
| Information Bit Payload (Note 5) | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 5160 | 8760 | 18336 | 1352 | 3368 | 5736 | 12960 | 1908 |
| For Sub-Frames 1,6 | | 3880 | 7480 | 14688 | 1128 | 3112 | 5160 | 10680 | 1584 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 5160 | 8760 | N/A | N/A | N/A | N/A | N/A | N/A |
| Number of Code Blocks (Notes 4 and 5) | | | | | | | | | |
| For Sub-Frames 4,9 | | 1 | 2 | 3 | 1 | 1 | 1 | 3 | 4 |
| For Sub-Frames 1,6 | | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 3 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 2 | N/A | N/A | N/A | N/A | N/A | N/A |
| Binary Channel Bits (Note 5) | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 13200 | 26400 | 39600 | 2592 | 7200 | 12000 | 26400 | 3960 |
| For Sub-Frames 1,6 | | 10656 | 21312 | 31968 | 2304 | 6192 | 10512 | 21312 | 3211 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 12528 | 25056 | N/A | N/A | N/A | N/A | N/A | N/A |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 2.324 | 4.124 | 6.604 | 0.496 | 1.296 | 2.179 | 4.498 | 6.98 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 |

Note 1: Void
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (other
Note 5: Given per component carrier per codeword

**Table A.3.4.2.1-3: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.62 TDD | R.63 TDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks (Note 4) | | 3 | 1 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 |
| Modulation | | 16QAM | 64QAM |
| Target Coding Rate | | 1/2 | 1/2 |
| Information Bit Payload | | | |
| For Sub-Frames 0,4,5,9 | Bits | 744 | 408 |
| For Sub-Frames 1,6 | Bits | 440 | 280 |
| Number of Code Blocks | | | |
| For Sub-Frames 0,4,5,9 | Code blocks | 1 | 1 |
| For Sub-Frames 1,6 | Clode blocls | 1 | 1 |
| Binary Channel Bits | | | |
| For Sub-Frames 0,4,5,9 | Bits | 1584 | 792 |
| For Sub-Frames 1,6 | | 1296 | 648 |
| Max. Throughput averaged over 1 frame | Mbps | 0.3856 | 0.2192 |
| UE DL Category | | 0 | 0 |
| Note 1: 2 symbols allocated to PDCCH.<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: Allocated PRB positions start from {9, 10, …, 9+N-1}, where N is the number of allocated resource blocks. | | | |

**Table A.3.4.2.1-4: Fixed Reference Channel two antenna ports**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.65 TDD | |
| Channel bandwidth | MHz | 20 | |
| Allocated resource blocks (Note 5) | | 100 | |
| Uplink-Downlink Configuration (Note 3) | | 1 | |
| Allocated subframes per Radio Frame (D+S) | | 2+2 | |
| Modulation | | 256QAM | |
| Target Coding Rate | | | |
| Information Bit Payload (Note 5) | | | |
| For Sub-Frames 4,9 | Bits | 63776 | |
| For Sub-Frames 1,6 | | 46888 | |
| For Sub-Frame 5 | Bits | N/A | |
| For Sub-Frame 0 | Bits | N/A | |
| Number of Code Blocks (Notes 4 and 5) | | | |
| For Sub-Frames 4,9 | | 11 | |
| For Sub-Frames 1,6 | | 9 | |
| For Sub-Frame 5 | | N/A | |
| For Sub-Frame 0 | | N/A | |
| Binary Channel Bits (Note 5) | | | |
| For Sub-Frames 4,9 | Bits | 115200 | |
| For Sub-Frames 1,6 | | 95424 | |
| For Sub-Frame 5 | Bits | N/A | |
| For Sub-Frame 0 | Bits | N/A | |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 22.133 | |
| UE Category | | 11-12 | |
| UE DL Category | | ≥ 11 | |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH. For 256QAM reference channel 1 symbol is allocated.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Given per component carrier per codeword

**Table A.3.4.2.1-5: Fixed Reference Channel two antenna ports when *EIMTA-MainConfigServCell-r12* is configured**

| Parameter | Unit | Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.67 TDD | | | | | | |
| Channel bandwidth | MHz | 10 | | | | | | |
| Allocated resource blocks (Note 5) | | 50 | | | | | | |
| Modulation | | 16QAM | | | | | | |
| Target Coding Rate | | 0.4 | | | | | | |
| Dynamic Uplink-Downlink Configuration (Note 3) | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Allocated subframes per Radio Frame (D+S) | | 1+2 | 3+2 | 5+2 | 5+1 | 6+1 | 7+1 | 2+2 |
| Information Bit Payload (Note 5) | | | | | | | | |
| For Sub-Frame 0 | Bits | 9912 | 9912 | 9912 | 9912 | 9912 | 9912 | 9912 |
| For Sub-Frame 1 | Bits | 7480 | 7480 | 7480 | 7480 | 7480 | 7480 | 7480 |
| For Sub-Frame 2 | Bits | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 3 | Bits | NA | NA | 9912 | NA | NA | 9912 | NA |
| For Sub-Frame 4 | Bits | NA | 9912 | 9912 | NA | 9912 | 9912 | NA |
| For Sub-Frame 5 | Bits | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 6 | Bits | 7480 | 7480 | 7480 | 9912 | 9912 | 9912 | 7480 |
| For Sub-Frame 7 | Bits | NA | NA | NA | 9912 | 9912 | 9912 | NA |
| For Sub-Frame 8 | Bits | NA | NA | 9912 | 9912 | 9912 | 9912 | NA |
| For Sub-Frame 9 | Bits | NA | 9912 | 9912 | 9912 | 9912 | 9912 | 9912 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Code Blocks (Notes 4 and 5) | | | | | | | | |
| For Sub-Frame 0 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frame 1 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frame 2 | | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 3 | | NA | NA | 2 | NA | NA | 2 | NA |
| For Sub-Frame 4 | | NA | 2 | 2 | NA | 2 | 2 | NA |
| For Sub-Frame 5 | | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 6 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| For Sub-Frame 7 | | NA | NA | NA | 2 | 2 | 2 | NA |
| For Sub-Frame 8 | | NA | NA | 2 | 2 | 2 | 2 | NA |
| For Sub-Frame 9 | | NA | 2 | 2 | 2 | 2 | 2 | 2 |
| Binary Channel Bits (Note 5) | | | | | | | | |
| For Sub-Frame 0 | Bits | 25056 | 25056 | 25056 | 25056 | 25056 | 25056 | 25056 |
| For Sub-Frame 1 | Bits | 21312 | 21312 | 21312 | 21312 | 21312 | 21312 | 21312 |
| For Sub-Frame 2 | Bits | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 3 | Bits | NA | NA | 26400 | NA | NA | 26400 | NA |
| For Sub-Frame 4 | Bits | NA | 26400 | 26400 | NA | 26400 | 26400 | NA |
| For Sub-Frame 5 | Bits | NA | NA | NA | NA | NA | NA | NA |
| For Sub-Frame 6 | Bits | 21312 | 21312 | 21312 | 26112 | 26112 | 26112 | 21312 |
| For Sub-Frame 7 | Bits | NA | NA | NA | 26400 | 26400 | 26400 | NA |
| For Sub-Frame 8 | Bits | NA | NA | 26400 | 26400 | 26400 | 26400 | NA |
| For Sub-Frame 9 | Bits | NA | 26400 | 26400 | 26400 | 26400 | 26400 | 26400 |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 2.49 | 4.47 | 6.45 | 5.70 | 6.70 | 7.69 | 3.48 |
| Max. Throughput averaged over 1 frame and over all dynamic UL-DL configurations (Note 5) | Mbps | 5.28 | | | | | | |
| UE Category | | ≥ 1 | | | | | | |

Note 1: 2 OFDM symbols are allocated to PDCCH in all subframes
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Given per component carrier per codeword.

### 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 | R.43-1 TDD | R.43-2 TDD | R.43-3 TDD | R.43-4 TDD | R.43-5 TDD |
| Channel bandwidth | MHz | 1.4 | 10 | 10 | 10 | 10 | 20 | 10 | 1.4 | 3 | 5 | 10 | 15 |
| Allocated resource blocks (Note 6) | | 6 | 50 | 50 | 6 | 3 | 100 | 50 | 6 | 15 | 25 | 50 | 75 |
| Uplink-Downlink Configuration (Note 4) | | 1 | 1 | 1 | 1 | 1 | 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 | 2 | 2+2 | 2+2 | 2+2 | 2+2 |
| Modulation | | QPSK | QPSK | 16QAM | 16QAM | 16QAM | 16QAM | 64QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate | | 1/3 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | ½ | ½ |
| Information Bit Payload (Note 6) | | | | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 408 | 4392 | 12960 | 1544 | 744 | 25456 | 18336 | 1192 | 3368 | 5736 | 12960 | 19080 |
| For Sub-Frames 1,6 | Bits | N/A | 3240 | 9528 | N/A | N/A | 21384 | 15840 | N/A | 2856 | 5160 | 10680 | 15840 |
| 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 | 208 | 4392 | N/A | N/A | N/A | N/A | N/A | 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 | 1 | 1 | 1 | 3 | 4 |
| For Sub-Frames 1,6 | | N/A | 1 | 2 | N/A | N/A | 4 | 3 | N/A | 1 | 1 | 2 | 3 |
| For Sub-Frame 5 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 1 | 1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Binary Channel Bits (Note 6) | | | | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 1248 | 12800 | 25600 | 3072 | 1536 | 51200 | 38400 | 2496 | 6960 | 11600 | 25600 | 38400 |
| For Sub-Frames 1,6 | | N/A | 10256 | 20512 | N/A | N/A | 41312 | 30768 | N/A | 5952 | 10112 | 20512 | 30912 |
| 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 | 624 | 12176 | N/A | N/A | N/A | N/A | N/A | 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 | 0.238 | 1.245 | 2.179 | 4.728 | 6.984 |
| UE Category | | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 2 | ≥ 2 |

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

## 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.

The reference measurement channels in Table A.3.4.3.2-2 apply with two CRS antenna ports.

**Table A.3.4.3.2-2: Fixed Reference Channel for CDM-multiplexed DM RS**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | R.70 TDD | R.71 TDD |
| Channel bandwidth | MHz | 10 | 10 |
| Allocated resource blocks | | 50 (Note 4) | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 2+2 | 2+2 |
| Modulation | | QPSK | 16QAM |
| Target Coding Rate | | | |
| For Sub-Frames 4,9 | | 0.65 | 0.6 |
| For Sub-Frames 1,6 | | 0.54 | 0.5 |
| Information Bit Payload | | | |
| For Sub-Frames 4,9 | Bits | 6968 | 12960 |
| For Sub-Frames 1,6 | Bits | 4264 | 7736 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | N/A |
| Number of Code Blocks per Sub-Frame (Note 5) | | | |
| For Sub-Frames 4,9 | | 2 | 3 |
| For Sub-Frames 1,6 | | 1 | 2 |
| For Sub-Frame 5 | | N/A | N/A |
| For Sub-Frame 0 | | N/A | N/A |
| Binary Channel Bits Per Sub-Frame | | | |
| For Sub-Frames 4,9 | Bits | 10800 | 21600 |
| For Sub-Frames 1,6 | Bits | 7872 | 15744 |
| For Sub-Frame 5 | Bits | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 2.2464 | 4.1392 |
| UE Category | | ≥ 1 | ≥ 2 |

Note 1: 3 symbols allocated to PDCCH in normal subframes and 2 symbols allocated to PDCCH in special subframes
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: For R.63, and R.64, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in the DwPTS portion of sub-frames 1,6.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

### A.3.4.3.3 Two antenna ports (CSI-RS)

The reference measurement channels in Table A.3.4.3.3-1 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and two CSI-RS antenna ports.

**Table A.3.4.3.3-1: Fixed Reference Channel for CDM-multiplexed DM RS with two CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| 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 A3.4.3.3-2 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 | R.66 TDD |
| Channel bandwidth | MHz | 10 | 10 | 20 |
| Allocated resource blocks | | 50 (Note 4) | 50 (Note 4) | 100 |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 3+2 | 3+2 | 3+2 |
| Modulation | | 64QAM | QPSK | 256QAM |
| Target Coding Rate | | ½ | | |
| Information Bit Payload | | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 18336 | N/A | N/A |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 16416 | 6200 | 71112 |
| For Sub-Frames 1,6 | | 11832 | 4264 | 48936 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 14688 | 4968 | 66592 |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | | 3 | 2 | N/A |
| For Sub-Frames 4,9 (CSI-RS subframe) | | 3 | 2 | 12 |
| For Sub-Frames 1,6 | | 2 | 1 | 8 |
| For Sub-Frame 5 | | N/A | N/A | N/A |
| For Sub-Frame 0 | | 3 | 1 | 11 |
| Binary Channel Bits Per Sub-Frame | | | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 36000 | 12000 | N/A |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 33600 | 11600 | 89600 |
| For Sub-Frames 1,6 | | 23616 | 7872 | 67584 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | 29520 | 9840 | 84480 |
| Max. Throughput averaged over 1 frame | Mbps | 7.1184 | 2.5896 | 30.669 |
| UE Category | | ≥ 2 | ≥ 1 | 11-12 |
| UE DL Category | | ≥ 6 | ≥ 6 | ≥ 11 |
| 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: For R.44 and R.48, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6. For R.66, 100 resource blocks are allocated in sub-frames 4, 9 and 88 resources blockes (RB0–RB43 and RB56–RB99) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | | | |

The reference measurement channels in Table A.3.4.3.4-2 apply for verifying TDD PMI accuracy measurement with two CRS antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-2: Fixed Reference Channel for four antenna ports (CSI-RS)**

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| Reference channel | | R.60 TDD | R.61 TDD | R.61-1 TDD |
| Channel bandwidth | MHz | 10 | 10 | 10 |
| Allocated resource blocks | | 50[4] | 50[4] | 39[5] |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 |
| Modulation | | QPSK | 16QAM | 16QAM |
| Target Coding Rate | | 1/2 | 1/2 | 1/2 |
| Information Bit Payload | | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits | N/A | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | Bits | 6200 | 11448 | 8760 |
| For Sub-Frames 1,6 | Bits | N/A | 7736 | 7480 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 9528 | 8760 |
| Number of Code Blocks per Sub-Frame (Note 6) | | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | | N/A | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | | 2 | 2 | 2 |
| For Sub-Frames 1,6 | | N/A | 2 | 2 |
| For Sub-Frame 5 | | N/A | N/A | N/A |
| For Sub-Frame 0 | | N/A | 2 | 2 |
| Binary Channel Bits Per Sub-Frame | | | | |
| For Sub-Frames 4 and 9 (Non CSI-RS subframe) | Bits | N/A | N/A | N/A |
| For Sub-Frames 4 and 9 (CSI-RS subframe) | Bits | 11600 | 23200 | 18096 |
| For Sub-Frames 1,6 | Bits | N/A | 15744 | 14976 |
| For Sub-Frame 5 | Bits | N/A | N/A | N/A |
| For Sub-Frame 0 | Bits | N/A | 19680 | 18720 |
| Max. Throughput averaged over 1 frame | Mbps | 1.24 | 4.7896 | 4.1240 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 1 |

Note 1: 2 symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW; 3 symbols allocated to PDCCH for 5 MHz and 3 MHz; 4 symbols allocated to PDCCH for 1.4 MHz. For subframe 1&6, only 2 OFDM symbols are allocated to PDCCH.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: For R. 60 and R.61, 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in sub-frame 0 and the DwPTS portion of sub-frames 1,6.
Note 5: For R. 61-1, 39 resource blocks (RB0–RB20 and RB30–RB47) are allocated in sub-frame 0, 1, 4, 6 and 9.
Note 6: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 7: Localized allocation started from RB #0 is applied.

The reference measurement channels in Table A.3.4.3.4-3 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-3: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.64 TDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks (Note 4) | | 6 |
| Uplink-Downlink Configuration (Note 3) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 4+2 |
| Modulation | | QPSK |
| Target Coding Rate | | 1/3 |
| Information Bit Payload | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 504 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 504 |
| For Sub-Frames 1,6 | | 256 |
| For Sub-Frames 0,5 | Bits | 504 |
| Number of Code Blocks per Sub-Frame | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Code blocks | 1 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Code blocks | 1 |
| For Sub-Frames 1,6 | Code blocks | 1 |
| For Sub-Frames 0,5 | Code blocks | 1 |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frames 4,9 (non CSI-RS subframe) | Bits | 1440 |
| For Sub-Frames 4,9 (CSI-RS subframe) | Bits | 1352 |
| For Sub-Frames 1,6 | | 1152 |
| For Sub-Frames 0,5 | Bits | 1440 |
| Max. Throughput averaged over 1 frame | Mbps | 0.2528 |
| UE DL Category | | 0 |
| Note 1: 2 symbols allocated to PDCCH.<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: Allocated PRB positions start from {9, 10, …, 9+N-1}, where N is the number of allocated resource blocks. | | |

The reference measurement channels in Table A.3.4.3.4-4 apply for verifying demodulation performance for CDM-multiplexed UE specific reference symbols with two cell-specific antenna ports and four CSI-RS antenna ports.

**Table A.3.4.3.4-4: Fixed Reference Channel for CDM-multiplexed DM RS with four CSI-RS antenna ports**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | R.69 TDD |
| Channel bandwidth | MHz | 10 |
| Allocated resource blocks | | 50 (Note 4) |
| Uplink-Downlink Configuration (Note 3) | | 1 |
| Allocated subframes per Radio Frame (D+S) | | 2+2 |
| Modulation | | QPSK |
| Target Coding Rate | | |
| For Sub-Frame 4(CSI-RS subframe) | | 0.8 |
| For Sub-Frame 9 (non CSI-RS subframe) | | 0.74 |
| For Sub-Frames 1,6 | | 0.61 |
| Information Bit Payload | | |
| For Sub-Frame 4(CSI-RS subframe) | Bits | 7992 |
| For Sub-Frame 9 (non CSI-RS subframe) | Bits | 7992 |
| For Sub-Frames 1,6 | Bits | 4776 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | N/A |
| Number of Code Blocks per Sub-Frame (Note 5) | | |
| For Sub-Frame 4(CSI-RS subframe) | | 2 |
| For Sub-Frame 9 (non CSI-RS subframe) | | 2 |
| For Sub-Frames 1,6 | | 1 |
| For Sub-Frame 5 | | N/A |
| For Sub-Frame 0 | | N/A |
| Binary Channel Bits Per Sub-Frame | | |
| For Sub-Frame 4(CSI-RS subframe) | Bits | 10000 |
| For Sub-Frame 9 (non CSI-RS subframe) | Bits | 10800 |
| For Sub-Frames 1,6 | Bits | 7872 |
| For Sub-Frame 5 | Bits | N/A |
| For Sub-Frame 0 | Bits | N/A |
| Max. Throughput averaged over 1 frame | Mbps | 2.5536 |
| UE Category | | ≥ 1 |
| Note 1: 3 symbols allocated to PDCCH.<br>Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].<br>Note 3: As per Table 4.2-2 in TS 36.211 [4].<br>Note 4: 50 resource blocks are allocated in sub-frames 4,9 and 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in the DwPTS portion of sub-frames 1,6.<br>Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). | | |

## 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 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.19-1 | R.20 | R.24 |
| Number of transmitter antennas | | 1 | 2 | 2 | 4 | 1 |
| Channel bandwidth | MHz | 10 | 10 | 5 | 5 | 10 |
| User roles (Note 1) | | W I1 I2 | W I1 I2 | W I1 I2 | W I1 I2 | W I1 |
| Resource allocation (Note 2) | | (0,0) (0,1) (0,4) | (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 | -4 0 -3 | +3 0 |
| Payload (Note 4) | | A R R | A R R | A R R | A R R | A R |
| Note 1: W=wanted user, I1=interfering user 1, I2=interfering user 2.<br>Note 2: The resource allocation per user is given as (N_group_PHICH, N_seq_PHICH).<br>Note 3: The power offsets (per user) represent the difference of the power of BPSK modulated symbol per PHICH relative to the first interfering user.<br>Note 4: A=fixed ACK, R=random ACK/NACK. | | | | | | |

# A.3.7 Reference measurement channels for PBCH performance requirements

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

| Parameter | Unit | Value | | |
|---|---|---|---|---|
| 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.
Note 2: 2 OFDM symbols are reserved for PDCCH; reference signal allocated as per TS 36.211.
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

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

## A.3.9.1 FDD

**Table A.3.9.1-1: Fixed Reference Channel for sustained data-rate test (FDD 64QAM)**

| Parameter | Unit | Value | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 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.

**Table A.3.9.1-2: Fixed Reference Channel for sustained data-rate test (FDD 64QAM)**

| Parameter | Unit | Value | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.31-6 FDD | | | | | | | |
| Channel bandwidth | MHz | 5 | | | | | | | |
| Allocated resource blocks (Note 5) | | Note 4 | | | | | | | |
| Allocated subframes per Radio Frame | | 9 | | | | | | | |
| Modulation | | 64QAM | | | | | | | |
| Coding Rate | | | | | | | | | |
| For Sub-Frame 1,2,3,4,6,7,8,9, | | 0.85 | | | | | | | |
| For Sub-Frame 5 | | N/A | | | | | | | |
| For Sub-Frame 0 | | 0.83 | | | | | | | |
| Information Bit Payload (Note 5) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 18336 | | | | | | | |
| For Sub-Frame 5 | Bits | N/A | | | | | | | |
| For Sub-Frame 0 | Bits | 15840 | | | | | | | |
| Number of Code Blocks (Notes 3 and 5) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 3 | | | | | | | |
| For Sub-Frame 5 | Bits | N/A | | | | | | | |
| For Sub-Frame 0 | Bits | 3 | | | | | | | |
| Binary Channel Bits (Note 5) | | | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 21600 | | | | | | | |
| For Sub-Frame 5 | Bits | N/A | | | | | | | |
| For Sub-Frame 0 | Bits | 19152 | | | | | | | |
| Number of layers | | 2 | | | | | | | |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 17.837 | | | | | | | |
| UE Categories | | ≥ 2 | | | | | | | |

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: If more 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..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 5: Given per component carrier per codeword.
Note 6: Ng=1/6.

