# Foreword

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

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

Version x.y.z

Where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

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

# 2 References

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

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

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

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

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

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

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

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

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

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

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

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

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

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

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

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

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

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

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

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

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

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

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

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

**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.

**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.

## 3.2 Symbols

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

BWChannel Channel bandwidth

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz.

BWGB Virtual guard band to facilitate transmitter (receiver) filtering above / below edge CCs.

 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

 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

FInterferer (offset) Frequency offset of the interferer

FInterferer Frequency of the interferer

FC Frequency of the carrier centre frequency

FC\_low The centre frequency of the *lowest carrier*, expressed in MHz.

FC\_high The centre frequency of the *highest carrier*, expressed in MHz.

FDL\_low The lowest frequency of the downlink operating band

FDL\_high The highest frequency of the downlink operating band

FUL\_low The lowest frequency of the uplink operating band

FUL\_high The highest frequency of the uplink operating band

Fedge\_low The *lower edge* of aggregated channel bandwidth, expressed in MHz.

Fedge\_high The *higher edge* of aggregated channel bandwidth, expressed in MHz.

Foffset Frequency offset from FC\_high to the *higher edge* or FC\_low to the *lower edge.*

Foffset\_NS\_23 Frequency offset in MHz needed if NS\_23 is used

FOOB The boundary between the E-UTRA out of band emission and spurious emission domains.

 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

 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

 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

 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

LCRB Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resource blocks

Ncp Cyclic prefix length

NDL Downlink EARFCN

 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

 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.

 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.

 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

NOffs-DL Offset used for calculating downlink EARFCN

NOffs-UL Offset used for calculating uplink EARFCN

 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

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NRB\_agg The number of the aggregated RBs within the fully allocated Aggregated Channel bandwidth.

NRB\_alloc Total number of simultaneously transmitted resource blocks in Aggregated Channel Bandwidth configuration.

NRB,c The transmission bandwidth configuration of component carrier *c*, expressed in units of resource blocks

NRB,largest BW The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks

NUL Uplink EARFCN

Rav Minimum average throughput per RB

PCMAX The configured maximum UE output power.

PCMAX,*c* The configured maximum UE output power for serving cell *c*.

PEMAX Maximum allowed UE output power signalled by higher layers. Same as IE *P-Max,* defined in [7].

PEMAX,*c* Maximum allowed UE output power signalled by higher layers for serving cell *c*. Same as IE *P-Max,* defined in [7].

PInterferer Modulated mean power of the interferer

PPowerClass PPowerClass is the nominal UE power (i.e., no tolerance).

PUMAX The measured configured maximum UE output power.

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart Indicates the lowest RB index of transmitted resource blocks.

RBend Indicates highest RB index of transmitted resource blocks.

ΔfOOB Δ Frequency of Out Of Band emission.

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*.

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, for serving cell *c*.

TC Allowed operating band edge transmission power relaxation.

TC,c Allowed operating band edge transmission power relaxation for serving cell *c*.

σ Test specific auxiliary variable used for the purpose of downlink power allocation, defined in Annex C.3.2.

## 3.3 Abbreviations

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

ABS Almost Blank Subframe

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

AWGN Additive White Gaussian Noise

BS Base Station

CA Carrier Aggregation

CA\_X CA for band X where X is the applicable E-UTRA operating band

CA\_X-Y CA for band X and Band Y where X and Y are the applicable E-UTRA operating band

CC Component Carriers

CPE Customer Premise Equipment

CPE\_X Customer Premise Equipment for E-UTRA operating band X

CW Continuous Wave

DL Downlink

EARFCN E-UTRA Absolute Radio Frequency Channel Number

EPRE Energy Per Resource Element

E-UTRA Evolved UMTS Terrestrial Radio Access

EUTRAN Evolved UMTS Terrestrial Radio Access Network

EVM Error Vector Magnitude

FDD Frequency Division Duplex

FRC Fixed Reference Channel

HD-FDD Half- Duplex FDD

MCS Modulation and Coding Scheme

MOP Maximum Output Power

MPR Maximum Power Reduction

MSD Maximum Sensitivity Degradation

OCNG OFDMA Channel Noise Generator

OFDMA Orthogonal Frequency Division Multiple Access

OOB Out-of-band

PA Power Amplifier

PCC Primary Component Carrier

P-MPR Power Management Maximum Power Reduction

PSS Primary Synchronization Signal

PSS\_RA PSS-to-RS EPRE ratio for the channel PSS

RE Resource Element

REFSENS Reference Sensitivity power level

r.m.s Root Mean Square

SCC Secondary Component Carrier

SNR Signal-to-Noise Ratio

SSS Secondary Synchronization Signal

SSS\_RA SSS-to-RS EPRE ratio for the channel SSS

TDD Time Division Duplex

UE User Equipment

UL Uplink

UL-MIMO Up Link Multiple Antenna transmission

UMTS Universal Mobile Telecommunications System

UTRA UMTS Terrestrial Radio Access

UTRAN UMTS Terrestrial Radio Access Network

xCH\_RA xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols not containing RS

xCH\_RB xCH-to-RS EPRE ratio for the channel xCH in all transmitted OFDM symbols containing RS

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 36.521-1 Annex F defines Test Tolerances. These Test Tolerances are individually calculated for each test. The Test Tolerances are used to relax the Minimum Requirements in this specification to create Test Requirements.