**Table A.3.9.1-3: Fixed Reference Channel for sustained data-rate test (FDD 256QAM)**

| Parameter | Unit | Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference channel | | R.68 FDD | R.68-1 FDD | R.68-2 FDD | R.68-3 FDD | | | |
| Channel bandwidth | MHz | 20 | 15 | 10 | 5 | | | |
| Allocated resource blocks (Note 4) | | Note 5 | Note 6 | Note 7 | Note 8 | | | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | | | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | | | |
| Coding Rate | | | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.88 | 0.85 | 0.85 | | | |
| For Sub-Frames 1,2,6,7 | | 0.74 | 0.74 | 0.74 | 0.77 | | | |
| For Sub-Frame 5 | | 0.75 | 0.77 | 0.77 | 0.79 | | | |
| For Sub-Frame 0 | | 0.76 | 0.77 | 0.78 | 0.84 | | | |
| Information Bit Payload (Note 4) | | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 97896 | 75376 | 48936 | 24496 | | | |
| For Sub-Frames 1,2,6,7 | | 84760 | 63776 | 42368 | 21384 | | | |
| For Sub-Frame 5 | Bits | 81176 | 61664 | 40576 | 19848 | | | |
| For Sub-Frame 0 | Bits | 84760 | 63776 | 42368 | 21384 | | | |
| Number of Code Blocks (Notes 3 and 4) | | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 16 | 13 | 8 | 4 | | | |
| For Sub-Frames 1,2,6,7 | | 14 | 11 | 7 | 4 | | | |
| For Sub-Frame 5 | Bits | 14 | 11 | 7 | 4 | | | |
| For Sub-Frame 0 | Bits | 14 | 11 | 7 | 4 | | | |
| Binary Channel Bits (Note 4) | | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 115200 | 86400 | 57600 | 28800 | | | |
| For Sub-Frames 1,2,6,7 | | 115200 | 86400 | 57600 | 28800 | | | |
| For Sub-Frame 5 | Bits | 109440 | 80640 | 52992 | 25344 | | | |
| For Sub-Frame 0 | Bits | 111936 | 83136 | 54336 | 25536 | | | |
| Number of layers | | 2 | 2 | 2 | 2 | | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 89.656 | 68.205 | 44.816 | 22.475 | | | |
| UE Categories | | 11-12 | 11-12 | 11-12 | 11-12 | | | |
| UE DL Categories | | ≥ 11 | ≥ 11 | ≥ 11 | ≥ 11 | | | |

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: Given per component carrier per codeword.
Note 5: 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 6: 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 7: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks $n_{PRB}$ = 2..24 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..24 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 64QAM)**

| 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 | R.31-4A TDD | R.31-5 TDD | R.31-5A TDD | R.31-6 TDD |
| Channel bandwidth | MHz | 10 | 10 | 20 | 15 | 20 | 20 | 15 | 15 | 10 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | Note 8 | Note 8 | Note 11 | Note 11 | Note 7 |
| Uplink-Downlink Configuration (Note 3) | | 5 | 5 | 5 | 1 | 1 | 2 | 1 | 2 | 1 |
| Number of HARQ Processes per component carrier | Processes | 15 | 15 | 15 | 7 | 7 | 10 | 7 | 10 | 7 |
| Allocated subframes per Radio Frame (D+S) | | 8+1 | 8+1 | 8+1 | 4 | 4 | 6+2 | 4 | 6+2 | 4 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate | | | | | | | | | | |
| For Sub-Frames 4,9 | | 0.40 | 0.59 | 0.59 | 0.87 | 0.88 | 0.88 | 0.85 | 0.85 | 0.85 |
| For Sub-Frames 3,8 | | 0.40 | 0.59 | 0.59 | N/A | N/A | 0.88 | N/A | 0.85 | N/A |
| For Sub-Frame 7 | | 0.40 | 0.59 | 0.59 | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frames 0 | | 0.40 | 0.62 | 0.61 | 0.90 | 0.90 | 0.90 | 0.88 | 0.88 | 0.90 |
| For Sub-Frames 1 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frames 5 | | 0.40 | 0.64 | 0.62 | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.88 |
| For Sub-Frames 6 | | 0.40 | 0.60 | 0.60 | N/A | N/A | N/A | N/A | N/A | N/A |
| Information Bit Payload | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 | 75376 | 55056 | 55056 | 36696 |
| For Sub-Frames 3,8 | Bits | 10296 | 25456 | 51024 | 0 | 0 | 75376 | 0 | 55056 | 0 |
| For Sub-Frame 7 | Bits | 10296 | 25456 | 51024 | 0 | 0 | N/A | 0 | N/A | 0 |
| For Sub-Frame 0 | Bits | 10296 | 25456 | 51024 | 51024 | 75376 | 75376 | 55056 | 55056 | 36696 |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| For Sub-Frame 5 | Bits | 10296 | 25456 | 51024 | 51024 | 71112 | 71112 | 52752 | 52752 | 35160 |
| For Sub-Frame 6 | Bits | 10296 | 25456 | 51024 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | | | | |
| For Sub-Frames 4,9 | | 2 | 5 | 9 | 9 | 13 | 13 | 9 | 9 | 6 |
| For Sub-Frames 3,8 | | 2 | 5 | 9 | N/A | N/A | 13 | N/A | 9 | N/A |
| For Sub-Frame 7 | | 2 | 5 | 9 | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 0 | | 2 | 5 | 9 | 9 | 13 | 13 | 9 | 9 | 6 |
| For Sub-Frame 1 | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| For Sub-Frame 5 | | 2 | 5 | 9 | 9 | 12 | 12 | 9 | 9 | 6 |
| For Sub-Frame 6 | Bits | 2 | 5 | 9 | n/a | N/A | N/A | N/A | N/A | N/A |
| Binary Channel Bits Per Sub-Frame | | | | | | | | | | |
| For Sub-Frames 4,9 | Bits | 26100 | 43200 | 86400 | 58752 | 86400 | 86400 | 64800 | 64800 | 43200 |
| For Sub-Frames 3,8 | Bits | 26100 | 43200 | 86400 | 0 | 0 | 86400 | 0 | 64800 | 0 |
| For Sub-Frame 7 | Bits | 26100 | 43200 | 86400 | 0 | 0 | 86400 | 0 | 64800 | 0 |
| For Sub-Frame 0 | Bits | 26100 | 41184 | 84384 | 56736 | 84384 | 84384 | 62784 | 62784 | 41184 |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| For Sub-Frame 5 | Bits | 26100 | 40176 | 82512 | 58320 | 82512 | 82512 | 60912 | 60912 | 40176 |
| For Sub-Frame 6 | Bits | 26100 | 42768 | 85968 | N/A | N/A | 0 | N/A | 0 | N/A |
| Number of layers | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 10) | Mbps | 8.237 | 20.365 | 40.819 | 20.409 | 29.724 | 52.337 | 25.330 | 38.309 | 14.525 |
| UE Category | | ≥ 1 | ≥ 2 | ≥ 2 | ≥ 2 | ≥ 3 | ≥ 3 | ≥ 3 | ≥ 3 | ≥ 2 |

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks $n_{PRB}$ = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks $n_{PRB}$ = 6..14,30..49 are allocated for the user data in all subframes.
Note 7: Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in the available downlink sub-frames according to uplink downlink configurations used .

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| Note 8: | Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in sub-frames 0,3,4,6,7,8,9. |
| Note 9: | Resource blocks $n_{PRB}$ = 4..71 are allocated for the user data in all sub-frames |
| Note10: | Given per component carrier per codeword. |
| Note11: | Resource blocks $n_{PRB}$ = 4..74 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..74 in other downlink sub-frames. |

**Table A.3.9.2-2: Fixed Reference Channel for sustained data-rate test (TDD 256QAM)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | R.68 TDD | R.68-1 TDD | R.68-2 TDD | R.68-3 TDD | R.68-4 TDD | |
| Channel bandwidth | MHz | 20 | 15 | 10 | 20 | 15 | |
| Allocated resource blocks | PRB | Note 6 | Note 7 | Note 8 | Note 6 | Note 7 | |
| Uplink-Downlink Configuration (Note 3) | | 1 | 1 | 1 | [2] | [2] | |
| Number of HARQ Processes per component carrier | Processes | 7 | 7 | 7 | [10] | [10] | |
| Allocated subframes per Radio Frame (D+S) | | 4+2 | 4+2 | 4+2 | [6+2] | [6+2] | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | |
| Target Coding Rate | | | | | | | |
| For Sub-Frame 0 | | 0.76 | 0.77 | 0.78 | 0.76 | 0.77 | |
| For Sub-Frame 1 | | N/A | N/A | N/A | N/A | N/A | |
| For Sub-Frames 3 | | N/A | N/A | N/A | 0.74 | 0.79 | |
| For Sub-Frames 4 | | 0.74 | 0.79 | 0.74 | 0.74 | 0.79 | |
| For Sub-Frame 5 | | 0.74 | 0.76 | 0.76 | 0.74 | 0.76 | |
| For Sub-Frame 6 | | N/A | N/A | N/A | [N/A] | [N/A] | |
| For Sub-Frame 7 | | N/A | N/A | N/A | [N/A] | [N/A] | |
| For Sub-Frames 8 | | N/A | N/A | N/A | 0.85 | 0.88 | |
| For Sub-Frames 9 | | 0.85 | 0.88 | 0.85 | 0.85 | 0.88 | |
| Information Bit Payload | | | | | | | |
| For Sub-Frame 0 | Bits | 84760 | 63776 | 42368 | 84760 | 63776 | |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 | |
| For Sub-Frames 3 | Bits | N/A | N/A | N/A | 84760 | 63776 | |
| For Sub-Frames 4 | Bits | 84760 | 63776 | 42368 | 84760 | 63776 | |
| For Sub-Frame 5 | Bits | 81176 | 61664 | 40576 | 81176 | 61664 | |
| For Sub-Frame 6 | Bits | 0 | 0 | 0 | [0] | [0] | |
| For Sub-Frame 7 | | N/A | N/A | N/A | [N/A] | [N/A] | |
| For Sub-Frames 8 | Bits | N/A | N/A | N/A | 97896 | 75376 | |
| For Sub-Frames 9 | Bits | 97896 | 75376 | 48936 | 97896 | 75376 | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frame 0 | | 14 | 11 | 7 | 14 | 11 | |
| For Sub-Frame 1 | | N/A | N/A | N/A | N/A | N/A | |
| For Sub-Frames 3 | | N/A | N/A | N/A | 14 | 11 | |
| For Sub-Frames 4 | | 14 | 11 | 7 | 14 | 11 | |
| For Sub-Frame 5 | | 14 | 11 | 7 | 14 | 11 | |
| For Sub-Frame 6 | | N/A | N/A | N/A | [N/A] | [11] | |
| For Sub-Frame 7 | | N/A | N/A | N/A | [N/A] | [11] | |
| For Sub-Frames 8 | | N/A | N/A | N/A | 16 | 13 | |
| For Sub-Frames 9 | | 16 | 13 | 8 | 16 | 13 | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frame 0 | Bits | 112512 | 83712 | 54912 | 112512 | 83712 | |
| For Sub-Frame 1 | Bits | 0 | 0 | 0 | 0 | 0 | |
| For Sub-Frames 3 | Bits | N/A | N/A | N/A | 115200 | 86400 | |
| For Sub-Frames 4 | Bits | 115200 | 86400 | 57600 | 115200 | 86400 | |
| For Sub-Frame 5 | | 110016 | 81216 | 53568 | 110016 | 81216 | |
| For Sub-Frame 6 | Bits | 0 | 0 | 0 | [0] | [0] | |
| For Sub-Frame 7 | | N/A | N/A | N/A | [N/A] | [N/A] | |
| For Sub-Frames 8 | Bits | N/A | N/A | N/A | 115200 | 86400 | |
| For Sub-Frames 9 | Bits | 115200 | 86400 | 57600 | 115200 | 86400 | |
| Number of layers | | 2 | 2 | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 5) | Mbps | 34.859 | 26.459 | 17.425 | [53.125] | [40.374] | |
| UE Categories | | 11-12 | 11-12 | 11-12 | 11-12 | 11-12 | |
| UE DL Categories | | ≥ 11 | ≥ 11 | ≥ 11 | ≥ 11 | ≥ 11 | |

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [4].
Note 3: As per Table 4.2-2 in TS 36.211 [4].
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Given per component carrier per codeword.
Note 6: Resource blocks $n_{PRB}$ = 4..99 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..99 in other

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| | downlink sub-frames. |
| Note 7: | Resource blocks $n_{PRB}$ = 4..74 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..74 in other downlink sub-frames. |
| Note 8: | Resource blocks $n_{PRB}$ = 3..49 are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB}$ = 0..49 in the available downlink sub-frames according to uplink downlink configurations used. |

## A.3.9.3 FDD (EPDCCH scheduling)

**Table A.3.9.3-1: Fixed Reference Channel for sustained data-rate test with EPDCCH scheduling (FDD)**

| Parameter | Unit | Value | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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.

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| 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.1A FDD | FDD | 10 | 50 | | | MCS.1A | 8 | 1 | |
| RC.1 TDD | TDD | 10 | 50 | Note 3 | | MCS.1 | 10 | 1 | |
| RC.1A TDD | TDD | 20 | 100 | Note 3 | | MCS.1B | 10 | 1 | |
| RC.3 FDD | FDD | 10 | 6 | - | | MCS.10 | 8 | 1 | |
| RC.3 TDD | TDD | 10 | 6 | Note 3 | | MCS.10 | 10 or 7 (Note 9) | 1 | |
| RC.4 FDD | FDD | 10 | 15 | - | | MCS.15 | 8 | 1 | Note 6 |
| RC.4 TDD | TDD | 10 | 15 | Note 3 | | MCS.15 | 10 | 1 | Note 6 |
| RC.5 FDD | FDD | 10 | 3 | - | | MCS.17 | 8 | 1 | |
| RC.5 TDD | TDD | 10 | 3 | Note 3 | | MCS.17 | 10 | 1 | |
| RC.14 FDD | FDD | 5 | 25 | - | | MCS.14 | 8 | 1 | |
| RC.15 FDD | FDD | 5 | 15 | - | | MCS.15 | 8 | 1 | Note 6 |
| RC.16 FDD | FDD/HD-FDD | 10 | 2 | | | MCS.20 | 8 | 1 | Note 8,10 |
| RC.16 TDD | TDD | 10 | 2 | Note 3 | | MCS.20 | 10 | 1 | Note 8 |
| **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 9) | 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 |
| **4 CRS Ports** | | | | | | | | | |
| RC.17 FDD | FDD | 10 | 50 | - | | MCS.18 | 8 | 1 | |
| RC.17 TDD | TDD | 10 | 50 | Note 3 | | MCS.18 | 7 | 1 | |
| **1 CRS Port + CSI-RS** | | | | | | | | | |
| RC.8 FDD | FDD | 10 | 6 | - | Non CSI-RS | MCS.11 | 8 | 1 | |
| | | | | | 2 CSI-RS | MCS.12 | | | |
| RC.8A FDD | FDD | 10 | 6 | - | Non CSI-RS | MCS.11A | 8 | 1 | |
| | | | | | 2 CSI-RS | MCS.12A | | | |
| RC.8 TDD | TDD | 10 | 6 | Note 3 | Non CSI-RS | MCS.11 | 10 | 1 | |
| | | | | | 2 CSI-RS | MCS.12 | | | |
| RC.8A TDD | TDD | 20 | 8 | Note 3 | Non CSI-RS | MCS.11B | 10 | 1 | |
| | | | | | 2 CSI-RS | MCS.12B | | | |
| RC.9 FDD | FDD | 10 | 50 | - | Non CSI-RS | MCS.3 | 8 | 1 | |
| | | | | | 2 CSI-RS | MCS.4 | | | |
| RC.9 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS | MCS.3 | 7 | 1 | |
| | | | | | 2 CSI-RS | MCS.4 | | | |
| **2 CRS Port + CSI-RS** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RC.7 FDD | FDD | 10 | 50 | - | Non CSI-RS | MCS.5 | 8 | 1 | |
| | | | | | 4 CSI-RS | MCS.7 | | | |
| RC.7 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS | MCS.5 | 10 | 1 | |
| | | | | | 8 CSI-RS | MCS.8 | | | |
| RC.11 FDD | FDD | 10 | 50 | - | Non CSI-RS | MCS.5 | 8 | 1 | |
| | | | | | 2 CSI-RS | MCS.6 | | | |
| RC.11 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS | MCS.5 | 10 | 1 | |
| | | | | | 2 CSI-RS | MCS.6 | | | |
| RC.18 FDD | FDD | 10 | 6 | - | Non CSI-RS | MCS.13 | 8 | 1 | |
| | | | | | 4 CSI-RS | MCS.19 | | | |
| RC.18 TDD | TDD | 10 | 6 | Note 3 | Non CSI-RS | MCS.13 | 7 | 1 | |
| | | | | | 4 CSI-RS | MCS.19 | | | |
| RC.17 TDD | TDD | 10 | 6 | Note 3 | 4 ZP-CSI-RS | MCS.21 | 10 | 1 | |
| RC.18 TDD | TDD | 10 | 6 | Note 3 | 4 ZP-CSI-RS | MCS.22 | 10 | 1 | |
| RC.19 TDD | TDD | 10 | 41 | Note3 | 4 ZP-CSI-RS | MCS.23 | 10 | 1 | Note 11 |
| RC.20 TDD | TDD | 10 | 50 | Note3 | Non CSI-RS | MCS.24 | 10 | 1 | |
| | | | | | 2 CSI-RS, 4 ZP-CSI-RS | MCS.25 | | | |
| **1 CRS Port + CSI-RS + CSI-IM** | | | | | | | | | |
| RC.13 FDD | FDD | 10 | 50 | - | Non CSI-RS/IM | MCS.3 | 8 | 1 | |
| | | | | | CSI-RS/IM | N/A | | | |
| RC.13 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS/IM | MCS.3 | 10 | 1 | |
| | | | | | CSI-RS/IM | N/A | | | |
| **2 CRS Port + CSI-RS + CSI-IM** | | | | | | | | | |
| RC.10 FDD | FDD | 10 | 50 | - | Non CSI-RS | MCS.5 | 8 | 1 | |
| | | | | | 4 CSI-RS, 1 CSI process | MCS.8 | | | |
| RC.10 TDD | TDD | 10 | 50 | Note 3 | Non CSI-RS | MCS.5 | 10 | 1 | |
| | | | | | 8 CSI-RS, 1 CSI process | MCS.9 | | | |
| RC.12 FDD | FDD | 10 | 6 | - | Non CSI-RS/IM | MCS.13 | 8 | 1 | |
| | | | | | CSI-RS/IM | N/A | | | |
| RC.12 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: | Allocate PDSCH on 5th and 6th PRBs within a subband. |
| Note 9: | The number of HARQ processes is 10 for TDD UL/DL configuration 2 and 7 for TDD UL/DL configuration 1. |
| Note 10: | The downlink subframes are scheduled at the 1st, 2nd, 8th, 9th, 16th, 17th, 18th, 24th, 26th, 32nd, 33rd, 34th subframes every 40ms. Information bit payload is available if downlink subframe is scheduled.(starting from 0th subframe) |
| Note 11: | 41 resource blocks (RB0–RB20 and RB30–RB49) are allocated in subframe 0 and 5 in RC.19 TDD. |

**Table A.4-1a: Void**

**Table A.4-1b: Void**

**Table A.4-1c: Void**

**Table A.4-1d: Void**

**Table A.4-1e: Void**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Table A.4-5: Void**

**Table A.4-5a: Void**

**Table A.4-5b: Void**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

| **CQI Index** | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | **Notes** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Target Coding Rate** | | | 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 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 21 | 22 | 24 | 25 | |
| MCS.14 | 25 | 3150 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 18 | 21 | 23 | 25 | 27 | 27 | |
| MCS.15 | 15 | 1890 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 18 | 21 | 23 | 25 | 27 | 27 | |
| MCS.16 | 15 | 1800 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 18 | 20 | 22 | 24 | 26 | 27 | |
| MCS.17 | 3 | 378 | DTX | 0 | 1 | 2 | 5 | 7 | 9 | 12 | 13 | 16 | 19 | 21 | 23 | 25 | 27 | 27 | |
| MCS.18 | 50 | 5800 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 20 | 22 | 23 | 26 | 27 | |
| MCS.19 | 6 | 624 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 17 | 18 | 20 | 22 | 24 | 25 | |
| MCS.20 | 2 | 252 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 16 | 19 | 21 | 23 | 23 | 23 | 23 | |
| MCS.21 | 6 | 696 | DTX | 0 | 0 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 18 | 20 | 21 | 24 | 25 | 27 | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCS.22 | 6 | 624 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 15 | 19 | 20 | 22 | 24 | 24 | |
| MCS.23 | 41 | 4264 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 10 | 12 | 14 | 15 | 18 | 20 | 22 | 24 | 24 | |
| MCS.24 | 50 | 5400 | DTX | 0 | 0 | 2 | 3 | 5 | 7 | 10 | 12 | 14 | 15 | 19 | 21 | 23 | 24 | 25 | |
| MCS.25 | 50 | 5100 | DTX | 0 | 0 | 1 | 3 | 5 | 7 | 8 | 12 | 13 | 15 | 18 | 20 | 22 | 23 | 24 | |

Note 1: Mapping between Imcs and TBS according to Tables 7.1.7.1-1 and 7.1.7.2.1-1 in TS 36.213 [6].
Note 2: 3 symbols allocated to PDCCH.
Note 3: Sub-frame#0 and #5 are not used for the corresponding requirement except for [MCS.23]. The next subframe (i.e. sub-frame#1 or #6) shall be used for potential retransmissions.

**Table A.4-14: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS indx Table 2 and 4-bit CQI Table 2 are used)**

| **CQI Index** | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | **Notes** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Target Coding Rate** | | | OOR | 0.0762 | 0.1885 | 0.4385 | 0.3691 | 0.4785 | 0.6016 | 0.4551 | 0.5537 | 0.6504 | 0.7539 | 0.6394 | 0.6943 | 0.7783 | 0.8643 | 0.9258 | |
| **Modulation** | | | OOR | QPSK | | | 16QAM | | | 64QAM | | | | 256QAM | | | | | |
| **MCS Scheme** | **PRB** | **Available RE-s** | **Imcs** | | | | | | | | | | | | | | | | |
| MCS.1A | 50 | 6300 | DTX | 0 | 1 | 3 | 5 | 7 | 10 | 11 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 26 | |
| MCS.1B | 100 | 12600 | DTX | 0 | 1 | 3 | 5 | 7 | 10 | 11 | 14 | 15 | 18 | 20 | 22 | 24 | 26 | 26 | |

Note 1: Mapping between Imcs and 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.

**Table A.4-15: Mapping of CQI Index to Modulation coding scheme (Modulation and TBS indx Table 2 and 4-bit CQI Table 2 are used)**

| **CQI Index** | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | **Notes** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Target Coding Rate** | | | OOR | 0.0762 | 0.1885 | 0.4385 | 0.3691 | 0.4785 | 0.6016 | 0.6826 | 0.5537 | 0.6504 | 0.7539 | 0.8525 | 0.6943 | 0.7783 | 0.8643 | 0.9258 | |
| **Modulation** | | | OOR | QPSK | | | 16QAM | | | | 64QAM | | | | 256QAM | | | | |
| **MCS Scheme** | **PRB** | **Available RE-s** | **Imcs** | | | | | | | | | | | | | | | | |
| MCS.11A | 6 | 684 | DTX | 0 | 1 | 3 | 5 | 7 | 8 | 10 | 13 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | |
| MCS.12A | 6 | 672 | DTX | 0 | 1 | 3 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | |
| MCS.11B | 8 | 912 | DTX | 0 | 1 | 3 | 5 | 7 | 9 | 10 | 13 | 14 | 16 | 18 | 19 | 22 | 24 | 26 | |
| MCS.12B | 8 | 896 | DTX | 0 | 1 | 3 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 19 | 22 | 24 | 25 | |

Note 1: Mapping between Imcs and 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 – Last unallocated PRB | First unallocated PRB – Last unallocated PRB | First unallocated PRB – Last unallocated PRB | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.<br>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | |

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

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

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

| **Relative power level $\gamma_{PRB}$ [dB]** | | | **PDSCH Data** |
|---|---|---|---|
| **Subframe** | | | |
| 0 | 5 | 1 – 4, 6 – 9 | |
| **Allocation** | | | |
| 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | 0 – (First allocated PRB-1) and (Last allocated PRB+1) – ($N_{RB}-1$) | |
| 0 | 0 | 0 | Note 1 |

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

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

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

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

| **Allocation $n_{PRB}$** | **Relative power level $\gamma_{PRB}$ [dB]** | | | | **PDSCH Data** | **PMCH Data** |
|---|---|---|---|---|---|---|
| | **Subframe** | | | | | |
| | 0 | 5 | 4, 9 | 1 – 3, 6 – 8 | | |
| 1 – 49 | 0 | 0 (Allocation: all empty PRB-s) | 0 | N/A | Note 1 | N/A |
| 0 – 49 | N/A | N/A | N/A | 0 | N/A | Note 2 |

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

Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH subframes shall contain cell-specific Reference Signals only in the first symbol of the first time slot. The parameter $\gamma_{PRB}$ is used to scale the power of PMCH.

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

N/A: Not Applicable

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

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

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

| Allocation $n_{PRB}$ | Relative power level $\gamma_{PRB}$ [dB] | | | PDSCH Data | PMCH Data |
|---|---|---|---|---|---|
| | Subframe | | | | |
| | 0, 4, 9 | 5 | 1 – 3, 6 – 8 | | |
| First unallocated PRB – Last unallocated PRB | 0 | 0 (Allocation: all empty PRB-s) | N/A | Note 1 | N/A |
| First unallocated PRB – Last unallocated PRB | N/A | N/A | N/A | N/A | Note 2 |

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

Note 2: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH subframes shall contain cell-specific Reference Signals only in the first symbol of the first time slot. The parameter $\gamma_{PRB}$ is used to scale the power of PMCH.

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

N/A: Not Applicable

### A.5.1.5 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 – Last unallocated PRB | First unallocated PRB – Last unallocated PRB | First unallocated PRB – Last unallocated PRB | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 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) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | 0 – (First allocated PRB of first block -1) and (Last allocated PRB of first block +1) – (First allocated PRB of second block -1) | |
| 0 | 0 | 0 | Note 1 |
| Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.<br>Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | |

## A.5.1.7 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 $N_{End,m}$, 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.5.1.8-1: 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<br>(PRB $N_{Start,1}$ ~ PRB $N_{End,1}$)<br>…<br>*m*-th unallocated PRB<br>(PRB $N_{Start,m}$ ~<br>PRB $N_{End,m}$)<br>…<br>*M*-th unallocated PRB<br>(PRB $N_{Start,M}$ ~<br>PRB $N_{End,M}$) | 1-st unallocated PRB<br>(PRB $N_{Start,1}$ ~ PRB $N_{End,1}$)<br>…<br>*m*-th unallocated PRB<br>(PRB $N_{Start,m}$ ~<br>PRB $N_{End,m}$)<br>…<br>*M*-th unallocated PRB<br>(PRB $N_{Start,M}$ ~<br>PRB $N_{End,M}$) | 1-st unallocated PRB<br>(PRB $N_{Start,1}$ ~ PRB $N_{End,1}$)<br>…<br>*m*-th unallocated PRB<br>(PRB $N_{Start,m}$ ~ PRB $N_{End,m}$)<br>…<br>*M*-th unallocated PRB<br>(PRB $N_{Start,M}$ ~<br>PRB $N_{End,M}$) | |
| 0 | 0 | 0 | Note 1,2,3 |

Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is 16QAM modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.

Note 2: The OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode10. The the transmit power is equal between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.

Note 3: The detailed test set-up for TM10 transmission i.e PMI configuration is specified to each test case.

## A.5.2 OCNG Patterns for TDD

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

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

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

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

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

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

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

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

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

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

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

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

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

### A.5.2.3 OCNG TDD pattern 3: 49 RB OCNG allocation with MBSFN in 10 MHz

**Table A.5.2.3-1: OP.3 TDD: OCNG TDD Pattern 3 for 5ms downlink-to-uplink switch-point periodicity**

| Allocation $n_{PRB}$ | Relative power level $\gamma_{PRB}$ [dB] | | | | PDSCH Data | PMCH Data |
|---|---|---|---|---|---|---|
| | Subframe | | | | | |
| | 0 | 5 | 4, 9[Note 2] | 1, 6 | | |
| 1 – 49 | 0 | 0<br>(Allocation: all empty PRB-s) | N/A | 0 | Note 1 | N/A |
| 0 – 49 | N/A | N/A | 0 | N/A | N/A | Note 3 |

Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter $\gamma_{PRB}$ is used to scale the power of PDSCH.
Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211.
Note 3: Each physical resource block (PRB) is assigned to MBSFN transmission. The data in each PRB shall be uncorrelated with data in other PRBs over the period of any measurement. The MBSFN data shall be QPSK modulated. PMCH symbols shall not contain cell-specific Reference Signals.
Note 4: If two or more transmit antennas are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas according to transmission mode 2. The transmit power shall be equally split between all the transmit antennas used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.

N/A Not Applicable

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

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

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

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

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

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

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

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

N/A Not Applicable

## A.5.2.5 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.

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 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.<br>Note 2: Subframes available for DL transmission depends on the Uplink-Downlink configuration in Table 4.2-2 in 3GPP TS 36.211<br>Note 3: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter $\gamma_{PRB}$ applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213. | | | | |

### A.5.2.7 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 | 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 | 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 | 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 | |

| | | | | |
|---|---|---|---|---|
| $N_{RB}-1)$ | $N_{RB}-1)$ | $N_{RB}-1)$ | $N_{RB}-1)$ | |
| 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.5.2.8 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 $N_{End,1}$)<br>…<br>*m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$)<br>…<br>*M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$)<br>…<br>*m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$)<br>…<br>*M*-th unallocated PRB (PRB $N_{Start,M}$ ~ PRB $N_{End,M}$) | 1-st unallocated PRB (PRB $N_{Start,1}$ ~ PRB $N_{End,1}$)<br>…<br>*m*-th unallocated PRB (PRB $N_{Start,m}$ ~ PRB $N_{End,m}$)<br>…<br>*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.

# A.6 Sidelink reference measurement channels

## A.6.1 General

The algorithm for determining the payload size $A$ is as follows; given a desired coding rate $R$ and radio block allocation $N_{RB}$

1. Calculate the number of channel bits $N_{ch}$ that can be transmitted during the first transmission of a given 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 $N_{RB}$ resource blocks.

b) $C$ is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [5].

3. If there is more than one $A$ that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

## A.6.2 Reference measurement channel for receiver characteristics

For ProSe Direct Discovery, Table A.6.2-1 is applicable for measurements on the Receiver Characteristics (clause 7) including the requirements of subclause 7.4D (Maximum input level).

For ProSe Direct Communication, Table A.6.2-2 is applicable for measurements on the Receiver Characteristics (clause 7) with the exception of subclause 7.4D (Maximum input level). Tables A.6.2-3, A.6.2-4, are applicable for subclause 7.4D (Maximum input level).

**Table A.6.2-1: Fixed Reference measurement channel for ProSe Direct Discovery receiver requirements and maximum input level**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 2 | 2 | 2 | 2 |
| Subcarriers per resource block | | | | 12 | 12 | 12 | 12 |
| Allocated subframes per Discovery period | | | | 1 | 1 | 1 | 1 |
| DFT-OFDM Symbols per subframe (see note) | | | | 11 | 11 | 11 | 11 |
| Modulation | | | | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size | | | | 232 | 232 | 232 | 232 |
| Transport block CRC | Bits | | | 24 | 24 | 24 | 24 |
| Maximum number of HARQ transmissions | | | | 1 | 1 | 1 | 1 |
| Binary Channel Bits (see note) | Bits | | | 528 | 528 | 528 | 528 |
| Max. Throughput averaged over 1 Discovery period of 320ms | kbps | | | 0.725 | 0.725 | 0.725 | 0.725 |
| UE Category | | | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |
| NOTE1: PSDCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.<br>NOTE2: Throughput is 232 bits per Discovey period. The discovery period is configured as 320ms in the test. | | | | | | | |

**Table A.6.2-2: Fixed Reference measurement channel for ProSe Direct Communication receiver requirements**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| Subcarriers per resource block | | | | 12 | 12 | | |
| Packets per SA period | | | | 1 | 1 | | |
| Modulation | | | | QPSK | QPSK | | |
| Transport Block Size | | | | 2216 | 4392 | | |
| Transport block CRC | Bits | | | 24 | 24 | | |
| Maximum number of HARQ transmissions | | | | 4 | 4 | | |
| Binary Channel Bits | Bits | | | 7200 | 14400 | | |
| Max. Throughput averaged over 1 SA period of 40ms | kbps | | | 55.4 | 109.8 | | |
| UE Category | | | | ≥ 1 | ≥ 1 | | |
| NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: Throughput (in kbps) will depend on SA period configuration | | | | | | | |

**Table A.6.2-3: Fixed Reference measurement channel for ProSe Direct Communication for maximum input power for UE categories 2-8**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 50 | | |
| Subcarriers per resource block | | | | 12 | 12 | | |
| Packets per SA period | | | | 1 | 1 | | |
| Modulation | | | | 16QAM | 16QAM | | |
| Transport Block Size | | | | 9912 | 18336 | | |
| Transport block CRC | Bits | | | 24 | 24 | | |
| Maximum number of HARQ transmissions | | | | 4 | 4 | | |
| Binary Channel Bits | Bits | | | 14400 | 28800 | | |
| Max. Throughput averaged over 1 SA period of 40ms | kbps | | | 247.8 | 458.4 | | |
| NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>NOTE 3: Throughput (in kbps) will depend on SA period configuration | | | | | | | |

**Table A.6.2-4: Fixed Reference measurement channel for ProSe Direct Communication for maximum input power for UE category 1**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 25 | 24 | | |
| Subcarriers per resource block | | | | 12 | 12 | | |
| Packets per SA period | | | | 1 | 1 | | |
| Modulation | | | | 16QAM | 16QAM | | |
| Transport Block Size | | | | 9912 | 10296 | | |
| Transport block CRC | Bits | | | 24 | 24 | | |
| Maximum number of HARQ transmissions | | | | 4 | 4 | | |
| Binary Channel Bits | Bits | | | 14400 | 13824 | | |
| Max. Throughput averaged over 1 SA period of 40ms | kbps | | | 247.8 | 257.4 | | |
| NOTE 1: For PSSCH transmission, the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).<br>NOTE 3: Throughput (in kbps) will depend on SA period configuration | | | | | | | |

### A.6.3 Reference measurement channels for PSDCH performance requirements Table A.6.3-1: Fixed Reference measurement channel for PSDCH performance requirement

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Reference channel | | **D.1 FDD / D.1 TDD** | | | | | |
| Channel bandwidth | MHz | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | | | 2 | 2 | 2 | 2 |
| Subcarriers per resource block | | | | 12 | 12 | 12 | 12 |
| DFT-OFDM Symbols per subframe (NOTE 1) | | | | 11 | 11 | 11 | 11 |
| Modulation | | | | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size | | | | 232 | 232 | 232 | 232 |
| Transport block CRC | Bits | | | 24 | 24 | 24 | 24 |
| Binary Channel Bits (NOTE 1) | Bits | | | 528 | 528 | 528 | 528 |
| Max. Throughput averaged over 1 Discovery period of 320ms | kbps | | | 0.725 | 0.725 | 0.725 | 0.725 |
| UE Category | | | | ≥ 1 | ≥ 1 | ≥ 1 | ≥ 1 |
| NOTE1: PSDCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. | | | | | | | |

## A.6.4 Reference measurement channels for PSCCH performance requirements

**Table A.6.4-1: Fixed reference measurement channel for PSCCH performance requirement**

| Parameter | | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reference channel | | | CC.1 FDD | CC.2 FDD | CC.3 FDD | CC.4 FDD | CC.5 FDD | CC.6 FDD |
| Channel bandwidth | | MHz | 5 | 10 | 5 | 10 | 5 | 10 |
| Allocated resource blocks | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Subcarriers per resource block | | | 12 | 12 | 12 | 12 | 12 | 12 |
| DFT-OFDM Symbols per subframe (see NOTE 1) | | | 11 | 11 | 11 | 11 | 11 | 11 |
| Modulation | | | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size | | Bits | 41 | 43 | 41 | 43 | 41 | 43 |
| Information bits | Frequency hopping flag | | 0 | 0 | 1 | 1 | 1 | 1 |
| | RB assignment | | Set as per PSSCH RB allocation specific in the test | | | | | |
| | Hopping bits | | N/A | N/A | 1 Type 2 Hopping | (1,1) Type 2 Hopping | 0 Type 1 Hopping | (1,0) Type 1 Hopping |
| | Time resource pattern ($I_{TRP}$) | | 8 (unless specified otherwise in the test) (NOTE 3) | | | | | |
| | Modulation and coding scheme | | Set as the PSSCH MCS specified in the test | | | | | |
| | Timing advance indication | | 0 (unless specified otherwise in the test) | | | | | |
| | Group destination ID | | As set by higher layers | | | | | |
| Transport block CRC | | Bits | 16 | 16 | 16 | 16 | 16 | 16 |
| Maximum number of HARQ transmissions | | | 2 | 2 | 2 | 2 | 2 | 2 |
| Binary Channel Bits (see NOTE 1,2) | | Bits | 264 | 264 | 264 | 264 | 264 | 264 |
| Max. Throughput averaged over one sc-period (bits/sc-period) | | | 41 | 43 | 41 | 43 | 41 | 43 |
| NOTE 1: PSCCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: Binary channel bits per HARQ transmission.<br>NOTE 3: For $N_{TRP}$ = 8 (FDD) and *trpt-Subset* = 010, $I_{TRP}$ = 8 corresponds to a time repetition pattern of (1,1,0,0,0,0,0,0) as per TS 36.213. | | | | | | | | |

# A.6.5 Reference measurement channels for PSSCH performance requirements

**Table A.6.5-1: Fixed reference measurement channel for PSSCH performance requirement**

| Parameter | Unit | Value | | | | |
|---|---|---|---|---|---|---|
| Reference channel | | CD.1 FDD | CD.2 FDD | CD.3 FDD | CD.4 FDD | CD.5 FDD |
| Channel bandwidth | MHz | 5 / 10 | 5 / 10 | 5 | 10 | 5 / 10 |
| Allocated resource blocks | | 10 | 10 | 25 | 50 | 2 |
| Subcarriers per resource block | | 12 | 12 | 12 | 12 | 12 |
| DFT-OFDM Symbols per subframe (see NOTE 1) | | 11 | 11 | 11 | 11 | 11 |
| Modulation | | QPSK | 16QAM | 16QAM | 16QAM | QPSK |
| Transport Block Size | | 872 | 2536 | 6546 | 12960 | 328 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 |
| Maximum number of HARQ transmissions | | 4 | 4 | 4 | 4 | 4 |
| Binary Channel Bits (see NOTE 1,2) | Bits | 2640 | 5280 | 13200 | 26400 | 528 |
| Max. Throughput averaged over one sc-period (bits/sc-period) | | 872 | 2536 | 6546 | 12960 | 328 |
| NOTE 1: PSSCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: Binary channel bits per HARQ transmission.<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.6.5-2: Fixed reference measurement channel for PSSCH for maximum Sidelink processes test**

| Parameter | Unit | Value | |
|---|---|---|---|
| Reference channel | | CD.6 FDD | CD.7 FDD |
| Channel bandwidth | MHz | 5 | 10 |
| Allocated resource blocks | | 25 | 50 |
| Subcarriers per resource block | | 12 | 12 |
| DFT-OFDM Symbols per subframe (see NOTE 1) | | 11 | 11 |
| Modulation | | 16QAM | 16QAM |
| Transport Block Size | | 15840 | 25456 |
| Transport block CRC | Bits | 24 | 24 |
| Maximum number of HARQ transmissions | | 4 | 4 |
| Binary Channel Bits (see NOTE 1,2) | Bits | 13200 | 26400 |
| Max. Throughput averaged over one sc-period (bits/sc-period) | | 15840 | 25456 |
| NOTE 1: PSSCH transmissions are rate-matched for 12 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211.<br>NOTE 2: Binary channel bits per HARQ transmission.<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.6.6 Reference measurement channels for PSBCH performance requirements

**Table A.6.6-1: Fixed reference measurement channel for PSBCH performance requirement**

| Parameter | Unit | Value |
|---|---|---|
| Reference channel | | CP.1 FDD |
| Channel bandwidth | MHz | 5 / 10 |
| Allocated resource blocks | | 6 |
| Subcarriers per resource block | | 12 |
| DFT-OFDM Symbols per subframe (see NOTE 1) | | 7 |
| Modulation | | QPSK |
| Transport Block Size | | 40 |
| Transport block CRC | Bits | 16 |
| Maximum number of HARQ transmissions | | 1 |
| Binary Channel Bits (see NOTE 1,2) | Bits | 1008 |
| Max. Throughput averaged over 40ms | kbps | 1 |
| NOTE 1: PSBCH transmissions are rate-matched for 8 DFT-OFDM symbols per subframe, and the last symbol shall be punctured as per TS 36.211. | | |

# A.7 Sidelink reference resource pool configurations

## A.7.1 Reference resource pool configurations for ProSe Direct Discovery demodulation tests

### A.7.1.1 FDD

**Table A.7.1.1-1: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #1-FDD)**

| Information Element | | | Value |
|---|---|---|---|
| discRxPool | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 0 |
| | numRepetition | | 1 |
| | tf-ResourceConfig | prb-Num | 12 |
| | | prb-Start | 0 |
| | | prb-End | 23 |
| | | offsetIndicator | 160 |
| | | subframeBitmap | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
| | txParameters | | not present |
| | rxParameters | | not present |
| discTxPoolCommon | | | not present |
| discTxPowerInfo | | | not present |
| SL-SyncConfig | | | not present |
| discInterFreqList | | | not present |

**Table A.7.1.1-2: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #2-FDD)**

| Information Element | | | Value |
|---|---|---|---|
| discRxPool(0) | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 0 |
| | numRepetition | | 1 |
| | tf-ResourceConfig | prb-Num | 12 |
| | | prb-Start | 0 |
| | | prb-End | 23 |
| | | offsetIndicator | 150 |
| | | subframeBitmap | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
| | txParameters | | not present |
| | rxParameters | | not present |
| discRxPool(1) | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 0 |
| | numRepetition | | 1 |
| | tf-ResourceConfig | prb-Num | 12 |
| | | prb-Start | 0 |
| | | prb-End | 23 |
| | | offsetIndicator | 170 |
| | | subframeBitmap | 10000000<br>00000000<br>00000000<br>00000000<br>00000000 |
| | *txParameters* | | not present |
| | *rxParameters* | *tdd-Config* | not present |
| | | *syncConfigIndex* | 0 |
| *discTxPoolCommon* | | | not present |
| *discTxPowerInfo* | | | not present |
| *SL-SyncConfig(0)* | *syncCP-Len* | | Normal |
| | *syncOffsetIndicator* | | 0 (160 mod 40) |
| | *slssid* | | 30 |
| | *txParameters* | | not present |
| | *rxParamsNCell* | *physCellId* | 1 |
| | | *discSyncWindow* | w1 |
| *discInterFreqList* | | | not present |

**Table A.7.1.1-3: ProSe Direct Discovery configuration for E-UTRA FDD (Configuration #3-FDD)**

| Information Element | | | Value |
|---|---|---|---|
| discRxPool(iPool),<br>iPool = 0…NPool-1 | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 3 |
| | numRepetition | | =2 if NPool > 10,<br>=1 otherwise |
| | tf-ResourceConfig | prb-Num | 5MHz: min{24, 2N-24*iPool} / 2<br>10MHz: 25<br>15MHz: min{74, 2N-74*iPool} / 2<br>20MHz: 50 |
| | | prb-Start | 0 |
| | | prb-End | 5 MHz: min{24, 2N-24*iPool} - 1<br>10 MHz: 49<br>15 MHz: min{74, 2N-74*iPool} - 1<br>20 MHz: 99 |
| | | offsetIndicator | 160 |
| | | subframeBitmap | a(0), a(1), …, a(39), s.t.<br><br>a(i * NPool + iPool) = 1, i = 0,..,K;<br>a(k) = 0 otherwise<br><br>where<br>K = 1 is NPool > 10, K = 3 otherwise |
| | txParameters | | not present |
| | rxParameters | | not present |
| discTxPoolCommon | | | not present |
| discTxPowerInfo | | | not present |
| SL-SyncConfig | | | not present |
| discInterFreqList | | | not present |
| NOTE 1: The resource pool configuration description is parameterized using channel BW, number of configured resource pools (NPool), and maximum number of configured Sidelink UEs to be supported (N). | | | |

## A.7.1.2 TDD

**Table A.7.1.2-1: ProSe Direct Discovery configuration for E-UTRA TDD Config 0 (Configuration #1-TDD)**

| Information Element | | | Value |
|---|---|---|---|
| discRxPool | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 0 |
| | numRepetition | | 1 |
| | tf-ResourceConfig | prb-Num | 12 |
| | | prb-Start | 0 |
| | | prb-End | 23 |
| | | offsetIndicator | 163 |
| | | subframeBitmap | 10000000<br>00000000<br>00000000<br>00000000<br>00000000<br>00 |
| | txParameters | | not present |
| | rxParameters | | not present |
| discTxPoolCommon | | | not present |
| discTxPowerInfo | | | not present |
| SL-SyncConfig | | | not present |
| discInterFreqList | | | not present |

**Table A.7.1.2-2: ProSe Direct Discovery configuration for E-UTRA TDD (Configuration #2-TDD)**

| Information Element | | | Value |
|---|---|---|---|
| discRxPool(iPool),<br>iPool = 0…NPool-1 | cp-Len | | Normal |
| | discPeriod | | rf32 |
| | numRetx | | 3 |
| | numRepetition | | =2 if NPool > 10,<br>=1 otherwise |
| | tf-ResourceConfig | prb-Num | 5MHz: min{24, 2N-24*iPool} / 2<br>10MHz: 25<br>15MHz: min{74, 2N-74*iPool} / 2<br>20MHz: 50 |
| | | prb-Start | 0 |
| | | prb-End | 5 MHz: min{24, 2N-24*iPool} - 1<br>10 MHz: 49<br>15 MHz: min{74, 2N-74*iPool} - 1<br>20 MHz: 99 |
| | | offsetIndicator | 163 |
| | | subframeBitmap | a(0), a(1), …, a(39), s.t.<br><br>a(i * NPool + iPool) = 1, i = 0,..,K;<br>a(k) = 0 otherwise<br><br>where<br>K = 1 is NPool > 10, K = 3 otherwise |
| | txParameters | | not present |
| | rxParameters | | not present |
| discTxPoolCommon | | | not present |
| discTxPowerInfo | | | not present |
| SL-SyncConfig | | | not present |
| discInterFreqList | | | not present |
| NOTE 1: The resource pool configuration description is parameterized using channel BWs, number of configured resource pools (NPool), and maximum number of configured Sidelink UE to be supported (N). | | | |

## A.7.2 Reference resource pool configurations for ProSe Direct Communication demodulation tests

### A.7.2.1 FDD

**Table A.7.2.1-1: ProSe Direct Communication pre-configuration for E-UTRAN FDD for out-of-network coverage operation (Configuration #1-FDD)**

| Information Element / (BW configuration) | | | | Value (5MHz) | Value (10MHz) |
|---|---|---|---|---|---|
| preconfigSync | syncCP-Len-r12 | | | Normal | |
| | syncOffsetIndicator1 | | | 1 | |
| | syncOffsetIndicator2 | | | 2 | |
| | syncTxParameters | | | 23 | |
| | syncTxThreshOoC | | | 0<br>(-110dBm / 15kHz) | |
| | filterCoefficient | | | fc0 | |
| | syncRefMinHyst | | | dB0 | |
| | syncRefDiffHyst | | | dB0 | |
| preconfigComm | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf40 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00011000<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00000000<br>11111111<br>11111111<br>00000000<br>00000000 | |
| | | trpt-Subset-r12 | | 010 | |

**Table A.7.2.1-2: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #2-FDD)**

| Information Element / (BW configuration) | | | | Value (5MHz) | Value (10MHz) |
|---|---|---|---|---|---|
| commRxPool | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf40 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00111100<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00000000<br>11111111<br>11111111<br>00000000<br>00000000 | |
| | | trpt-Subset-r12 | | 010 | |
| | rxParametersNCell | | | not present | |
| | txParameters | | | not present | |
| commTxPoolNormalCommon | | | | not present | |
| SL-SyncConfig | | | | not present | |

**Table A.7.2.1-3: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #3-FDD)**

| Information Element / (BW configuration) | | | | Value (5MHz) | Value (10MHz) |
|---|---|---|---|---|---|
| commRxPool(0) | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf40 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00110000<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00001111<br>11110000<br>00000000<br>11111111<br>00000000 | |
| | | trpt-Subset-r12 | | 010 | |
| | rxParametersNCell | | | not present | |
| | txParameters | | | not present | |
| commRxPool(1) | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf40 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00110000<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00001111<br>11110000<br>00001111<br>11110000<br>00000000 | |
| | | trpt-Subset-r12 | | 010 | |
| | rxParametersNCell | tdd-Config | | not present | |
| | | syncConfigIndex | | 0 | |
| | txParameters | | | not present | |
| commTxPoolNormalCommon | | | | not present | |
| SL-SyncConfig(0) | syncCP-Len | | | Normal | |
| | syncOffsetIndicator | | | 1 | |
| | slssid | | | 30 | |
| | txParameters | | | not present | |

| | | | | |
|---|---|---|---|---|
| | rxParamsNCell | physCellId | | 1 |
| | | discSyncWindow | | w1 |

**Table A.7.2.1-4: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #4-FDD)**

| Information Element / (BW configuration) | | | | Value (5MHz) | Value (10MHz) |
|---|---|---|---|---|---|
| commRxPool(0) | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf80 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 11110000<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00000000<br>11111111<br>00000000<br>11111111<br>00000000 | |
| | | trpt-Subset-r12 | | 001 | |
| | rxParametersNCell | | | not present | |
| | txParameters | | | not present | |
| commRxPool(1) | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf80 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00001111<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00000000<br>00000000<br>11111111<br>00000000<br>11111111 | |
| | | trpt-Subset-r12 | | 001 | |
| | rxParametersNCell | | | not present | |
| | txParameters | | | not present | |
| commTxPoolNormalCommon | | | | not present | |
| SL-SyncConfig | | | | not present | |

**Table A.7.2.1-5: ProSe Direct Communication configuration for E-UTRA FDD (Configuration #5-FDD)**

| Information Element / (BW configuration) | | | | Value (5MHz) | Value (10MHz) |
|---|---|---|---|---|---|
| commRxPool | sc-CP-Len | | | Normal | |
| | sc-Period | | | sf40 | |
| | sc-TF-ResourceConfig | prb-Num | | 13 | 25 |
| | | prb-Start | | 0 | 0 |
| | | prb-End | | 24 | 49 |
| | | offsetIndicator | | 0 | |
| | | subframeBitmap | | 00011000<br>00000000<br>00000000<br>00000000<br>00000000 | |
| | data-CP-Len | | | Normal | |
| | dataHoppingConfig | hoppingParameter | | 504 | |
| | | numSubbands | | ns2 | |
| | | rb-Offset | | 0 | |
| | ue-SelectedResourceConfig | data-TF-ResourceConfig | prb-Num | 13 | 25 |
| | | | prb-Start | 0 | 0 |
| | | | prb-End | 24 | 49 |
| | | | offsetIndicator | 0 | |
| | | | subframeBitmap | 00000000<br>11111111<br>11111111<br>11111111<br>11111111 | |
| | | trpt-Subset-r12 | | 001 | |
| | rxParametersNCell | | | not present | |
| | txParameters | | | not present | |
| commTxPoolNormalCommon | | | | not present | |
| SL-SyncConfig | | | | not present | |

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

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

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | 0.0 |
| 30 | -1.0 |
| 70 | -2.0 |
| 90 | -3.0 |
| 110 | -8.0 |
| 190 | -17.2 |
| 410 | -20.8 |

**Table B.2.1-3 Extended Vehicular A model (EVA)**

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | 0.0 |
| 30 | -1.5 |
| 150 | -1.4 |
| 310 | -3.6 |
| 370 | -0.6 |
| 710 | -9.1 |
| 1090 | -7.0 |
| 1730 | -12.0 |
| 2510 | -16.9 |

**Table B.2.1-4 Extended Typical Urban model (ETU)**

| Excess tap delay [ns] | Relative power [dB] |
|---|---|
| 0 | -1.0 |
| 50 | -1.0 |
| 120 | -1.0 |
| 200 | 0.0 |
| 230 | 0.0 |
| 500 | 0.0 |
| 1600 | -3.0 |
| 2300 | -5.0 |
| 5000 | -7.0 |

## B.2.2 Combinations of channel model parameters

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** | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ |
| **2x1 case** | $R_{spat} = R_{eNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$ |
| **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** | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$ |
| **2x1 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 |
| **2x1 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** | $R_{low} = \mathbf{I}_2$ |
| **2x1 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 (XP/X-pol) antennas at both eNodeB and UE. The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at eNB and cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at UE.

For the cross-polarized antennas, the N antennas are labelled such that antennas for one polarization are listed from 1 to N/2 and antennas for the other polarization are listed from N/2+1 to N, where N is the number of transmit or receive antennas.

## B.2.3A.1 Definition of MIMO Correlation Matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P\left(R_{eNB} \otimes \Gamma \otimes R_{UE}\right)P^T$$

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

$$P(a,b) = \begin{cases} 1 & for \quad a = (j-1)Nr + i \quad and \quad b = 2(j-1)Nr + i, \qquad i = 1,\cdots,Nr,\ j = 1,\cdots Nt/2 \\ 1 & for \quad a = (j-1)Nr + i \quad and \quad b = 2(j - Nt/2)Nr - Nr + i, \quad i = 1,\cdots,Nr,\ j = Nt/2+1,\cdots,Nt \\ 0 & otherwise \end{cases}$$

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, $R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \mathbf{1} \end{pmatrix}$.

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 | | |
|---|---|---|
| α | β | γ |
| 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**

| | |
|---|---|
| **4x2 case** | $R_{high} = \begin{bmatrix} 1.0000 & 0.0000 & 0.9000 & 0.0000 & -0.3000 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9000 & 0.0000 & 0.3000 & 0.0000 & 0.2700 \\ 0.9000 & 0.0000 & 1.0000 & 0.0000 & -0.2700 & 0.0000 & -0.3000 & 0.0000 \\ 0.0000 & 0.9000 & 0.0000 & 1.0000 & 0.0000 & 0.2700 & 0.0000 & 0.3000 \\ -0.3000 & 0.0000 & -0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9000 & 0.0000 \\ 0.0000 & 0.3000 & 0.0000 & 0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9000 \\ -0.2700 & 0.0000 & -0.3000 & 0.0000 & 0.9000 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.3000 & 0.0000 & 0.9000 & 0.0000 & 1.0000 \end{bmatrix}$ |
| **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,

For 8 transmission antennas, $D_{\theta_k} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_k} & 0 & 0 \\ 0 & 0 & e^{j2\theta_k} & 0 \\ 0 & 0 & 0 & e^{j3\theta_k} \end{bmatrix}$;

For 4 transmission antennas, $D_{\theta_k} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_k} \end{bmatrix}$.

- $\theta_k$ controls the phase variation, and the phase for k-th subframe is denoted by $\theta_k = \theta_0 + \Delta\theta \cdot k$, where $\theta_0$ is the random start value with the uniform distribution, i.e., $\theta_0 \in [0, 2\pi]$, $\Delta\theta$ is the step of phase variation, which is defined in Table B.2.3A.4-1, and *k* is the linear increment of 1 for every subframe throughout the simulation,
- $W$ is the precoding matrix for Nt 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) |
|---|---|
| $\Delta\theta$ | $1.2566\times10^{-3}$ |

# B.2.4 Propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t,\tau) = \delta(\tau) + a\exp(-i2\pi f_D t)\delta(\tau - \tau_d),$$

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

## B.2.4.1 Propagation conditions for CQI tests with multiple CSI processes

For CQI tests with multiple CSI processes, the following additional multi-path profile is used for 2 port transmission:

$$H = \begin{bmatrix} 1 & j \\ 1 & -j \end{bmatrix} \circ H_{MP}$$

Where $\circ$ represents Hadamard product, $H_{MP}$ indicates the 2x2 propagation channel generated in the manner defined in Clause B.2.4.

# B.2.5 Void

# B.2.6 MBSFN Propagation Channel Profile

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.

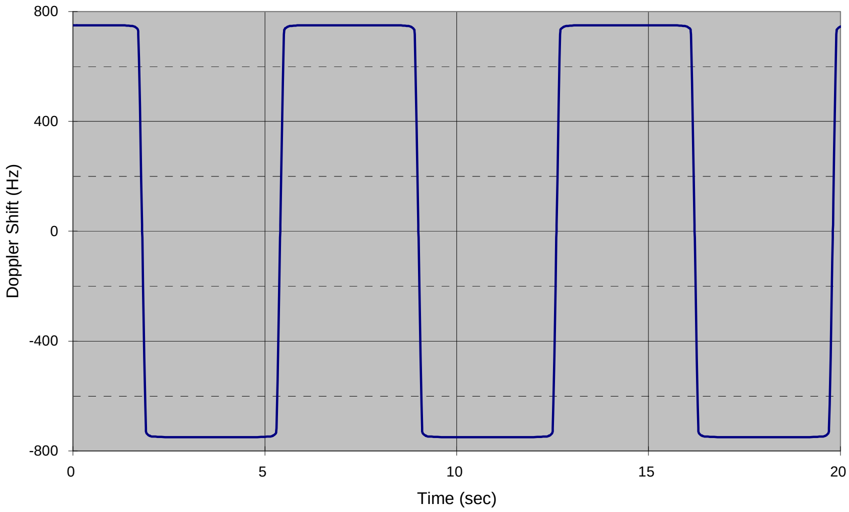


**Figure B.3-1: Doppler shift trajectory**

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 $y_{bf}(i) = [y_{bf}(i) \quad \tilde{y}_{bf}(i)]^T$ the elements of which are to be mapped onto the same physical RE but transmitted on different antenna elements:

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

# B.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.

## B.6 Interference models for enhanced performance requirements Type-B

This clause provides a description for the modelling of interfering cell transmissions for enhanced performance requirements Type-B including: transmission mode 2, 3, 4 and 9 type of interference modelling and a definition of the random interference model.

### B.6.1 Transmission mode 2 interference model

This subclause provides transmission mode 2 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

Precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.2 Transmission mode 3 interference model

This subclause provides transmission mode 3 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined for each user defined in section B.6.6 with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For rank-1 transmission, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4].

For rank-2 transmission, precoding for spatial multiplexing with large delay CDD over two layers for the number of antenna ports in the requirement scenario shall be applied to the randomly modulated layer symbols, as specified in subclause 6.3.4.2.2 of [4].

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.3 Transmission mode 4 interference model

This subclause provides transmission mode 4 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For each TTI, for each user defined in B.6.6, a single precoding matrix for the number of layers $\upsilon$ 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 randomly modulated layer symbols, as specified in subclause 6.3.4.2.1 of [4] with the selected precoding matrices as specified in subclause B.6.6.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.4 Transmission mode 9 interference model

This subclause provides transmission mode 9 interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe, each interfering cell shall transmit randomly modulated data over the PDSCH region as specified in subclause B.6.6. Transmitted physical channels shall include PSS, SSS and PBCH.

The transmission rank shall be randomly determined with probabilities of occurrence of each possible transmission rank as specified in subclause B.6.6.

The MCS shall be randomly determined with probabilities of occurrence of each possible MCS as specified in subclause B.6.6.

For each TTI, for each user defined in B.6.6, a single precoding matrix for the number of layers $\upsilon$ 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 $\upsilon = 2$.

The generic beamforming model in subclause B.4.3 shall be applied assuming cell-specific reference signals and CSI reference signals as specified in the requirement scenario. Random precoding with selected rank and precoding matrices for each subframe shall be applied to randomly modulated layer symbols including the user-specific reference symbols over antenna port 7 when the rank is one and antenna ports 7, 8 when the rank is two.

For each TTI, for each user defined in B.6.6, the scrambling ID value nSCID is randomly assigned from the set of {0,1}.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.5 CRS interference model

This subclause provides for the CRS interference modelling for each explicitly modelled interfering cell in the requirement scenario. In each subframe there is no PDSCH transmitted. Transmitted physical channels shall include PSS, SSS and PBCH.

For unallocated REs in the control region, precoding for transmit diversity for the number of antenna ports in the requirement scenario shall be applied to QPSK randomly modulated layer symbols, as specified in subclause 6.3.4.3 of [4]. The EPRE ratio for these REs shall be as defined for PDCCH in Annex C.3.2.

## B.6.6 Random interference model

This subclause presents the interference model which defines the resource allocation, MCS and rank for the two interference cells. The model includes approximately 10% DTX on these interference cells. Table B.6.6-1 shows the resource allocation for four users in two different configurations for each of the two interferers. Table B.6.6-2 shows the resource allocation to be used for special subframes with TM9 interference. Table B.6.6-3 shows the probabilities for the MSC and rank for these users.

**Table B.6.6-1: Resource allocation for the random interference model**

| Resource allocation configurations Indexes | User Index | Resource allocation for random interference model | | | | Probability |
|---|---|---|---|---|---|---|
| | | Resource allocation type | Bitmap for resource allocation (Note 1) | | | |
| | | | 1st field bitmap | 2nd field bitmap | 3rd field bitmap | |
| **Configuration 1** | User 0 | 1 | 00 | 0 | 10101000101010 | 50% |
| | User 1 | 1 | 00 | 0 | 01010101010101 | |
| | User 2 | 0 | 01001001001001001 | | | |
| | User 3 | 0 | 00100100100100100 | | | |
| **Configuration 2** | User 0 | 1 | 00 | 0 | 10101010101010 | 50% |
| | User 1 | 1 | 00 | 1 | 01010100010101 | |
| | User 2 | 0 | 01001001001001001 | | | |
| | User 3 | 0 | 00100100100100100 | | | |

NOTE 1: The 1st, 2nd, and 3rd field bitmaps are only valid for resource allocation type 1 which was defined in [6].
NOTE 2: The resource allocation model is used for both 1st and 2nd interfering cells and the resource allocation is independent for each interfering cell.

### Table B.6.6-2: Resource allocation for the random interference model for TM9 special subframes

| Resource allocation configurations Indexes | User Index | Resource allocation for random interference model | | | | Probability |
|---|---|---|---|---|---|---|
| | | Resource allocation type | Bitmap for resource allocation (Note 1) | | | |
| | | | 1st field bitmap | 2nd field bitmap | 3rd field bitmap | |
| **Configuration 1** | User 0 | 1 | 00 | 0 | 10101000101010 | 50% |
| | User 1 | 1 | 00 | 0 | 01010101000001 | |
| | User 2 | 0 | 01001000001001001 | | | |
| | User 3 | 0 | 00100100000100100 | | | |
| **Configuration 2** | User 0 | 1 | 00 | 0 | 10101000101010 | 50% |
| | User 1 | 1 | 00 | 1 | 01010000010101 | |
| | User 2 | 0 | 01001000001001001 | | | |
| | User 3 | 0 | 00100100000100100 | | | |

NOTE 1: The 1st, 2nd, and 3rd field bitmaps are only valid for resource allocation type 1 which was defined in [6].
NOTE 2: The resource allocation model is used for both 1st and 2nd interfering cells and the resource allocation is independent for each interfering cell.

### Table B.6.6-3 MCS and rank configuration for the random interference model

| MCS probability | | | Rank probability | |
|---|---|---|---|---|
| **MCS5** | **MCS14** | **MCS25** | **Rank 1** | **Rank 2** |
| 50% | 25% | 25% | 80% | 20% |

NOTE 1: The MCS and rank should follow the probability indicated in the table randomly per UE per TTI.
NOTE 2: The probabilities for MCS and rank configuration are used for both 1st and 2nd interfering cells. The MCS and rank configurations are independent for each interfering cell.

# 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.

**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: -∞ dB is allocated for this channel in this test. | | | | |

**Table C.3.3-2: Downlink physical channels transmitted in aggressor cell when ABS is configured in this cell when the CRS assistance information is provided**

| Physical Channel | Parameters | Unit | EPRE Ratio | |
|---|---|---|---|---|
| | | | Non-ABS | ABS |
| PBCH | PBCH_RA | dB | $\rho_A$ | $\rho_A$ |
| | PBCH_RB | dB | $\rho_B$ | $\rho_B$ |
| PSS | PSS_RA | dB | $\rho_A$ | $\rho_A$ |
| SSS | SSS_RA | dB | $\rho_A$ | $\rho_A$ |
| PCFICH | PCFICH_RB | dB | $\rho_B$ | Note 1 |
| PHICH | PHICH_RA | dB | $\rho_A$ | Note 1 |
| | PHICH_RB | dB | $\rho_B$ | Note 1 |
| PDCCH | PDCCH_RA | dB | $\rho_A$ | Note 1 |
| | PDCCH_RB | dB | $\rho_B$ | Note 1 |
| PDSCH | PDSCH_RA | dB | N/A | Note 1 |
| | PDSCH_RB | dB | N/A | Note 1 |
| OCNG | OCNG_RA | dB | $\rho_A$ | Note 1 |
| | OCNG_RB | dB | $\rho_B$ | Note 1 |
| Note 1: $-\infty$ dB is allocated for this channel in this test. | | | | |

# C.3.4 Power Allocation for Measurement of Performance Requirements when Quasi Co-location Type B: same Cell ID

For the performance requirements related to quasi-colocation type B behaviour when transmission points share the same Cell ID, the power allocation for the physical channels of the serving cell is listed in Table C.3.4-1 and the power allocation for the physical channels of the cell transmitting PDSCH is listed in Table C.3.4-2

**Table C.3.4-1: Downlink physical channels transmitted in the serving cell (TP1)**

| Physical Channel | EPRE Ratio |
|---|---|
| PBCH | PBCH_RA = $\rho_A$+ $\sigma$ |
| | PBCH_RB = $\rho_B$+ $\sigma$ |
| PSS | PSS_RA = 0 (Note 2) |
| SSS | SSS_RA = 0 (Note 2) |
| PDSCH | PDSCH_RA = $\rho_A$ |
| | PDSCH_RB = $\rho_B$ |
| PCFICH | PCFICH_RB = $\rho_B$+ $\sigma$ |
| PDCCH | PDCCH_RA = $\rho_A$+ $\sigma$ |
| | PDCCH_RB = $\rho_B$+ $\sigma$ |

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

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

NOTE 3: $\rho_A$, $\rho_B$ and $\sigma$ are test specific.

**Table C.3.4-2: Downlink physical channels for the transmission point transmitting PDSCH (TP2)**

| Physical Channel | Value |
|---|---|
| PDSCH | Test Specific |

# C.3.5 Simplified CA testing method

For CA tests which require more than 16 independent faders, if a test system cannot support a throughput measurement with fading on all carriers simultaneously, the simplified CA testing method shall be used.

In the simplified CA testing method, the resulting propagation channel(s) shall be generated by considering a number of independent faders needed for one carrier and connecting them to the signal of randomly chosen carrier(s). The maximum number of channel faders on the test will be less than or equal to 16. The remaining carrier(s) shall be connected without a channel fader but with AWGN. The throughput is then collected only for the carrier(s) connected to channel faders.

In the simplified CA testing method, the test shall be repeated by choosing carrier(s) excluding already chosen carrier(s) until all the carrier(s) are tested under fading conditions. All the collected throughtputs from each carrier shall be compared against the reference value of the requirements.

All supported carriers shall be configured and activated during the test.

# 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).

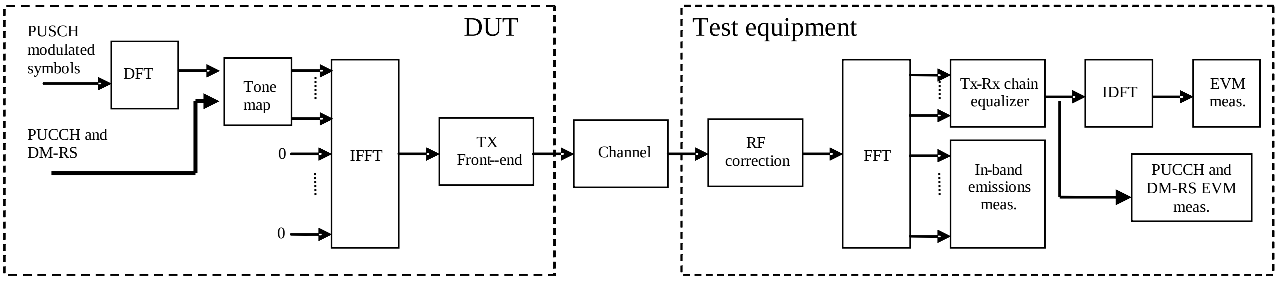


**Figure F.1-1: EVM measurement points**

# 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 $|T_m|$ modulation symbols with the considered modulation scheme being active within the measurement period,

$z'(v)$ are the samples of the signal evaluated for the EVM,

$i(v)$ is the ideal signal reconstructed by the measurement equipment, and

$P_0$ is the average power of the ideal signal. For normalized modulation symbols $P_0$ is equal to 1.

The basic EVM measurement interval is defined over one slot in the time domain for PUCCH and PUSCH and over one preamble sequence for the PRACH.

# F.3 Basic in-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks. The in-band emission requirement is evaluated for PUCCH and PUSCH transmissions. The in-band emission requirement is not evaluated for PRACH transmissions.

The in-band emissions are measured as follows

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

where

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

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

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

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

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

The relative in-band emissions are, given by

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

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 or Physical Sidelink Channel signal under test is modified and, in the case of PUSCH or Physical Sidelink Channel data signal, decoded according to:

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

where

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

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

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

where

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

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

Notation:

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

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

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

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

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

The EVM analyser shall

- detect the start of each slot and estimate $\Delta\tilde{t}$ and $\Delta\tilde{f}$ ,
- determine $\Delta\tilde{c}$ so that the EVM window of length $W$ is centred
  - on the time interval determined by the measured cyclic prefix minus 16 samples of the considered OFDM symbol for symbol 0 for normal CP, i.e. the first 16 samples of the CP should not be taken into account for this step. In the determination of the number of excluded samples, a sampling rate of 30.72MHz was assumed. If a different sampling rate is used, the number of excluded samples is scaled linearly.
  - on the measured cyclic prefix of the considered OFDM symbol symbol for symbol 1 to 6 for normal CP and for symbol 0 to 5 for extended CP.
  - on the measured preamble cyclic prefix for the PRACH

To determine the other parameters a sample timing offset equal to $\Delta\tilde{c}$ is corrected from the signal under test. The EVM analyser shall then

- correct the RF frequency offset $\Delta\tilde{f}$ for each time slot, and
- apply an FFT of appropriate size. The chosen FFT size shall ensure that in the case of an ideal signal under test, there is no measured inter-subcarrier interference.

The carrier leakage shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative carrier leakage power also has to satisfy the applicable requirement.

At this stage the allocated RBs shall be separated from the non-allocated RBs. In the case of PUCCH and PUSCH EVM, the signal on the non-allocated RB(s), $Y(t, f)$, is used to evaluate the in-band emissions.

Moreover, the following procedure applies only to the signal on the allocated RB(s).

- In the case of PUCCH and PUSCH and Physical Sidelink Channel, the UL EVM analyzer shall estimate the TX chain equalizer coefficients $\tilde{a}(t, f)$ and $\tilde{\varphi}(t, f)$ used by the ZF equalizer for all subcarriers by time averaging at each signal subcarrier of the amplitude and phase of the reference and data symbols. The time-averaging length is 1 slot. This process creates an average amplitude and phase for each signal subcarrier used by the ZF equalizer. The knowledge of data modulation symbols may be required in this step because the determination of symbols by demodulation is not reliable before signal equalization.

- In the case of PRACH, the UL EVM analyzer shall estimate the TX chain coefficients $\tilde{a}(t)$ and $\tilde{\varphi}(t)$ used for phase and amplitude correction and are 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 n slots in the time domain.

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

where n is

n = 20 for PUCCH, PUSCH, PSDCH, PSCCH, and PSSCH,

n = 48 for PBSCH.

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

Thus $\overline{\mathrm{EVM}}_{\mathrm{l}}$ 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 |
| 30 | | | | TBD | | | FDD |
| 31 | | | TBD | | | | FDD |
| … | | | | | | | |
| 33 | | | | [-102] | | | TDD |
| 34 | | | | [-102] | | | TDD |
| 35 | | | | [-102] | | | TDD |
| 36 | | | | [-102] | | | TDD |
| 37 | | | | [-102] | | | TDD |
| 38 | | | | [-102] | | | TDD |
| 39 | | | | [-102] | | | TDD |
| 40 | | | | [-102] | | | TDD |
| 42 | | | | [-102] | | | TDD |
| 43 | | | | [-102] | | | TDD |
| 44 | | | | [-102] | | | TDD |

Note 1: The transmitter shall be set to $P_{UMAX}$ as defined in clause 6.2.5
Note 2: Reference measurement channel is G.3 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1
Note 3: The signal power is specified per port
Note 4: For the UE which supports both Band 3 and Band 9 the reference sensitivity level is FFS.
Note 5: For the UE which supports both Band 11 and Band 21 the reference sensitivity level is FFS.

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

**Table G.2-2: Minimum uplink configuration for reference sensitivity**

| E-UTRA Band / Channel bandwidth / NRB / Duplex mode | | | | | | | |
|---|---|---|---|---|---|---|---|
| **E-UTRA Band** | **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **Duplex Mode** |
| 1 | | | | [6][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 |
| 30 | | | | [6][1] | | | FDD |
| 31 | | | [5][4] | | | | 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).
Note 2: For the UE which supports both Band 11 and Band 21 the minimum uplink configuration for reference sensitivity is FFS.
Note 3: For Band 20; in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RBstart _11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RBstart _16
Note 4: For Band 31; in the case of 5MHz channel bandwidth, the UL resource blocks shall be located at RBstart _10

Unless given by Table G.2-3, the minimum requirements specified in Tables G.2-1 and G.2-2 shall be verified with the network signalling value NS_01 (Table 6.2.4-1) configured.

**Table G.2-3: Network Signalling Value for reference sensitivity**

| 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 |
| 30 | NS_21 |
| 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 | | | 5 | 10 | | |
| Allocated resource blocks | | | | 25 | 50 | | |
| Subcarriers per resource block | | | | 12 | 12 | | |
| Allocated subframes per Radio Frame | | | | 9 | 9 | | |
| Modulation | | | | QPSK | QPSK | | |
| Target Coding Rate | | | | 1/3 | 1/3 | | |
| Number of HARQ Processes | Processes | | | 8 | 8 | | |
| Maximum number of HARQ transmissions | | | | [4] | [4] | | |
| Information Bit Payload per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 2216 | 4392 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 1800 | 4392 | | |
| Transport block CRC | Bits | | | 24 | 24 | | |
| Number of Code Blocks per Sub-Frame (Note 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 1 | 1 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 1 | 1 | | |
| Binary Channel Bits Per Sub-Frame | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | | | 6300 | 13800 | | |
| For Sub-Frame 5 | Bits | | | N/A | N/A | | |
| For Sub-Frame 0 | Bits | | | 5460 | 12960 | | |
| Max. Throughput averaged over 1 frame | kbps | | | 1952.8 | 3952.8 | | |
| UE Category | | | | 1-8 | 1-8 | | |

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

**Table G.3-2 Fixed Reference Channel for Receiver Requirements (TDD)**

| Parameter | Unit | Value | | | | | |
|---|---|---|---|---|---|---|---|
| Channel Bandwidth | MHz | | | | 10 | | |
| Allocated resource blocks | | | | | 50 | | |
| Uplink-Downlink Configuration (Note 5) | | | | | 1 | | |
| Allocated subframes per Radio Frame (D+S) | | | | | 4+2 | | |
| Number of HARQ Processes | Processes | | | | 7 | | |
| Maximum number of HARQ transmission | | | | | [4] | | |
| Modulation | | | | | QPSK | | |
| Target coding rate | | | | | 1/3 | | |
| Information Bit Payload per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | | | | 4392 | | |
| For Sub-Frame 1, 6 | | | | | 3240 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 4392 | | |
| Transport block CRC | Bits | | | | 24 | | |
| Number of Code Blocks per Sub-Frame (Note 5) | | | | | | | |
| For Sub-Frame 4, 9 | | | | | 1 | | |
| For Sub-Frame 1, 6 | | | | | 1 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 1 | | |
| Binary Channel Bits Per Sub-Frame | Bits | | | | | | |
| For Sub-Frame 4, 9 | | | | | 13800 | | |
| For Sub-Frame 1, 6 | | | | | 11256 | | |
| For Sub-Frame 5 | | | | | N/A | | |
| For Sub-Frame 0 | | | | | 13104 | | |
| Max. Throughput averaged over 1 frame | kbps | | | | 1965.6 | | |
| UE Category | | | | | 1-5 | | |

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

# Annex H (normative):<br>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 shall be set to 1 by a UE supporting intra-band contiguous CA bandwidth class C |
| 1 | - The A-MPR associated with NS_05 for Band 1 in Clause 6.2.4 in version 12.10.0 of this specification. | - This bit shall be set to 1 by a UE supporting A-MPR associated to NS_05 for Band 1. |
| 2 | The A-MPR associated with NS_04 for Band 41 in Table 6.2.4-4 in version 14.1.0 of this specification. | This bit 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 I.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 | 263R 1 | | | 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** |

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| **09-2009** | **RP#45** | RP-090877 | 320 | | | CR Sensitivity relaxation for small BW | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 324 | | | Correction of Band 3 spurious emission band UE co-existence | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 249R 1 | | | 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 | 282R 1 | | | Additional SRS relative power requirement and update of measurement definition | **9.1.0** |
| **09-2009** | **RP#45** | RP-090877 | 284R 1 | | | 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 | 265R 2 | | | CQI reference measurement channels | **9.1.0** |
| **09-2009** | **RP#45** | RP-090878 | 321R 1 | | | 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 | 241R 1 | | | 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 | 259R 3 | | | 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 | 339R 1 | | | 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 | 345R 1 | | | 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 | 373R 1 | | | 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 | 386R 3 | | | 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 | 392R 2 | | | 36.101 Symbols and abreviations for Pcmax | 9.2.0 |

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| 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 | 404R 3 | | | CR Power control exception R8 | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 416R 1 | | | Relative power tolerance: special case for receiver tests | 9.2.0 |
| 12-2009 | RP-46 | RP-091263 | 420R 1 | | | CSI reporting: test configuration for CQI fading requirements | 9.2.0 |
| 12-2009 | RP-46 | RP-091284 | 421R 1 | | | 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 | 442R 1 | | | In Band Emissions Requirements Correction CR | 9.2.0 |
| 12-2009 | RP-46 | RP-091262 | 444R 1 | | | 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 |

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|---|---|---|---|---|---|---|---|
| 06-2010 | RP-48 | RP-100628 | 564 | | | LTE MBMS performance requirements (TDD) | 9.4.0 |
| 06-2010 | RP-48 | RP-100629 | 553r2 | | | Performance requirements for dual-layer beamforming | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 524r2 | | | CR: low Category CSI requirement | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 519 | | | Correction of FRC reference and test case numbering | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 526 | | | Correction of carrier frequency and EARFCN of Band 21 for TS36.101 | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 508r1 | | | Addition of PDSCH TDD DRS demodulation tests for Low UE categories | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 539 | | | Specification of minimum performance requirements for low UE category | 9.4.0 |
| 06-2010 | RP-48 | RP-100630 | 569 | | | Addition of minimum performance requirements for low UE category TDD CRS single-antenna port tests | 9.4.0 |
| 06-2010 | RP-48 | RP-100631 | 549r3 | | | Introduction of sustained downlink data-rate performance requirements | 9.4.0 |
| 06-2010 | RP-48 | RP-100683 | 530r1 | | | Band 20 Rx requirements | 9.4.0 |
| 09-2010 | RP-49 | RP-100920 | 614r2 | | | Add OCNG to MBMS requirements | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 599 | | | Correction of PDCCH content for PHICH test | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 597r1 | | | Beamforming model for transmission on antenna port 7/8 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 600r1 | | | Correction of full correlation in frequency-selective CQI test | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 601 | | | Correction on single-antenna transmission fixed reference channel | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 605 | | | Reference sensitivity requirements for the 1.4 and 3 MHz bandwidths | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 608r1 | | | CR for DL sustained data rate test | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 611 | | | Correction of references in section 10 (MBMS performance requirements) | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 613 | | | Band 13 and Band 14 spurious emission corrections | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 617r1 | | | Rx Requirements | 9.5.0 |
| 09-2010 | RP-49 | RP-100926 | 576r1 | | | Clarification on DL-BF simulation assumptions | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 582r1 | | | Introduction of additional Rel-9 scenarios | 9.5.0 |
| 09-2010 | RP-49 | RP-100925 | 575r1 | | | Correction to band 20 ue to ue Co-existence table | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 581r1 | | | Test configuration corrections to CQI reporting in AWGN | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 595 | | | Corrections to RF OCNG Pattern OP.1 and 2 | 9.5.0 |
| 09-2010 | RP-49 | RP-100919 | 583 | | | Editorial corrections of 36.101 | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 586 | | | Addition of minimum performance requirements for low UE category TDD tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 590r1 | | | Downlink power for receiver tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100920 | 591 | | | OCNG use and power in beamforming tests | 9.5.0 |
| 09-2010 | RP-49 | RP-100916 | 593 | | | Throughput for multi-datastreams transmissions | 9.5.0 |
| 09-2010 | RP-49 | RP-100914 | 588 | | | Missing note in Additional spurious emission test with NS_07 | 9.5.0 |
| 09-2010 | RP-49 | RP-100927 | 596r2 | | | CR LTE_TDD_2600_US spectrum band definition additions to TS 36.101 | 10.0.0 |
| 12-2010 | RP-50 | RP-101309 | 680 | | | Demodulation performance requirements for dual-layer beamforming | 10.1.0 |
| 12-2010 | RP-50 | RP-101325 | 672 | | | Correction on the statement of TB size and subband selection in CSI tests | 10.1.0 |
| 12-2010 | RP-50 | RP-101327 | 652 | | | Correction to Band 12 frequency range | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 630 | | | Removal of [ ] from TDD Rank Indicator requirements | 10.1.0 |
| 12-2010 | RP-50 | RP-101329 | 635r1 | | | Test configuration corrections to CQI TDD reporting in AWGN (Rel-10) | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 645 | | | EVM window length for PRACH | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 649 | | | Removal of NS signalling from TDD REFSENS tests | 10.1.0 |
| 12-2010 | RP-50 | RP-101330 | 642r1 | | | Correction of Note 4 In Table 7.3.1-1: Reference sensitivity QPSK PREFSENS | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 627 | | | Add 20 RB UL Ref Meas channel | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 654r1 | | | Additional in-band blocking requirement for Band 12 | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 678 | | | Further clarifications for the Sustained Downlink Data Rate Test | 10.1.0 |
| 12-2010 | RP-50 | RP-101341 | 673r1 | | | Correction on MBMS performance requirements | 10.1.0 |
| 12-2010 | RP-50 | RP-101349 | 667r3 | | | CR Removing brackets of Band 41 reference sensitivity to TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101356 | 666r2 | | | Band 42 and 43 parameters for UMTS/LTE 3500 (TDD) for TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101359 | 646r1 | | | CR for CA, UL-MIMO, eDL-MIMO, CPE | 10.1.0 |
| 12-2010 | RP-50 | RP-101361 | 620r1 | | | Introduction of L-band in TS 36.101 | 10.1.0 |
| 12-2010 | RP-50 | RP-101379 | 670r1 | | | Correction on the PMI reporting in Multi-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 |

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| 03-2011 | RP-51 | RP-110359 | 717 | | | Introduction of requirement for adjacent intraband CA image rejection | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 719 | | | Minimum requirements for the additional Rel-9 scenarios | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 723 | | | Corrections to power settings for Single layer beamforming with simultaneous transmission | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 726r1 | | | Correction to the PUSCH3-0 subband tests for Rel-10 | 10.2.0 |
| 03-2011 | RP-51 | RP-110338 | 730 | | | Removing the square bracket for TS36.101 | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 739 | | | Removal of square brackets for dual-layer beamforming demodulation performance requirements | 10.2.0 |
| 03-2011 | RP-51 | RP-110359 | 751 | | | CR: Maximum input level for intra band CA | 10.2.0 |
| 03-2011 | RP-51 | RP-110349 | 754r2 | | | UE category coverage for dual-layer beamforming | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 756r1 | | | Further clarifications for the Sustained Downlink Data Rate Test | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 759 | | | Removal of square brackets in sustained data rate tests | 10.2.0 |
| 03-2011 | RP-51 | RP-110337 | 762r1 | | | Clarification to LTE relative power tolerance table | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 764 | | | Introducing UE-selected subband CQI tests | 10.2.0 |
| 03-2011 | RP-51 | RP-110343 | 765 | | | Verification framework for PUSCH 2-2 and PUCCH 2-1 reporting | 10.2.0 |
| 04-2011 | | | | | | Editorial: Spec Title correction, removal of “Draft” | 10.2.1 |
| 06-2011 | RP-52 | RP-110804 | 766 | | | Add Expanded 1900MHz Band (Band 25) in 36.101 | 10.3.0 |
| 06-2011 | RP-52 | RP-110795 | 768 | | | Fixing Band 24 inclusion in TS 36.101 | 10.3.0 |
| 06-2011 | RP-52 | RP-110788 | 772 | | | CR: Corrections for UE to UE co-existence requirements of Band 3 | 10.3.0 |
| 06-2011 | RP-52 | RP-110812 | 774 | | | Add 2GHz S-Band (Band 23) in 36.101 | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 782 | | | CR: Band 19 A-MPR refinement | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 787 | | | REFSENS in lower SNR | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 805 | | | Clarification for MBMS reference signal levels | 10.3.0 |
| 06-2011 | RP-52 | RP-110792 | 810 | | | FDD MBMS performance requirements for 64QAM mode | 10.3.0 |
| 06-2011 | RP-52 | RP-110787 | 814 | | | Correction on CQI mapping index of RI test | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 824 | | | Corrections to in-band blocking table | 10.3.0 |
| 06-2011 | RP-52 | RP-110794 | 826 | | | Correction of TDD Category 1 DRS and DMRS RMCs | 10.3.0 |
| 06-2011 | RP-52 | RP-110794 | 828 | | | TDD MBMS performance requirements for 64QAM mode | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 829 | | | Correction of TDD RMC for Low SNR Demodulation test | 10.3.0 |
| 06-2011 | RP-52 | RP-110796 | 830 | | | Informative reference sensitivity requirements for Low SNR for TDD | 10.3.0 |
| 06-2011 | RP-52 | RP-110787 | 778r1 | | | Minor corrections to DL-RMC-s for Maximum input level | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 832 | | | PDCCH and PHICH performance: OCNG and power settings | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 818r1 | | | Correction on 2-X PMI test for R10 | 10.3.0 |
| 06-2011 | RP-52 | RP-110791 | 816r1 | | | Addition of performance requirements for dual-layer beamforming category 1 UE test | 10.3.0 |
| 06-2011 | RP-52 | RP-110789 | 834 | | | Performance requirements for PUCCH 2-0, PUCCH 2-1 and PUSCH 2-2 tests | 10.3.0 |
| 06-2011 | RP-52 | RP-110807 | 835r1 | | | CR for UL MIMO and CA | 10.3.0 |
| 09-2011 | RP-53 | RP-111248 | 862r1 | | | Removal of unnecessary channel bandwidths from REFSENS tables | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 869r1 | | | Clarification on BS precoding information field for RI FDD and PUCCH 2-1 PMI tests | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 872r1 | | | CR for B14Rx requirement Rrel 10 | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 890r1 | | | CR to TS36.101: Correction on the accuracy test of CQI. | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 893 | | | CR to TS36.101: Correction on CQI mapping index of TDD RI test | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 904 | | | Correction of code block numbers for some RMCs | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 907 | | | Correction to UL RMC for FDD and TDD | 10.4.0 |
| 09-2011 | RP-53 | RP-111248 | 914r1 | | | Adding codebook subset restriction for single layer closed-loop spatial multiplexing test | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 883 | | | Sustained data rate: Correction of the ACK/NACK feedback mode | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 929 | | | 36.101 CR on MBSFN FDD requirements(R10) | 10.4.0 |
| 09-2011 | RP-53 | RP-111251 | 938 | | | TDD MBMS performance requirements for 64QAM mode | 10.4.0 |
| 09-2011 | RP-53 | RP-111252 | 895 | | | Further clarification for the dual-layer beamforming demodulation requirements | 10.4.0 |
| 09-2011 | RP-53 | RP-111255 | 908r1 | | | Introduction of Band 22 | 10.4.0 |
| 09-2011 | RP-53 | RP-111255 | 939 | | | Modifications of Band 42 and 43 | 10.4.0 |
| 09-2011 | RP-53 | RP-111260 | 944 | | | CR for TS 36.101 Annex B: Static channels for CQI tests | 10.4.0 |
| 09-2011 | RP-53 | RP-111262 | 878r1 | | | Correction of CSI reference channel subframe description | 10.4.0 |
| 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 |

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| 12-2011 | RP-54 | RP-111686 | 949 | | | CR for TS36.101: Adding note to the function of MPR | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 950 | | | Clarification on applying CSI reports during rank switching in RI FDD test - Rel-10 | 10.5.0 |
| 12-2011 | RP-54 | RP-111734 | 953r1 | | | Corrections for Band 42 and 43 introduction | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 956 | | | UE spurious emissions | 10.5.0 |
| 12-2011 | RP-54 | RP-111682 | 959 | | | Add scrambling identity n_SCID for MU-MIMO test | 10.5.0 |
| 12-2011 | RP-54 | RP-111690 | 960r1 | | | P-MPR definition | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 962 | | | Pcmax,c Computation Assumptions | 10.5.0 |
| 12-2011 | RP-54 | RP-111733 | 963r1 | | | Correction of frequency range for spurious emission requirements | 10.5.0 |
| 12-2011 | RP-54 | RP-111680 | 966 | | | General review of the reference measurement channels | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 945 | | | Corrections of Rel-10 demodulation performance requirements<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 946 | | | Corrections of UE categories for Rel-10 CSI requirements<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 982r2 | | | Introduction of SDR TDD test scenario for CA UE demodulation<br>This CR is only partially implemented due to confliction with CR 966 | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 971r1 | | | CR on Colliding CRS for non-MBSFN ABS | 10.5.0 |
| 12-2011 | RP-54 | RP-111693 | 972r1 | | | Introduction of eICIC demodulation performance requirements for FDD and TDD | 10.5.0 |
| 12-2011 | RP-54 | RP-111686 | 985 | | | Adding missing UL configuration specification in some UE receiver requirements for case of 1 CC UL capable UE | 10.5.0 |
| 12-2011 | RP-54 | RP-111684 | 998 | | | Correction and maintenance on CQI and PMI requirements (Rel-10) | 10.5.0 |
| 12-2011 | RP-54 | RP-111735 | 1004 | | | MPR for CA Multi-cluster | 10.5.0 |
| 12-2011 | RP-54 | RP-111691 | 1005 | | | CA demodulation performance requirements for LTE FDD | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1006 | | | CQI reporting accuracy test on frequency non-selective scheduling on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1007 | | | CQI reporting accuracy test on frequency-selective scheduling on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1008 | | | PMI reporting accuracy test for TDD on eDL MIMO | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1009r1 | | | CR for TS 36.101: RI performance requirements | 10.5.0 |
| 12-2011 | RP-54 | RP-111692 | 1010r1 | | | CR for TS 36.101: Introduction of static CQI tests (Rel-10) | 10.5.0 |
| 03-2012 | RP-55 | RP-120291 | 1014 | | | RF: Updates and corrections to the RMC-s related annexes (Rel-10) | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1015r1 | | | On eICIC ABS pattern | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1016r1 | | | On eICIC interference models | 10.6.0 |
| 03-2012 | RP-55 | RP-120299 | 1017r1 | | | TS36.101 CR: on eDL-MIMO channel model using cross-polarized antennas | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1020r1 | | | TS36.101 CR: Correction to MBMS Performance Test Parameters | 10.6.0 |
| 03-2012 | RP-55 | RP-120303 | 1021 | | | Harmonic exceptions in LTE UE to UE co-ex tests | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1023 | | | Unified titles for Rel-10 CSI tests | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1033r1 | | | Introduction of reference channel for eICIC demodulation | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1040r1 | | | Correction of Actual code rate for CSI RMCs | 10.6.0 |
| 03-2012 | RP-55 | RP-120304 | 1041r1 | | | Definition of synchronized operation | 10.6.0 |
| 03-2012 | RP-55 | RP-120296 | 1048r1 | | | Intra band 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 | 10.6.0 |

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| 03-2012 | RP-55 | RP-120303 | 1077r 1 | | | CR for 36.101: B41 REFSENS and MOP changes to accommodate single filter architecture | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1082 | | | TM3 tests for eICIC | 10.6.0 |
| 03-2012 | RP-55 | RP-120300 | 1083r 1 | | | 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 | 1070r 1 | | | Introduction of Band 26/XXVI to TS 36.101 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1074 | | | Band 41 CA CR for TS36.101, section 5 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1075r 1 | | | Band 41 CA CR for TS36.101, section 6 | 11.0.0 |
| 03-2012 | RP-55 | RP-120310 | 1076 | | | Band 41 CA CR for TS36.101, section 7 | 11.0.0 |
| 06-2012 | RP-56 | RP-120795 | 1085r 2 | | | Modulator specification tightening | 11.1.0 |
| 06-2012 | RP-56 | RP-120777 | 1087r 1 | | | Carrier aggregation Relative power tolerance, removal of TBD. | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1089 | | | UE spurious emissions for Band 7 and Band 38 coexistence | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1092 | | | Deleting square brackets in Reference Measurement Channels | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1097 | | | CR to TS36.101: Correction on parameters for the eDL-MIMO CQI and PMI tests | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1098r 1 | | | CR to TS36.101: Fixed reference channel for PDSCH demodulation performance requirements on eDL-MIMO – NOT implemented as it is based on a wrong version of the spec | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1107 | | | RMC correction on eDL-MIMO RI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1108r 1 | | | FRC correction on frequency selective CQI and PMI test (Rel-11) | 11.1.0 |
| 06-2012 | RP-56 | RP-120774 | 1111 | | | Correction on test point for PMI test (Rel-11) | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1114r 1 | | | Corrections and clarifications on eICIC demodulation test | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1117r 1 | | | Corrections and clarifications on eICIC CSI tests | 11.1.0 |
| 06-2012 | RP-56 | RP-120783 | 1119r 1 | | | Corrections on UE performance requirements | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1120 | | | Introduction of CA band combination Band1 + Band19 to TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120769 | 1127 | | | Addition of ETU30 channel model | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1140 | | | Addition of Maximum Throughput for R.30-1 TDD RMC | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1141 | | | CR for 36.101: The clarification of MPR and A-MPR for CA | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1142 | | | Corrections for eICIC demod test case with MBSN ABS | 11.1.0 |
| 06-2012 | RP-56 | RP-120785 | 1144 | | | Removing brackets of contiguous allocation A-MPR for CA_NS_04 | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1149r 1 | | | Introduction of PDCCH test with colliding RS on MBSFN-ABS | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1153r 1 | | | Some clarifications and OCNG pattern for eICIC demodulation requirements | 11.1.0 |
| 06-2012 | RP-56 | RP-120773 | 1155 | | | Introduction of TDD CA Soft Buffer Limitation | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1156 | | | B26 and other editorial corrections | 11.1.0 |
| 06-2012 | RP-56 | RP-120779 | 1161 | | | Corrections on CQI and PMI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120780 | 1163 | | | FRC for TDD PMI test | 11.1.0 |
| 06-2012 | RP-56 | RP-120778 | 1165r 1 | | | Clean-up of UL-MIMO for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1171 | | | Removal of unnecessary references to single carrier requirements from Interband CA subclauses | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1174 | | | PDCCH wrong detection in receiver spurious emissions test | 11.1.0 |
| 06-2012 | RP-56 | RP-120776 | 1184 | | | Corrections to 3500 MHz | 11.1.0 |
| 06-2012 | RP-56 | RP-120793 | 1189r 2 | | | Introduction of Band 44 | 11.1.0 |
| 06-2012 | RP-56 | RP-120784 | 1193r 1 | | | 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 | 1200r 1 | | | Introduction of e850_LB (Band 27) to TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120764 | 1212 | | | Correction of PHS protection requirements for TS 36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120793 | 1213r 1 | | | Introduction of Band 28 into TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1215r 1 | | | Proposed revision of subclause 4.3A for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120781 | 1217r 1 | | | Proposed revision on subclause 6.3.4A for TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120795 | 1219r 1 | | | Aligning requirements between Band 18 and Band 26 in TS36.101 | 11.1.0 |
| 06-2012 | RP-56 | RP-120782 | 1221 | | | SNR definition | 11.1.0 |

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| 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 | 1233r 1 | | | RF: Corrections to power allocation parameters for transmission mode 8 (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1235 | | | RF-CA: non-CA notation and applicability of test points in scenarios without and with CA operation (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1237 | | | ACK/NACK feedback modes for FDD and TDD TM4 CA demodulation requirements (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1239 | | | Correction of feedback mode for CA TDD demodulation requirements (resubmission of R4-63AH-0194 for Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1241 | | | ABS pattern setup for MBSFN ABS test (resubmission of R4-63AH-0204 for Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121302 | 1243 | | | CR on 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 | 1268r 1 | | | TS 36.101 CR for CA_38 | 11.2.0 |
| 09-2012 | RP-57 | RP-121327 | 1269 | | | Introduction of CA_B7_B20 in 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1271 | | | Corrections of FRC subframe allocations and other minor problems | 11.2.0 |
| 09-2012 | RP-57 | RP-121305 | 1274 | | | Introduction of requirements for TDD CA Soft Buffer Limitation | 11.2.0 |
| 09-2012 | RP-57 | RP-121307 | 1276 | | | Correction of eDL-MIMIO CSI RMC tables and references | 11.2.0 |
| 09-2012 | RP-57 | RP-121307 | 1278 | | | Correction of MIMO channel model for polarized antennas | 11.2.0 |
| 09-2012 | RP-57 | RP-121303 | 1280 | | | Addition of 15 and 20MHz Bandwidths for Band 23 to TS 36.101 (Rel-11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121334 | 1283r 1 | | | Add requirements for inter-band CA of B_1-18 and B_11-18 in TS36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1285r 1 | | | CR for MPR mask for multi-clustered simultaneous transmission in single CC in Rel-11 | 11.2.0 |
| 09-2012 | RP-57 | RP-121447 | 1288r 2 | | | Introduction of Japanese Regulatory Requirements to LTE Band 8(R11) | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1289 | | | CR for Band 27 MOP | 11.2.0 |
| 09-2012 | RP-57 | RP-121315 | 1290 | | | CR for Band 27 A-MPR | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1291 | | | CR to replace protected frequency range with new band number 27 | 11.2.0 |
| 09-2012 | RP-57 | RP-121215 | 1292r 1 | | | Introduction of CA band combination Band3 + Band5 to TS 36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1300r 1 | | | 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 | 1310r 1 | | | Correction on frequency non-selective CQI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121306 | 1313r 1 | | | eDL-MIMO CQI/PMI test | 11.2.0 |
| 09-2012 | RP-57 | RP-121313 | 1316 | | | Correction of the definition of unsynchronized operation | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1320r 1 | | | Correction to Transmit Modulation Quality Tests for Intra-Band CA | 11.2.0 |
| 09-2012 | RP-57 | RP-121338 | 1324r 2 | | | 36.101 CR for LTE_CA_B7 | 11.2.0 |
| 09-2012 | RP-57 | RP-121331 | 1325 | | | Introduction of CA_3_20 RF requirements into TS36.101 | 11.2.0 |
| 09-2012 | RP-57 | RP-121316 | 1326 | | | A-MPR table correction for NS_18 | 11.2.0 |
| 09-2012 | RP-57 | RP-121304 | 1332r 1 | | | Bandwidth combination sets for intra-band and inter-band carrier aggregation | 11.2.0 |
| 09-2012 | RP-57 | RP-121325 | 1339 | | | Introduction of LTE Advanced Carrier Aggregation of Band 4 and Band 13 | 11.2.0 |
| 09-2012 | RP-57 | RP-121326 | 1340r 1 | | | Introduction of CA configurations CA-12A-4A and CA-17A-4A | 11.2.0 |
| 09-2012 | RP-57 | RP-121324 | 1341 | | | Introduction of CA_B3_B7 in 36.101 | 11.2.0 |

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| 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 | 1388r 1 | | | Introduction of one periodic CQI test for CA deployments | 11.3.0 |
| 12-2012 | RP-58 | RP-121894 | 1396 | | | Introduction of CA_B5_B12 in 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121850 | 1401 | | | Introducing the additional frequency bands of 5 MHz x 2 in 1.7 GHz in Japan to Band 3 | 11.3.0 |
| 12-2012 | RP-58 | RP-121887 | 1406r 1 | | | Reference sensitivity for the small bandwidth of CA_4-12 | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1407 | | | CR on eICIC RI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1409 | | | Cleaning of 36.101 Performance sections Rel-11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1416 | | | Out-of-band blocking requirements for inter-band carrier aggregation | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1418 | | | Adding missed SNR reference values for CA soft buffer tests | 11.3.0 |
| 12-2012 | RP-58 | RP-121890 | 1422 | | | Introduction of CA_4A-5A into 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1431 | | | Clean up of specification R11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121867 | 1436 | | | Band 1 to Band 33 and Band 39 UE coexistence requirements | 11.3.0 |
| 12-2012 | RP-58 | RP-121871 | 1437r 1 | | | Editorial corrections for Band 26 | 11.3.0 |
| 12-2012 | RP-58 | RP-121896 | 1438 | | | Introduction of Band 5 + Band 17 inter-band CA configuration into 36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1442 | | | Correction of eDL-MIMO RI test and RMC table for the CSI test | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1444 | | | Minor correction to ceiling function example - rel11 | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1449 | | | Correction of SNR definition | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1450 | | | Brackets clean up for eICIC CSI/demodulation | 11.3.0 |
| 12-2012 | RP-58 | RP-121860 | 1455 | | | CR on eICIC RI testing (Rel-11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1459 | | | Correction on FRC table | 11.3.0 |
| 12-2012 | RP-58 | RP-121879 | 1461r 1 | | | CR for LTE B14 HPUE (Power Class 1 ) | 11.3.0 |
| 12-2012 | RP-58 | RP-121862 | 1464 | | | Adding references to the appropriate beamforming model (Rel-11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121898 | 1465r 1 | | | Introduction of CA_8_20 RF requirements into TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121882 | 1468r 1 | | | Introduction of inter-band CA_11-18 into TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1472r 1 | | | Introduction of advanced receivers demodulation performance (FDD) | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1473r 1 | | | Introduction of performance requirements for verifying the receiver type for advanced receivers (FDD/TDD) | 11.3.0 |
| 12-2012 | RP-58 | RP-121886 | 1474 | | | CR to remove the square bracket of A-MPR in TS36.101 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1476 | | | Correction of some errors in reference sensitivity for CA in TS 36.101 (R11) | 11.3.0 |
| 12-2012 | RP-58 | RP-121903 | 1480r 1 | | | Introduction of Advanced Receivers Test Cases for TDD | 11.3.0 |
| 12-2012 | RP-58 | RP-121901 | 1490r 1 | | | Introduction of Band 29 | 11.3.0 |
| 12-2012 | RP-58 | RP-121849 | 1494 | | | Low-channel Band 1 coexistence with PHS | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1498r 1 | | | Completion of the tables of bandwidth combinations specified for CA | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1499r 1 | | | 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 | 1509r 1 | | | UE-UE coexistence between bands with small frequency separation | 11.3.0 |
| 12-2012 | RP-58 | RP-121911 | 1510 | | | Adding UE-UE Coexistence Requirement for Band 3 and Band 26 | 11.3.0 |
| 12-2012 | RP-58 | RP-121866 | 1513 | | | Maintenance of Band 23 UE Coexistence | 11.3.0 |
| 12-2012 | RP-58 | RP-121851 | 1515 | | | Corrections to TM4 rank indicator Test 3 | 11.3.0 |
| 12-2012 | RP-58 | RP-121861 | 1517 | | | Correction of test configuraitons and FRC for CA demodulation | 11.3.0 |

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| | | | | | | with power imbalance | |
| 12-2012 | RP-58 | RP-121860 | 1518 | | | Applicable OFDM symbols of Noc_2 for PDCCH/PCFICH ABS-MBSFN test cases | 11.3.0 |
| 03-2013 | RP-59 | RP-130279 | 1519 | | | OCNG patterns for Enhanced Performance Requirements Type A | 11.4.0 |
| 03-2013 | RP-59 | RP-130277 | 1520 | | | Corrections on in-band blocking for Band 29 for carrier aggregation | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1523 | | | Brackets removal in Rel-11 TM4 rank indicator Test 3 | 11.4.0 |
| 03-2013 | RP-59 | RP-130279 | 1524r 1 | | | Cleanup of Advanced Receivers requirement scenarios for demodulation and CSI (FDD/TDD) | 11.4.0 |
| 03-2013 | RP-59 | RP-130258 | 1528 | | | Corrections to CQI reporting | 11.4.0 |
| 03-2013 | RP-59 | RP-130262 | 1536 | | | Corrections for eICIC performance requirements (rel-11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1539 | | | Correction of CA power imbalance performance requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1543 | | | Correction of a symbol for MPR in single carrier for TS 36.101(R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1544r 1 | | | Correction of some inter-band CA requiements for TS 36.101 (R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130276 | 1546 | | | Correction of contigous allocation A-MPR for CA_NS_05 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1547r 1 | | | Clarification of spurious emission domain for CA in TS 36.101 (R11) | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1548 | | | CR for CA performance requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130284 | 1553r 1 | | | Introduction of downlink non-contiguous CA into REL -11 TS 36.101 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1557 | | | CA_1C: CA_NS_02 and CA_NS_03 A-MPR REL-11 | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1560 | | | Editorial corrections to subclause 5 | 11.4.0 |
| 03-2013 | RP-59 | RP-130267 | 1562 | | | Addition of UE Regional Requirements to Band 23 Based on New Regulatory Order in the US | 11.4.0 |
| 03-2013 | RP-59 | RP-130272 | 1567 | | | Band 26: modification of A-MPR for 'NS_15' | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1571r 1 | | | Band 41 requirements for operation in China and Japan | 11.4.0 |
| 03-2013 | RP-59 | RP-130260 | 1574 | | | Remove [ ] from CSI test case parameters | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1575 | | | Corrections to UE co-existence | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1579 | | | UE-UE co-existence between Band 1 and Band 33/39 | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1580 | | | Correction on reference to note for Band 7 and 38 co-existence | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1584r 1 | | | Cleanup for CA UE RF requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1586 | | | Corrections on UL configuration for CA UE receiver requirements | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1588 | | | Correction of Transmit modulation quality requirements for CA | 11.4.0 |
| 03-2013 | RP-59 | RP-130268 | 1590 | | | Revision of Common Test Parameters for User-specific Demodulation Tests | 11.4.0 |
| 03-2013 | RP-59 | RP-130278 | 1595 | | | Correction for a Band 27 A-MPR table | 11.4.0 |
| 03-2013 | RP-59 | RP-130264 | 1597 | | | Correction of CA CQI test setup | 11.4.0 |
| 03-2013 | RP-59 | RP-130287 | 1600r 1 | | | Correction of B12 DL Specification in Table 5.5A-2 | 11.4.0 |
| 03-2013 | RP-59 | RP-130263 | 1602 | | | Correction of table reference | 11.4.0 |
| 06-2013 | RP-60 | RP-130765 | 1604r 1 | | | Complementary description for definition of MIMO Correlation Matrices using cross polarized antennas | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1607 | | | Correction of transport format parameters for CQI index 10 (15 RBs) - Rel 11 | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1610 | | | Maintenance of Band 23 A-MPR (NS_11) in TS 36.101 (Rel-11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1613 | | | CR for 36.101 : Adding the definition of CA_NS_05 and CA_NS_06 for additional spurious emissions for CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1619 | | | CR for introducing UE TM3 demodulation performance requirements under high speed | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1623 | | | Correction of test parameters for eICIC performance requirements | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1625 | | | Correction of test parameters for eICIC CSI requirements | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1627 | | | Correction of resource allocation for the multiple PMI Cat 1 UE test | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1629 | | | Removal of note 2 from band 28 | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1641 | | | Correction of the CSI-RS parameter configuration | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1650r 1 | | | Addition of Band 41 for intra-band non-contiguous CA for 36.101 | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1654r 1 | | | MPR for intra-band non-contiguous CA | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1656 | | | Modification of configured output power to account for larger tolerance | 11.5.0 |
| 06-2013 | RP-60 | RP-130769 | 1658r 1 | | | Missing symbols in the NS_15 table | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1673 | | | Corrections to Rx requirements for inter-band CA configurations with REFSENS exceptions | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1681r 1 | | | Correction for TS 36.101 | 11.5.0 |
| 06-2013 | RP-60 | RP-130763 | 1684 | | | RF: Corrections to RMC-s for sustained data rate test | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1685 | | | Non-contiguous intraband CA channel spacing | 11.5.0 |
| 06-2013 | RP-60 | RP-130766 | 1689 | | | Carrier aggregation in multi RAT and multiple band combination | 11.5.0 |

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| 06-2013 | RP-60 | RP-130766 | 1691 | | | Completion of out-of-band blocking requirements for inter-band CA with one UL | 11.5.0 |
| 06-2013 | RP-60 | RP-130767 | 1695r 1 | | | CR on the bandwidth coverage issue of CA demodulation performance (Rel-11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130765 | 1697 | | | Correction on UE maximum output power for intra-band CA (R11) | 11.5.0 |
| 06-2013 | RP-60 | RP-130770 | 1698r 1 | | | 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 |
| 06-2013 | RP-60 | RP-130771 | 1532r 1 | | | Introduction of CA 1+8 into TS36.101(Rel-12) | 12.0.0 |
| 06-2013 | RP-60 | RP-130781 | 1545r 1 | | | Introduction of LTE Advanced inter-band Carrier Aggregation of Band 3 and Band 28 to TS 36.101 | 12.0.0 |
| 06-2013 | RP-60 | RP-130785 | 1608r 1 | | | Introduction of LTE Advanced inter-band Carrier Aggregation of Band 23 and Band 29 to TS 36.101 | 12.0.0 |
| 06-2013 | RP-60 | RP-130777 | 1642r 1 | | | Introduction of CA B3+19 into TS36.101(Rel-12) | 12.0.0 |
| 06-2013 | RP-60 | RP-130787 | 1687 | | | Introduction of CA_4A-4A into 36.101 | 12.0.0 |
| 06-2013 | RP-60 | RP-130795 | 1712 | | | Adding 5MHz CBW for B3 of Inter band CA of B3+26 | 12.0.0 |
| 06-2013 | RP-60 | RP-130775 | 1713r 1 | | | Introduction of LTE Advanced Inter-Band Carrier Aggregation of Band 2 and Band 13 | 12.0.0 |
| 06-2013 | RP-60 | RP-130790 | 1723r 1 | | | Introduction of the LTE 450 band to TS 36.101 | 12.0.0 |
| 06-2013 | RP-60 | RP-130791 | 1724r 1 | | | Introduction of the WCS band to TS 36.101 | 12.0.0 |
| 06-2013 | RP-60 | RP-130784 | 1707r 1 | | | Introduction of CA 19+21 into TS36.101(Rel-12) | 12.0.0 |
| 09-2013 | RP-61 | RP-131300 | 1730r 1 | | | 36.101 CR for LTE_CA_C_B3 | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1732 | | | CR on performance requirements of CA soft buffer managemen (Rel-12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1733r 1 | | | CR to introdue TM3 and TM4 test for 5MHz channel bandwidth | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1736 | | | CR on applicability of CA sustained data rate tests (Rel-12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131293 | 1739 | | | Performance requirement for UE under EVA200 | 12.1.0 |
| 09-2013 | RP-61 | RP-131290 | 1743 | | | CR for introduction of FeICIC PBCH performance requirement | 12.1.0 |
| 09-2013 | RP-61 | RP-131290 | 1745 | | | CR for introduction of FeICIC RI reporting requirements | 12.1.0 |
| 09-2013 | RP-61 | RP-131292 | 1747 | | | Beamforming model for EPDCCH test | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1748 | | | CR to introduce CSI tests for LTE450 | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1749 | | | CR to extend UE category of the existing 5MHz performance requirements | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1767 | | | UE REFSENS when supporting intra-band CA and inter-band CA | 12.1.0 |
| 09-2013 | RP-61 | RP-131279 | 1772 | | | Correlation matrix for high speed train demodulation scenarios (Rel-12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131280 | 1776 | | | Corrections to sustained data rate test (Rel-12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1781 | | | CR to introduce a new PHICH test based on 5MHz | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1782 | | | CR placeholder for applicability of new 5MHz tests | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1783r 1 | | | CR : Proposal of applicability of new 5MHz tests | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1784 | | | CR: PHICH tests for 5MHz | 12.1.0 |
| 09-2013 | RP-61 | RP-131290 | 1786 | | | CR for introduction of FeICIC CQI requirements | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1794 | | | Clarification of multi-cluster transmission | 12.1.0 |
| 09-2013 | RP-61 | RP-131294 | 1800r 1 | | | CA UE Coexistence Table update (Release 12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131302 | 1802 | | | Coexistence between Band 27 and Band 38 (Release 12) | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1803 | | | Addional requirement for CA_1A-18A into TS36.101 | 12.1.0 |
| 09-2013 | RP-61 | RP-131296 | 1804 | | | Add requirements for CA_1A-26A into TS36.101 | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1807 | | | Incorrect REFSENS UL allocation for CA_1C | 12.1.0 |
| 09-2013 | RP-61 | RP-131297 | 1808r 1 | | | Introduction of CA_2A-4A into 36.101 | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1811 | | | Contiguous intraband CA REFSENS with one UL | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1822 | | | The Pcmax clauses restructured: This CR was NOT implemented as it was based on the wrong version of the spec | 12.1.0 |
| 09-2013 | RP-61 | RP-131298 | 1824 | | | Introduction of inter-band CA Band 2+5 | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1831 | | | MPR for intra-band non-contiguous CA | 12.1.0 |
| 09-2013 | RP-61 | RP-131281 | 1832 | | | Correction to Rel-10 A-MPR for CA_NS_04 | 12.1.0 |
| 09-2013 | RP-61 | RP-131285 | 1834 | | | CR for 36.101 : Add the definition of 5+20MHz for spectrum emission mask for CA | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1839 | | | CR to introduce CSI tests for LTE450 | 12.1.0 |

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|---|---|---|---|---|---|---|---|
| 09-2013 | RP-61 | RP-131293 | 1840 | | | Remianed Transmitter requirements for intra-band non-contiguous CA | 12.1.0 |
| 09-2013 | RP-61 | RP-131303 | 1841 | | | CR to introdue TM3 and TM4 test for 5MHz channel bandwidth | 12.1.0 |
| 12-2013 | RP-62 | RP-131928 | 1847r 1 | | | Corrections to the notes in the band UE co-existence requirements table (Rel-12) | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 1852 | | | Clean-up of uplink reference measurement channels (Rel-12) | 12.2.0 |
| 12-2013 | RP-62 | RP-131946 | 1857 | | | Introduction of CA band combination Band2 + Band12 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131954 | 1858 | | | Introduction of CA band combination Band12 + Band25 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1867 | | | CA_NS_05 Emissions | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1869 | | | NS signaling for CA refsens | 12.2.0 |
| 12-2013 | RP-62 | RP-131965 | 1870 | | | Introduction of CA_23A-23A RF requirements into 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1877r 2 | | | Intraband CA channel bandwidth combination table restructuring | 12.2.0 |
| 12-2013 | RP-62 | RP-131940 | 1878 | | | Addition of CA_3C missing UE to UE co-existence requirement and corection to SEM | 12.2.0 |
| 12-2013 | RP-62 | RP-131959 | 1885 | | | Introduction of LTE_CA_C_B27 to 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1887 | | | CR on correction of definition on Fraction of Maximum Throughput for CA | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1889 | | | CR on correction of test configurations of CA soft buffer tests | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1893 | | | CR for FeICIC demodulation performance requirements | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1895r 1 | | | CR on FeICIC PBCH performance requirement | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1897r 1 | | | CR on RI reporting requirement | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1899 | | | Beamforming model for EPDCCH localized test | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1901 | | | Downlink physical setup for EPDCCH test | 12.2.0 |
| 12-2013 | RP-62 | RP-131926 | 1904 | | | Correction on the UE category for eICIC CQI test | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1906 | | | CR for receiver type verification test of CSI-RS based advanced receivers (Rel-12) | 12.2.0 |
| 12-2013 | RP-62 | RP-131956 | 1910r 1 | | | Spurious emission band UE co-existence requirements for cross-region issue | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1916r 2 | | | Allowed power reductions for multiple transmissions in a subframe | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 1917r 1 | | | The coexistence requirements between Band 39 and Band 3 | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 1918r 1 | | | The Pcmax clauses restructured and removal of addition of ΔTc to P-MPR | 12.2.0 |
| 12-2013 | RP-62 | RP-131956 | 1919 | | | Configured maximum output power for multiple TAG transmission | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1927r 1 | | | Configured maximum output power for multiple TAG transmission | 12.2.0 |
| 12-2013 | RP-62 | RP-131927 | 1934 | | | CR on correction of FRC of power imbalance test | 12.2.0 |
| 12-2013 | RP-62 | RP-131927 | 1937 | | | UE-UE coexistence for Band 40 | 12.2.0 |
| 12-2013 | RP-62 | RP-131957 | 1955r 1 | | | Introduction of LTE Advanced intra-band contiguous Carrier Aggregation in Band 23 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131961 | 1956r 1 | | | Introduction of CA_3A-3A into TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1957 | | | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource) | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1958 | | | CR Minimum requirement with Same Cell ID (with multiple NZP CSI-RS resources) | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 1962 | | | Introduction of reference SNR-s for FeICIC demodulation performance requirements | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 1964 | | | OCNG pattern for EPDCCH test | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 1965 | | | CA performance requirements for TDD intra-band NC CA | 12.2.0 |
| 12-2013 | RP-62 | RP-131958 | 1966r 1 | | | CA performance requirements for TDD intra-band NC CA | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1968 | | | Introduction of UE TM3 demodulation performance requirements under ETU300 | 12.2.0 |

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|---|---|---|---|---|---|---|---|
| 12-2013 | RP-62 | RP-131937 | 1970 | | | Introduction of test 1-A for CoMP | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1972 | | | Modification of TM9 test to verify correct SNR estimation | 12.2.0 |
| 12-2013 | RP-62 | RP-131928 | 1984 | | | Correction to blocking requirements and use of Delta_RIB | 12.2.0 |
| 12-2013 | RP-62 | RP-131950 | 1985 | | | Introduction of CA band combination Band5 + Band25 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 1988r 1 | | | CR on test point clarification for CA demodulation test | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1994 | | | CR to Introduce fading CQI test for CoMP (TDD) | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1996 | | | CR to Introduce channel model for CoMP fading CQI tests | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 1998 | | | CR to Introduce RI test for CoMP (FDD) | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2001r 1 | | | Distributed EPDCCH Demodulation Test | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2003r 1 | | | Localized EPDCCH Demodulation Test | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2005r 1 | | | Localized EPDCCH Demodulation Test | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2007 | | | Introduction of DL CoMP FDD static CQI test | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2009 | | | Introduction of DL CoMP TDD static CQI test | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 2014 | | | P-max for Band 38 to Band 7 coexistence | 12.2.0 |
| 12-2013 | RP-62 | RP-131948 | 2015 | | | Introduction of CA band combination B5 + B7 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131952 | 2017 | | | Introduction of CA band combination B7 + B28 to TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2024 | | | Minimum requirement with Same Cell ID (with multiple NZP CSI-RS resources) TDD | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2026 | | | CR Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource) TDD | 12.2.0 |
| 12-2013 | RP-62 | RP-131936 | 2028 | | | Editoral change on FeICIC PBCH Noc setup | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2032 | | | Introduction of test 1-A for CoMP | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 2035r 1 | | | Correction of nominal guard bands for bandwidth classes A, B and C | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2042 | | | CR to Introduce RI test for CoMP (TDD) | 12.2.0 |
| 12-2013 | RP-62 | RP-131937 | 2043 | | | CR to Introduce fading CQI test for CoMP (FDD) | 12.2.0 |
| 12-2013 | RP-62 | RP-131931 | 2045 | | | Correction of TDD PCFICH/PDCCH test parameter table | 12.2.0 |
| 12-2013 | RP-62 | RP-131939 | 2047 | | | Add EVA200 to table of channel model parameters | 12.2.0 |
| 12-2013 | RP-62 | RP-131963 | 2050r 1 | | | Introduction of CA_7A-7A into TS 36.101 | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 2057 | | | Band 41 deployment in Japan | 12.2.0 |
| 12-2013 | RP-62 | RP-131926 | 2059 | | | CA_1C: Correction on CA_NS_02 A-MPR table | 12.2.0 |
| 12-2013 | RP-62 | RP-131924 | 2060 | | | Simplification of Band 12/17 in-band blocking test cases | 12.2.0 |
| 12-2013 | RP-62 | RP-131967 | 2064 | | | Correction of duplicated notes on table 7.3.1A-3 | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2066 | | | Introduction of EPDCCH TM10 localized test R-12 | 12.2.0 |
| 12-2013 | RP-62 | RP-131938 | 2068 | | | Introduction of SDR test for PDSCH with EPDCCH scheduling | 12.2.0 |
| 03-2014 | RP-63 | RP-140377 | 2115 | | | Editorial Correction for TS36.101 Rel-12 | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2108 | | | UL-DL configuration and other parameters for FeICIC TDD CQI fading test (Rel-12) | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2097 | | | CR on TM9 localized ePDCCH test | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2101 | | | CR on reference measurement channel for ePDCCH test | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2110 | | | CR for TS36.101 COMP demodulation requirements | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2113 | | | CR for Combinations of channel model parameters | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2114 | | | CR for EPDCCH power allocation (Rel-12) | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2106 | | | Cleanup of the specification for FeICIC (Rel-12) | 12.3.0 |
| 03-2014 | RP-63 | RP-140375 | 2089 | | | CR for introduction of 15MHz based single carrier and CA SDR tests in Rel-12 | 12.3.0 |

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|---|---|---|---|---|---|---|---|
| 03-2014 | RP-63 | RP-140375 | 2080r 1 | | | CR on TM3 demodulation and soft buffer management test | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2086 | | | CR on reference measurement channel for TM10 PDSCH demodulation test | 12.3.0 |
| 03-2014 | RP-63 | RP-140241 | 2174 | | | Introduction of 3MHz in Band 8 for CA_8_20 RF requirements into TS36.101 | 12.3.0 |
| 03-2014 | RP-63 | RP-140417 | 2173r 1 | | | Addition of bandwidth combination set for CA_2A-29A and CA_4A-29A | 12.3.0 |
| 03-2014 | RP-63 | RP-140387 | 2071r 1 | | | Introduction of TDD inter-band CA_B39_B41 into 36.101 | 12.3.0 |
| 03-2014 | RP-63 | RP-140378 | 2069 | | | CA_3C is adding 100RB+75RB uplink configuration for reference sensitivity | 12.3.0 |
| 03-2014 | RP-63 | RP-140388 | 2070 | | | CR for TS36.101 on CA_C_B39 | 12.3.0 |
| 03-2014 | RP-63 | RP-140386 | 2072 | | | Introduction of CA band B3+B27 to TS36.101 | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2074 | | | CR of EPDCCH localzied test with TM10 QCL Type-B configuration (Rel-12) | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2142 | | | Clarification of contiguous and non-contiguous intra-band UE capabilities in the same band | 12.3.0 |
| 03-2014 | RP-63 | RP-140385 | 2161 | | | Inrtroduction of additional bandwidth combination set for CA_2A-4A | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2131r 1 | | | CR to finalize RI test for CoMP | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2147 | | | Correction of coding rate for 18RBs in UL RMC table | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2144 | | | Channel spacing for non-contiguous intra-band carrier aggregation | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2163 | | | Distributed EPDCCH Demodulation Test | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2137 | | | Configured transmitted power for CA | 12.3.0 |
| 03-2014 | RP-63 | RP-140368 | 2122 | | | CR for 36.101. Editorial correction on OCNG pattern | 12.3.0 |
| 03-2014 | RP-63 | RP-140370 | 2160 | | | Correction of table notes for NS_12-NS_15 spurious emissions requirements | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2129r 1 | | | CR to finalize fading CQI test for CoMP | 12.3.0 |
| 03-2014 | RP-63 | RP-140375 | 2119 | | | Introduction of requirements for SNR test for TM9 | 12.3.0 |
| 03-2014 | RP-63 | RP-140374 | 2125 | | | CR on correction of downlink SDR tests with EPDCCH scheduling | 12.3.0 |
| 03-2014 | RP-63 | RP-140371 | 2127 | | | Correction on DL CoMP static CQI tests (Rel 12) | 12.3.0 |
| 06-2014 | RP-64 | RP-140909 | 2177r 3 | | | RF: Corrections to spurious emission requirements with NS different than NS_01 (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140932 | 2187r 1 | | | Additional bandwidth combination set for LTE Advanced inter-band Carrier Aggregation of Band 3 and Band 20 | 12.4.0 |
| 06-2014 | RP-64 | RP-140934 | 2188 | | | Additional bandwidth combination set for LTE Advanced inter-band Carrier Aggregation of Band 7 and Band 20 | 12.4.0 |
| 06-2014 | RP-64 | RP-140943 | 2195r 1 | | | CR for TS 36.101 on introduction CA_41D | 12.4.0 |
| 06-2014 | RP-64 | RP-140943 | 2196r 3 | | | CR to TS 36.101 on introduction of CA BW class D requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2198 | | | CR on correction on TDD IRC CQI test | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2207 | | | CR of EPDCCH localzied test with TM10 QCL Type-B configuration (Rel-12): correction of CSI-RS configurations | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2209 | | | Clean up of TM9 SNR tests | 12.4.0 |
| 06-2014 | RP-64 | RP-140933 | 2210r 1 | | | Introduction of band B4+B27 CA to TS36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140942 | 2213 | | | Introduction of CA band combination B1+B20 to TS 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2216 | | | CR for EPDCCH test (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2218 | | | CR of modification on FeICIC rank testing (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2220 | | | CR on FeICIC PBCH performance requirement (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2222 | | | Correction on out-of-band blocking for CA | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2226 | | | Update demodualtion performance requirements with new UE categories | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2228 | | | Correction for CA sustained data rate test (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2229 | | | Correction on wrong annotation for close- loop spatial multiplexing performance | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2233 | | | Clarification of Intra-band contiguous CA class C Narrow band blocking requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2239 | | | Correction for CA soft buffer test (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2241 | | | CR on OCNG and propagation conditions for dual layer TM9 test (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2247 | | | Remove [ ] from eICIC TDD RI requirement | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2256 | | | Verification of exceptions of REFSENS requirements for carrier aggregation | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2258 | | | Applicability of exceptions to reference sensitivity requirements for CA | 12.4.0 |
| 06-2014 | RP-64 | RP-140909 | 2269 | | | In-band blocking case numbering re-establisment | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2273 | | | CR for TS36.101 FRC tables for COMP demodulation requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2277 | | | Editorial correction of note in clause 4.4 | 12.4.0 |

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| 06-2014 | RP-64 | RP-140926 | 2282r 1 | | | Editorial correction of note in clause 4.4 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2283 | | | Introduction of new bandwidth combination set for CA_1A-5A UE | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2286 | | | CR for finalizing DL COMP CSI reporting requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2288 | | | CR for adding DL CoMP CSI RMC tables (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140921 | 2291 | | | Simplification of 36.101 Table 5.6A.1-1 for LTE_CA_C_B27 | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2293 | | | Finalization of CoMP demodulation test cases | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2294 | | | Editorial corrections for UE performance requirements for R12 | 12.4.0 |
| 06-2014 | RP-64 | RP-140937 | 2295 | | | Introduction of CA performance requirements for Band 27 CA | 12.4.0 |
| 06-2014 | RP-64 | RP-140931 | 2296 | | | Introduction of CA 1+11 to 36.101 (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140994 | 2309 | | | Inclusion of the out of band emission limit concluded in CEPT into band 28 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2314 | | | UE to UE co-existence between B42/B43 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2318 | | | Perf: Corrections to CA (Class C) performance with power imbalance (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140920 | 2319 | | | Introduction of CA performance requirements for Band 23 CA | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2321 | | | CR of modification on FeICIC rank testing (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2323 | | | CR of introducing FeICIC TM9 testing (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2325 | | | CR for EPDCCH SDR test (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2328 | | | Clean-up CR for demodulation requirements (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2330r 1 | | | Additional updates of UE categories for demodualtion performance requirements (Rel-12) | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2333 | | | Throughput calculation for eICIC demodulation requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2335r 1 | | | Introduction of Band 28 requirements for flexible operation in Japan | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2337r 1 | | | Add missing Uplink downlink configuration to eICIC TDD RI requirement | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2338 | | | Add static propagation condition matrix for 1 x 2 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2341 | | | Cleanup of terminology for Rx requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140945 | 2344 | | | CR on separating CA UE demodulation tests from single carrier tests in Rel-12 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2351 | | | Test configuration for intra-band contiguous carrier aggregation power control | 12.4.0 |
| 06-2014 | RP-64 | RP-140935 | 2358 | | | Addition of bandwidth combination sets for CA_2A-29A, CA_3A-5A, CA_4A-5A, CA_4A-12A, and CA_4A-29A into 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2362 | | | Correction of test configurations for intra-band non-contiguous aggregation | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2365 | | | Clarification on CA bandwidth classes | 12.4.0 |
| 06-2014 | RP-64 | RP-140917 | 2374 | | | CR on correction of downlink SDR tests with EPDCCH scheduling | 12.4.0 |
| 06-2014 | RP-64 | RP-140922 | 2377 | | | Correction on LTE_CA_C_B39 | 12.4.0 |
| 06-2014 | RP-64 | RP-140911 | 2378 | | | Corrections on CA CQI tests | 12.4.0 |
| 06-2014 | RP-64 | RP-140930 | 2381r 1 | | | Introduction of LTE-Advanced CA of Band 8 and Band 40 to TS36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140927 | 2382r 1 | | | FRC for DL MIMO enahncement PMI requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140603 | 2384r 2 | | | CR for TS 36.101 on introduction CA_40D | 12.4.0 |
| 06-2014 | RP-64 | RP-140944 | 2385r 1 | | | CR to TS 36.101 on introduction of 3DL intra-band non-contiguous CA requirements | 12.4.0 |
| 06-2014 | RP-64 | RP-140938 | 2387 | | | Introduction of CA_2A-2A into TS 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140927 | 2392 | | | Introduction of 4Tx beam steering model | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2394 | | | CA_7C A-MPR Corrections | 12.4.0 |
| 06-2014 | RP-64 | RP-140936 | 2395r 2 | | | Introduction of a new CA_7C bandwidth combination set into 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140918 | 2398 | | | CR for TS36.101 CSI RMC table | 12.4.0 |
| 06-2014 | RP-64 | RP-140940 | 2413 | | | Introduction of LTE_CA_NC_B42 into 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140942 | 2420 | | | Introduction of CA band combination B1+B20 to TS 36.101 | 12.4.0 |
| 06-2014 | RP-64 | RP-140919 | 2422 | | | CA_3C is deleting 75RB+75RB uplink configuration for reference sensitivity | 12.4.0 |
| 06-2014 | RP-64 | RP-140914 | 2425 | | | CR on correction for TM10 CSI reporting requirements | 12.4.0 |
| 09-2014 | RP-65 | RP-141197 | 2458r 1 | | | Introduction of CA_B1_B3_B19 into TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141428 | 2568 | | | Updated REFSENS requirements for band combinations with Band 4 and Band 12 | 12.5.0 |
| 09-2014 | RP-65 | RP-141468 | 2508r 1 | | | Introduction of 3 DL CA for Band 1+3+20 | 12.5.0 |
| 09-2014 | RP-65 | RP-141469 | 2571 | | | Correction to CA in Band 1+20 | 12.5.0 |
| 09-2014 | RP-65 | RP-141525 | 2504r 1 | | | Perf: Cleanup and better description of DL-RMC-s with dynamic coding rate for CSI requirements (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141525 | 2565 | | | Corrections to UE coex table | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2434 | | | Correction on support of a bandwidth combination set | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2452r 1 | | | Remove the redundant table for FDD 4Tx multi-layer tests and correct the test case number (Rel-12) | 12.5.0 |

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| 09-2014 | RP-65 | RP-141527 | 2466 | | | Unequal DL CC RB allocations in Maximum input level | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2469 | | | Intra-band contiguous CA ACS case 2 test clarification | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2484 | | | Corrections on delta Tc for UE MOP for intra-band contiguous CA | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2487 | | | Removal of Class B in UE TX requirement | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2516r 1 | | | CR for CA applicability rule in 36.101 in Rel-12 | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2519r 1 | | | Editorial CR for CA performance tests in 36.101 in Rel-12 | 12.5.0 |
| 09-2014 | RP-65 | RP-141527 | 2548 | | | Correction to NS_20 A-MPR for Band 23 | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2447 | | | CR of introducing FeICIC TM9 testing (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2454 | | | Maintenance of CoMP demodulation performance requirements (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2456 | | | Clean-up CR for EPDCCH and FeICIC PBCH (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141530 | 2471 | | | Throughput calculation for feICIC demodulation requirements | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2439 | | | CR on correction on CQI reporting TDD CSI meas in case two CSI subframe sets with CRS test (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2441 | | | CR on correction on RI reporting CSI meas in case two CSI subframe sets with CRS tests (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2444 | | | Clarification of high speed train scenario in 36.101 (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2478 | | | CQI reporting under fading: CQI indices in set | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2490 | | | Correction on A-MPR table | 12.5.0 |
| 09-2014 | RP-65 | RP-141532 | 2499 | | | RF: Corrections to spurious emission band co-existence requirement for Band 44 | 12.5.0 |
| 09-2014 | RP-65 | RP-141535 | 2559 | | | Addition of E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA for Band 4 and 27 | 12.5.0 |
| 09-2014 | RP-65 | RP-141537 | 2541 | | | Band 42 contiguous CA channel bandwidth correction | 12.5.0 |
| 09-2014 | RP-65 | RP-141546 | 2463r 1 | | | Introduction of PMI reporting requirements for DL MIMO enhancement | 12.5.0 |
| 09-2014 | RP-65 | RP-141548 | 2457r 2 | | | Introduction of CA_B1_B3 into TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141549 | 2556 | | | Addition of bandwidth combination set for CA_2A-4A | 12.5.0 |
| 09-2014 | RP-65 | RP-141550 | 2566 | | | Addition of 3MHz bandwidth for Band 12 , in the B2+B12 CA combination | 12.5.0 |
| 09-2014 | RP-65 | RP-141551 | 2445 | | | Introduction of CA 8+11 to 36.101 (Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141553 | 2491r 1 | | | Introduction of a new bandwidth combination set for CA_25A-25A into 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141554 | 2533r 1 | | | Introduction of requirements for 3DL inter-band carrier aggregation (FDD) | 12.5.0 |
| 09-2014 | RP-65 | RP-141554 | 2534 | | | Introduction of requirements for 3DL combinations with Band 30 (FDD) | 12.5.0 |
| 09-2014 | RP-65 | RP-141557 | 2461r 1 | | | Introduction of CA_B19_B42_B42 into TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141559 | 2460r 1 | | | Introduction of CA_B1_B42_B42 into TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141560 | 2427 | | | Adding 15MHz channel BW to B40 3DL and new bandwidth combination set for the 2DL | 12.5.0 |
| 09-2014 | RP-65 | RP-141561 | 2488r 1 | | | Corrections on Maximum input level for intra-band non-contiguous 3DL | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2436 | | | Corrections on Maximum input level and ACS for intra-band CA | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2481r 1 | | | Introduction of CA band combination B41+ B42 to TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2522 | | | CR on CA power imbalance tests in Rel-12 | 12.5.0 |
| 09-2014 | RP-65 | RP-141562 | 2560 | | | CR Reducing MPR for Contiguous CA with Non-Contiguous Resource Allocations | 12.5.0 |
| 09-2014 | RP-65 | RP-141563 | 2555r 1 | | | UL configuration for CA_4A-12A reference sensitivity | 12.5.0 |
| 09-2014 | RP-65 | RP-141563 | 2557 | | | Addition of bandwidth combination set for CA_4A-12A | 12.5.0 |
| 09-2014 | RP-65 | RP-141612 | 2494r 2 | | | Introduction of inter-band CA_18-28 into TS36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141635 | 2552r 2 | | | Introduction of CA_1A-7A into 36.101(Rel-12) | 12.5.0 |
| 09-2014 | RP-65 | RP-141636 | 2480r 2 | | | Introduction of 3DLs CA band combination of Band1 +5 + 7 to TS 36.101 Rel-12 | 12.5.0 |
| 09-2014 | RP-65 | RP-141653 | 2435r 3 | | | Introduction of 3 Band Carrier Aggregation (3DL/1UL) of Band 1, Band 3 and Band 8 to TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141682 | 2570r 1 | | | Introduction of CA band combination B1+B7+B20 to TS 36.101 | 12.5.0 |
| 09-2014 | RP-65 | RP-141708 | 2492r 3 | | | Introduction of 3 Band Carrier Aggregation of Band 1,Band 3 and Band 5 to TS 36.101 | 12.5.0 |
| 12-2014 | RP-66 | RP-142147 | 2671 | | | Correction of CoMP TDD CSI tests (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2574 | | | CR for REFSENSE in lower SNR and change history | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2581 | | | CR on 4Tx codebook PMI testing | 12.6.0 |
| 12-2014 | RP-66 | RP-142142 | 2587 | | | CR for 1 PRB allocation performance in presence of MBSFN (rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2590 | | | Maintenance of CA demodulation performance requirements (Rel- | 12.6.0 |

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| 12-2014 | RP-66 | RP-142147 | 2592 | | | Clean up for FeICIC demodulation performance requirements (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142166 | 2600 | | | Correction of placement of CA_40D in Table | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2601 | | | CQI test for TDD CL_C 20MHz+15MHz in Rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2602 | | | Sustained downlink data rate test for TDD CL_C 20MHz+15MHz in Rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142165 | 2611 | | | Removal of square brackets for CA_B1_B3 and CA_B1_B3_B19 | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2620 | | | CQI reporting in AWGN: CQI indices in set | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2629 | | | CR to fix error of CA capability for CA performance tests in 36.101 in Rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2637 | | | Definition of the bits in the bitmap for indication of modified MPR behavior | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2641 | | | Applicability of in-gap and out-of-gap measurements for intra-band NC CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142183 | 2642 | | | Introduction of additional bandwidth combination set for CA_2A-5A | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2643 | | | Corrections for 3DL inter-band CA band combinations | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2661 | | | Maintenance of TM10 demodulation test configurations on PQI set and ZP-CSIRS ( Rel-12 test 8.3.1.3.2, 8.3.2.4.2 ) | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2582r 1 | | | Introduction of PUSCH 3-2 requirements into TS36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142162 | 2603r 1 | | | Normal demodulation test for TDD CL_C 20MHz+15MHz in Rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2576r 1 | | | Corrections on Out-of-band blocking requirements for CA Class B and D | 12.6.0 |
| 12-2014 | RP-66 | RP-142149 | 2678 | | | CR to specify applicability of CoMP RI test (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2688 | | | Removal of bracket for UL MIMO | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2689 | | | Corection of B29 REFSENS for CA_2A-29A-30A and CA_4A-29A-30A | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2700 | | | Delete the incorrect notes for FDD DMRS demodulation tests (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142160 | 2594r 3 | | | Correcting requirements for inter-band CA_18-28 in TS36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2705 | | | CR of modification on PMI reporting requirements for DL MIMO enhancement | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2720 | | | Band 22 correction in UE to UE co-existance table. | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2722 | | | Correction to non-contiguous downlink intraband CA receiver requirements | 12.6.0 |
| 12-2014 | RP-66 | RP-142159 | 2752 | | | Removal of dRib from CA_1A-7A | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2723 | | | Correction to table format of allowed channel bandwidths of non-contiguous intraband CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142164 | 2643r 1 | | | Corrections for 3DL inter-band CA band combinations | 12.6.0 |
| 12-2014 | RP-66 | RP-142146 | 2731 | | | Modifications for NS_12 and NS_13 | 12.6.0 |
| 12-2014 | RP-66 | RP-142189 | 2739 | | | Introduction of CA_5-13 into 36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | 2706r 1 | | | CR of reference measurement channel for PUSCH3-2 test | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2727r 1 | | | CR for CA applicability rule in 36.101 in Rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142188 | 2676r 1 | | | CR to remove CA capability column in CA performance test tables (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142173 | r3 | | | Introduction of PUSCH 3-2 requirements into TS36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2690r 1 | | | CR on sustained data rate test for 3DL CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2681r 2 | | | CR on normal demodulation test for 3DL CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2747r 1 | | | TS36.101 removal of brackets (RF) | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2755 | | | Correction to Transmit Modulation Quality for CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2710r 1 | | | Clarification on UL and DL CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2717r 1 | | | Clarification of notes relating to interferer offsets in intraband CA receiver requirement tables. | 12.6.0 |
| 12-2014 | RP-66 | RP-142147 | 2735r 1 | | | Band 28 and NS_24 | 12.6.0 |
| 12-2014 | RP-66 | RP-142179 | 2684r 1 | | | CR for UE requirements for 256QAM | 12.6.0 |
| 12-2014 | RP-66 | RP-142180 | 2729r 1 | | | Introduction of Dual Connectivity to TS 36.101 Rel-12, RF part | 12.6.0 |
| 12-2014 | RP-66 | RP-142184 | 2680r 1 | | | Introduction of dual uplink inter-band CA in TS 36.101 rel-12 | 12.6.0 |
| 12-2014 | RP-66 | RP-142182 | 2701r 1 | | | Introduction of inter-band CA_1-28 into TS36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2758 | | | Correction to Note 2 of Harmonic Signal Exceptions in Spurious | 12.6.0 |

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| 12-2014 | RP-66 | RP-142144 | 2751r 2 | | | Removal of brackets and TBD from CA feature | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2697r 1 | | | Maintenance of CA performance requirements (Rel-12) | 12.6.0 |
| 12-2014 | RP-66 | RP-142187 | 2679r 2 | | | CR to introduce CQI test for 3 DL CA | 12.6.0 |
| 12-2014 | RP-66 | RP-142185 | 2721r 1 | | | Addition of 2UL non-contiguous intraband CA feature | 12.6.0 |
| 12-2014 | RP-66 | RP-142144 | 2704r 2 | | | UE to UE co-existence between B42/B43 | 12.6.0 |
| 12-2014 | RP-66 | RP-142176 | 2685r 2 | | | Introduction of LC MTC into TS 36.101 | 12.6.0 |
| 12-2014 | RP-66 | RP-142190 | 2759r 1 | | | Introduction of additional band combinations for 3DL inter-band CA | 12.6.0 |
| 03-2015 | RP-67 | RP-150387 | 2760r 2 | | | Introduce additional bands of LC MTC | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2761 | | | CR on corrections to Dual-Layer Spatial Multiplexing with multiple CSI-RS config Rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2765r 1 | | | CR for applicability and test rules for TDD-FDD CA performance requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2766 | | | Introduction of CQI tests for TDD-FDD CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150395 | 2767r 1 | | | CR to introduce the SU-MIMO whitening verification test | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2768r 1 | | | CR on power imbalance test for 3DL CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2769 | | | CR on sustained data rate test for TDD FDD CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150394 | 2770r 1 | | | CR for introduction of 256QAM demodulation performance requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150393 | 2772r 1 | | | CR: DC UE performance requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2773r 1 | | | CR: MTC demodulation performance requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2774r 1 | | | CR: MTC CSI requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150396 | 2775r 1 | | | Introduction of the eIMTA functional PDSCH demodulation test | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2776r 3 | | | CR on RF core requirements for D2D | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2777 | | | Modification of CSI reference measurement channel Rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2779 | | | Editorial correction for CA_18A-28A | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2781 | | | Removing brackets for CA_1A-28A MSD requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2783 | | | Editorial correction on symbols for enhanced performance requirements type A | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2784 | | | Corrections on reference measurement channel | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2792 | | | Correction of TS 36.101 for the Pcell support of 25+41 | 12.7.0 |
| 03-2015 | RP-67 | RP-150395 | 2793r 1 | | | CR for single cell demodulation test for SU-MIMO | 12.7.0 |
| 03-2015 | RP-67 | RP-150391 | 2794 | | | Introduction of CA_3A-42A and CA_3A-42C into 36.101 | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2797 | | | UL HARQ in PDSCH and PDCCH/PCFICH demod test cases for eICIC/feICIC with MBSFN ABS | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2800 | | | Correction to eICIC aggressor cell configurations | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2801 | | | R4-73AH-0040: Correction for uplik CA configuration in TS 36.101 Rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2802r 1 | | | Correction of MSD levels for CA_1A-8A in TS 36.101 rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2805 | | | Removal of eDL-MIMO term from specification | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2809 | | | Clarification of 2UL/3DL contiguous intraband CA REFSENS test | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2811r 1 | | | CR on TM4 normal demodulation test for 3DL CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2812 | | | CR on introducing new DL referece measurement channels | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2813r 1 | | | CR on normal demodulation test for TDD-FDD CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2815 | | | Additions of bandwidth combination set reference | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2816 | | | Correction of band number in Table 5.6A.1-2a for LTE_CA_B4_B12_B30 | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2819 | | | UE to UE co-existence between B42/B43 | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2822 | | | Corrections to CA in-band emissions requirement | 12.7.0 |
| 03-2015 | RP-67 | RP-150381 | 2830 | | | Uplink RMCs for sustained data rate test | 12.7.0 |
| 03-2015 | RP-67 | RP-150382 | 2833 | | | Corrections to the CA power imbalance test | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2839r 1 | | | CR for soft buffer tests for TDD-FDD CA in 36.101 in Rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150392 | 2842 | | | Editorial CR for CA UE performance tests in 36.101 in Rel-12 | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2847 | | | UE spurious emissions structure correction for CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2850 | | | Correction of PCMAX for uplink inter-band and intra-band carrier | 12.7.0 |

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| 03-2015 | RP-67 | RP-150387 | 2851 | | | Exceptions for spurious response for UL CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150388 | 2852r 1 | | | Correction of REFSENS, OOBB and uplink configuration for 3DL/1UL CA | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2853 | | | SNR definition for category 0 UE | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2854r 1 | | | FRC for category 0 UE PDSCH performance requirements | 12.7.0 |
| 03-2015 | RP-67 | RP-150390 | 2855r 1 | | | Introduction of new PHICH and PBCH performance requirements for category 0 UE | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2861 | | | Correction to FOOB reference in definition of MPR for contiguous CA with non-contiguous resource allocation | 12.7.0 |
| 03-2015 | RP-67 | RP-150387 | 2862 | | | Band 31 update | 12.7.0 |
| 03-2015 | RP-67 | RP-150384 | 2867 | | | Implementation of CA configurations specified in later releases | 12.7.0 |
| 06-2015 | RP-68 | RP-150958 | 2870r 2 | | | Intra-band contiguous CA reference sensitivity definition for Class D | 12.8.0 |
| 06-2015 | RP-68 | RP-150961 | 2881r 2 | | | CR on MTC CQI tests | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2882r 2 | | | CR on 256QAM demodulation performance requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2883r 3 | | | CR on 256QAM sustained data rate tests for single carrier and TDD or FDD CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2885r 4 | | | CR on 256QAM CQI test | 12.8.0 |
| 06-2015 | RP-68 | RP-150963 | 2886r 3 | | | CR on DC SDR tests | 12.8.0 |
| 06-2015 | RP-68 | RP-150963 | 2887r 2 | | | Maintenance CR for DC demodualtion performance requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2888 | | | CR to restore R.10-2 FDD | 12.8.0 |
| 06-2015 | RP-68 | RP-150961 | 2889r 3 | | | Introduction of UE category 0 PDSCH/PHICH/PBCH performance requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2901 | | | UE to UE co-existence between B42/B43 | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2902 | | | Correction of maximum aggregated bandwidth for CA_26A-41A | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2903r 2 | | | Introduction of TDD SU-MIMO whitening verification test | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2904 | | | Correction of FRC table for CA demodualtion with power imbalance | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2905r 1 | | | Add SCell power levels for 2DL CA power imbalance test | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2907 | | | Corrections on UL transmit power for CA receiver requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2909 | | | Corrections to the CA power imbalance test | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2910r 1 | | | Clarification on RMC for D2D UE | 12.8.0 |
| 06-2015 | RP-68 | RP-150960 | 2911 | | | Correction on TDD eIMTA PDSCH functionality test | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2931 | | | 3.5 GHz out-of-band blocking | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2933 | | | Correction of FRC names | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2936 | | | Correction of the 3DL CA REFSENS | 12.8.0 |
| 06-2015 | RP-68 | RP-150962 | 2939r 1 | | | CR on 256QAM sustained data rate tests for TDD FDD CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2940r 1 | | | Maintenance CR for 3DL CA performance requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2941r 1 | | | Maintenance CR for TDD FDD CA demodulation performance requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2944 | | | Corrections on 2UL intra-band non-contiguous CA requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2947 | | | Updates to the definitions of CA capability (Rel-12) | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2950 | | | Clarification of PDSCH allocation in CSI PUSCH 3-0 feICIC tests (Rel-12) | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2956 | | | NS value for intra-band contiguous CA configurations not allowed A-MPR | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2958 | | | Receiver spurious emissions requirements for downlink-only bands | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2959 | | | Amendments to MPR for uplink inter-band and intra-band non-contiguous CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2960r 1 | | | NS values for secondary cells of non-contigous CA configurations | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2961r 1 | | | Corrections to test configurations for intra-band non-contiguous CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2962 | | | Corrections to test configurations for 3DL inter-band CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2967 | | | Adding REFSENS exception requirements for 1+3+26 | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2971 | | | Corrections to NS_22 and NS_23 | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2972 | | | Corrections to 41D fallback | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2972 | | | Corrections to EVM requirements for ProSe and Annex F of 36.101 | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2976 | | | Removal of B27 from 2UL CA_7A_20A co-existence protected band list | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2977r | | | CR on corrections to D2D RF core requirements | 12.8.0 |

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| 06-2015 | RP-68 | RP-150963 | 2978r 1 | | | CR on corrections to D2D RF core requirements | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 2979 | | | CR clarification of RMC for DL category 0 UE HD-FDD | 12.8.0 |
| 06-2015 | RP-68 | RP-150960 | 2980r 1 | | | Introducation of TDD eIMTA CQI requirement | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 2985 | | | Change of 1.4MHz single carrier SNR values for multiple CA configurations | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 2992 | | | Clarification to spurious emission requirement for the edge of spurious domain | 12.8.0 |
| 06-2015 | RP-68 | RP-150955 | 2996 | | | Correction to CA_7C A-MPR in CA-NS_06 | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2998r 1 | | | CR to update UE performance tests for UE DL category in 36.101 in Rel-12 | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 2999 | | | CR to update Annex for new DL category in 36.101 in Rel-12 | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 3002 | | | CR for updating CA applicability rule in 36.101 in Rel-12 | 12.8.0 |
| 06-2015 | RP-68 | RP-150957 | 3005r 1 | | | CR for Rel-12 NAICS - Definitions | 12.8.0 |
| 06-2015 | RP-68 | RP-150965 | 3012r 1 | | | Clarification on uplink configuration for reference sensitivity of inter-band CA | 12.8.0 |
| 06-2015 | RP-68 | RP-150954 | 3018 | | | EVM for Intra-band contiguous UL CA for non-equal Channel BWs | 12.8.0 |
| 06-2015 | RP-68 | RP-150958 | 3019 | | | A-MPR correction for CA_39C CA_NS_07 | 12.8.0 |
| 09-2015 | RP-69 | RP-151482 | 3006r 3 | | | CR for Rel-12 NAICS - Demodulation Test | 12.9.0 |
| 09-2015 | RP-69 | RP-151482 | 3008r 3 | | | CR for Rel-12 NAICS - Interference Models | 12.9.0 |
| 09-2015 | RP-69 | RP-151482 | 3009r 3 | | | CR for Rel-12 NAICS - CQI Tests | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3024 | | | Corrections to CSI PUCCH 1-0 static test 4 and PUSCH 3-2 tests | 12.9.0 |
| 09-2015 | RP-69 | RP-151476 | 3025 | | | Correction to RC.2 TDD Nr. HARQ Proc. into TS36.101 | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3027 | | | Table 7.3.1A-0f (2UL CA MSD) notes numbering correction | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3030r 1 | | | Correction to TDD FDD CA | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3032 | | | Alignment of CA Receiver requirements parameters | 12.9.0 |
| 09-2015 | RP-69 | RP-151476 | 3035 | | | Correction to CoMP demodulation requirements | 12.9.0 |
| 09-2015 | RP-69 | RP-151475 | 3039 | | | Correction to RI test parameters in TS 36.101 (Rel-12) | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3049 | | | UE co-existence requirements between Band 42 and Japanese bands | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3051 | | | Introduction of relaxation rule for multiple 3DL inter-band CA configurations | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3053 | | | Removal of square brackets of B42 requirements in Rel-12 specification | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3059r 1 | | | Corrections on CA reference sensitivity requirements | 12.9.0 |
| 09-2015 | RP-69 | RP-151480 | 3061r 1 | | | Correction for eIMTA CQI tests | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3062 | | | Maintenance of eIMTA PDSCH demodulation test | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3067r 1 | | | Corrections of Spurious emission band UE co-existence for interband 2UL CA in Table 6.6.3.2A-0 | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3069r 1 | | | Revisions of Spurious emission band UE co-existence in Table 6.6.3.2-1 | 12.9.0 |
| 09-2015 | RP-69 | RP-151475 | 3075 | | | Correction to PDCCH/PCFICH test parameters in TS 36.101 (Rel-12) | 12.9.0 |
| 09-2015 | RP-69 | RP-151475 | 3079 | | | Correction to PMI delay in PMI test for TDD | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3082 | | | Maintanence CR for MTC CSI performance requirements | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3084 | | | Maintanence CR for SCE demodulation and CSI requriements | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3086 | | | Maintenance CR for DC demodulation performance requirements and SDR tests | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3088r 1 | | | Cleanup of TDD-FDD CA demodulation performance requirments | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3090 | | | Cleanup of R12 SU-MIMO Enhanced Performance Type C requirments | 12.9.0 |
| 09-2015 | RP-69 | RP-151482 | 3093r 1 | | | CR for Rel-12 NAICS - Fixed Reference Channels | 12.9.0 |
| 09-2015 | RP-69 | RP-151481 | 3096r 2 | | | CR on demodulation performance requirements for D2D Discovery | 12.9.0 |
| 09-2015 | RP-69 | RP-151481 | 3097r 2 | | | CR on demodulation performance requirements for D2D Communication | 12.9.0 |
| 09-2015 | RP-69 | RP-151475 | 3101 | | | Correction on UE maximum output power class of Band 22 for UL MIMO | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3103 | | | Removal of square brackets for Cat-0 UE demodulation requirements | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3105 | | | Removal of square brackets for LTE-CA_B41_B42 | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3111r 1 | | | Corrections on 3DL CA performance requirements | 12.9.0 |

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| 09-2015 | RP-69 | RP-151483 | 3119 | | | Minor correction in 36.101 | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3120 | | | CR adding clarification for Band 28 restrictions in 36.101 | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3126 | | | CR for UE performance tests for intra-band contiguous CA with minimum channel spacing on Band 41 | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3134r 1 | | | Modification of test parameters for TM9 demodulation with 256QAM (Rel-12) | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3136r 1 | | | Spreading of harmonic for 2UL interband and 2 UL non-contiguous intraband CA | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3140 | | | Correction to FDD-TDD closed loop spatial multiplexing 3CC requirement table | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3142r 1 | | | Correction to DC supported testable bandwidth list | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3144r 1 | | | Clarification of UL configuration for CA demodulation requirements | 12.9.0 |
| 09-2015 | RP-69 | RP-151479 | 3152 | | | Corrections to CSI RMCs used for PUSCH 3-2 testing (Rel-12) | 12.9.0 |
| 09-2015 | RP-69 | RP-151483 | 3154r 1 | | | Corrections to applicability of CSI requirements for low UE categories (Rel-12) | 12.9.0 |
| 09-2015 | RP-69 | RP-151349 | 3156r 4 | | | CR for Rel-12 NAICS - TM10 Demodulation and CSI Test | 12.9.0 |
| 09-2015 | RP-69 | RP-151475 | 3161 | | | Correction of applicability of CA_NS_31 | 12.9.0 |
| 12-2015 | RP-70 | RP-152131 | 3176r 1 | | | Release 12 CR to align NS_04 values to meet FCC OOBE requirements | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3179r 1 | | | Editorial correction for eIMTA CQI tests | 12.10.0 |
| 12-2015 | RP-70 | RP-152135 | 3182r 1 | | | CR to finalize demodulation performance requirements for D2D Communication | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3185r 1 | | | Simplified CA fading Test method becomes optional | 12.10.0 |
| 12-2015 | RP-70 | RP-152135 | 3187r 1 | | | CR on corrections for ProSe Direct Discovery demodulation requirements | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3190 | | | Correction of the applicable UE categories for 256QAM UE demodulation performance requirements (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3192r 1 | | | Correction of TDD-FDD CA performance requirements (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3194 | | | Correction on FDD CA and TDD TDD CA performance requirements (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152130 | 3201r 1 | | | CR: Removal of 1.4MHz MBMS test (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152132 | 3204 | | | Correction of the AMPR table for NS_14 in TS 36.101 R12 | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3213 | | | Corrections to the CSI minimum requirement for PUSCH 3-2 (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3215r 1 | | | Corrections to MIMO Correlation Matrices using cross polarized antennas (Rel-12) | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3224r 1 | | | CR for UE performance tests for intra-band contiguous CA with minimum channel spacing on Band 41 | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3226r 1 | | | Correction in SNR definition for CSI test | 12.10.0 |
| 12-2015 | RP-70 | RP-152130 | 3231 | | | Correction to reference channel for CQI requirements | 12.10.0 |
| 12-2015 | RP-70 | RP-152164 | 3243 | | | Introduction of 2 UL and 3 DL interband cases with MSD | 12.10.0 |
| 12-2015 | RP-70 | RP-152132 | 3245 | | | CR on FRC for CDM-multiplexed DM RS | 12.10.0 |
| 12-2015 | RP-70 | RP-152132 | 3248 | | | Correction to physical channel for CQI reporting in type A test case | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3260 | | | CR for Rel-12 NAICS - Demodulation Test | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3262 | | | Correction on CA_4A-4A-5A table reference | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3268 | | | Clarification of Pcell support in 36.101 in CA scenarios | 12.10.0 |
| 12-2015 | RP-70 | RP-152132 | 3272 | | | A-MPR correction for CA_NS_06 CA-7C non-contiguous RB allocation | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3275r 1 | | | Clarification on relative power tolereance for CA | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3279 | | | Correction of uplink configuration for CA_18-28 | 12.10.0 |
| 12-2015 | RP-70 | RP-152131 | 3284 | | | Missing RB allocation and OCNG Pattern for Cat 1 UEs in Multiple PMI CSI Reference Symbol tests | 12.10.0 |
| 12-2015 | RP-70 | RP-152131 | 3293r 1 | | | Correction of supported sub-block frequency arrangement for CA_41-41 | 12.10.0 |
| 12-2015 | RP-70 | RP-152131 | 3295 | | | Correction of test configuration for combinations of inter-band and intra-band CA | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3310 | | | Correction on CQI test 1A for TDD eIMTA | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3313 | | | Correction of the resource allocation in FRC for CAT0 UE demodulation tests | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3328r 1 | | | Removal of DC channel bandwidth combination set table | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3330 | | | CR on demodulation requirements of Dual Connectivity | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3333 | | | Correction of MSD levels for 2UL inter-band CA in TS 36.101 Rel-12 | 12.10.0 |
| 12-2015 | RP-70 | RP-152164 | 3344 | | | Removal of (NOTE 4) from Table 5.6A.1-2a | 12.10.0 |

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|---|---|---|---|---|---|---|---|
| 12-2015 | RP-70 | RP-152136 | 3351 | | | CR: PDSCH ETU600 performance requirements | 12.10.0 |
| 12-2015 | RP-70 | RP-152133 | 3374r 1 | | | Correction to Pcmax for CA to include delta_T_ProSe | 12.10.0 |
| 12-2015 | RP-70 | RP-152136 | 3377 | | | NS_05 modification for PHS protection in Japan | 12.10.0 |
| 01-2016 | RP-70 | | | | | Editorial correction to sections 6.6.3.3.18 (put back to void) and renamed to section 6.6.3.3.19 | 12.10.1 |
| 03-2016 | RP-71 | RP-160488 | 3380 | | | Correction to Type A CQI test parameters in TS 36.101 | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3383 | | | Correction in beam steering rate for 4 Tx antenna in Rel-12 | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3385 | | | CR for correction to syncOffsetIndicator parameter in D2D resource pool configuration | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3389 | | | Correction for eIMTA CQI reporting tests | 12.11.0 |
| 03-2016 | RP-71 | RP-160488 | 3392 | | | Beamforming model correction on TM10 DPS UE tests | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3398 | | | [Rel-12] NS_05 modification for PHS protection in Japan | 12.11.0 |
| 03-2016 | RP-71 | RP-160488 | 3404 | | | CQI reports in CoMP fading test | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3410r 1 | | | Correction of Pcmax for Dual Connectivity | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3418r 1 | | | Alignment of Inter-band CA with two bands | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3426 | | | Corrections to Notes in 2UL spurious emission table | 12.11.0 |
| 03-2016 | RP-71 | RP-160487 | 3428 | | | Rel-12] Correction on Intra-band non-contiguous CA | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3435 | | | Correction on UE category in Annex of TS 36.101 | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3437 | | | Removal of brackets for Maximum input level for 256QAM in TS 36.101 | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3439 | | | Removal of brackets for Measurment channels for MTC in TS 36.101 | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3448 | | | Removing DC_5-17 from 36.101 Rel 12 | 12.11.0 |
| 03-2016 | RP-71 | RP-160488 | 3451 | | | Correction to TDD CQI Reporting for feICIC | 12.11.0 |
| 03-2016 | RP-71 | RP-160488 | 3452 | | | Maintenance CR for CA (Rel-12) | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3454 | | | Maintenance CR for DC (Rel-12) | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3455 | | | Maintenance CR for D2D (Rel-12) | 12.11.0 |
| 03-2016 | RP-71 | RP-160489 | 3457r 1 | | | CR: Correction of FRC for SDR test (Rel-12) | 12.11.0 |
| 03-2016 | RP-71 | RP-160488 | 3472 | | | CR of editorial change on PHICH group and Ng in Rel-12 | 12.11.0 |
| 2016/06 | RP-72 | RP-161141 | 3488 | | F | Correction on B39 coexistence spurious emission requirements | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3490 | | F | Square brackets on B39 single carrier spurious emission requirements for protecting B3 | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3495 | | F | CSI requirements for 2DL FDD-TDD for UE Cat 3 (Rel 12) | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3497 | | F | Wrong RMC description in overview table (Rel-12) | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3529 | | F | Correction on UE category for MTC in TS 36.101 | 12.12.0 |
| 2016/06 | RP-72 | RP-161140 | 3534 | | F | ACS for CA Bandwidth Class D: Case 2 wanted signal power | 12.12.0 |
| 2016/06 | RP-72 | RP-161140 | 3537 | | F | Maintenance CR for demodulation performance requirements (Rel-12) | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3558 | - | F | Corrections to 9.6.1.3 and 9.6.1.4 TDD FDD CQI Reporting test | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3586 | - | F | CR on Frequency bands for UE category 0 | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3613 | - | F | CR: Maintenance CR for demodulation performance requirements (Rel-12) | 12.12.0 |
| 2016/06 | RP-72 | RP-161141 | 3622 | - | A | Editorial correction for TM4 MMSE-IRC PDSCH demodulation test | 12.12.0 |
| 2016/09 | RP-73 | RP-161785 | 3643 | - | F | Correct UE DL category for 256QAM demodulation | 12.13.0 |
| 2016/09 | RP-73 | RP-161632 | 3654 | - | A | Improving the single antenna port description in UL-MIMO clauses | 12.13.0 |
| 2016/09 | RP-73 | RP-161784 | 3661 | - | A | Correction of CA REFSENS harmonic formula | 12.13.0 |
| 2016/09 | RP-73 | RP-161784 | 3670 | - | A | CR: Update the power level setting for tests 8.3.1.2 and 8.3.2.3 (Rel-12) | 12.13.0 |
| 2016/09 | RP-73 | RP-161634 | 3745 | - | F | Removal of square brackets for Cat-0 REFSENS configuration | 12.13.0 |
| 2016/09 | RP-73 | RP-161633 | 3763 | - | A | CR for fixing power level for TM9 dual layer test in Rel-12 | 12.13.0 |
| 2016/09 | RP-73 | RP-161634 | 3774 | - | F | 2UL CA 5+17 correction | 12.13.0 |
| 2016/09 | RP-73 | RP-161634 | 3792 | - | F | Modification on E-UTRA Prose out of band blocking requirement | 12.13.0 |
| 2016/09 | RP-73 | RP-161633 | 3797 | - | F | Correction of OCNG | 12.13.0 |
| 2016/09 | RP-73 | RP-161784 | 3802 | - | F | CR: Correction of power parameter for demodulation tests | 12.13.0 |
| 2016/09 | RP-73 | RP-161634 | 3822 | - | F | Correction on subframe pair definition for PCMAX of DC | 12.13.0 |
| 2016/09 | RP-73 | RP-161784 | 3825 | - | F | Correction of CR Implementation error to 36.101 | 12.13.0 |
| 2016/09 | RP-73 | RP-161630 | 3828 | - | F | Bracket removal for B3 and B39 UE co-existence | 12.13.0 |
| 2016/12 | RP-74 | RP-162459 | 3874 | 2 | F | Clarification on UE maximum output power | 12.14.0 |
| 2016/12 | RP-74 | RP-162459 | 3899 | 1 | B | CR for updating applicability rule for UE cat 9 Ues and DL Cat. 13 UEs in Rel-12 | 12.14.0 |
| 2016/12 | RP-74 | RP-162412 | 3925 | - | F | UE to UE co-existence for B42 with 2ULs | 12.14.0 |
| 2016/12 | RP-74 | RP-162415 | 3994 | 1 | F | Correction to cell mapping for periodic CQI reporting on multiple cells | 12.14.0 |
| 2016/12 | RP-74 | RP-162411 | 4020 | - | A | RMCs and applicabililty of core RF requirements | 12.14.0 |
| 2016/12 | RP-74 | RP-162411 | 4029 | - | A | Correction of spurious emissions requirements for Band 9 range and intra-band CA | 12.14.0 |

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| 2016/12 | RP-74 | RP-162420 | 4038 | - | F | Optional PCell indication | 12.14.0 |
| 2016/12 | RP-74 | RP-162413 | 4063 | 1 | A | Corrections to CA table reference and header | 12.14.0 |
| 2016/12 | RP-74 | RP-162459 | 4075 | 1 | F | Corrections of CA Refsens exceptions in 7.3.1A (Rel-12) | 12.14.0 |
| 2016/12 | RP-74 | RP-162459 | 4079 | 1 | F | DeltaRIB for SDL CA | 12.14.0 |
| 2016/12 | RP-74 | RP-162459 | 4083 | 1 | F | CR for fixing soft buffer management test for TDD-FDD CA in Rel-12 | 12.14.0 |
| 2016/12 | RP-74 | RP-162404 | 4089 | 1 | F | Introduction of MSD requirement for IMD5 on band3 of CA_3A-8A 2UL CA | 12.14.0 |
| 2016/12 | RP-74 | RP-162406 | 4100 | - | A | Versioning indicator bit for NS_04 A-MPR table | 12.14.0 |
| 2016/12 | RP-74 | RP-162420 | 4109 | - | F | RF: Pb setting in power imbalance TCs (Rel-12) | 12.14.0 |
| 2016/12 | RP-74 | RP-162420 | 4112 | - | F | RF: Correction to RMC for UE Category 1 in CSI tests (Rel-12) | 12.14.0 |
| 2016/12 | RP-74 | RP-162413 | 4116 | - | F | RF: Beamforming model missing in chapter 9 TM9 receiver Type A tests (Rel-12) | 12.14.0 |
| 2016/12 | RP-74 | RP-162459 | 4122 | - | F | RF: Incorrect Number of EREGs per ECCE for special subframe mentioned for TC 8.7.4 (Rel-12) | 12.14.0 |
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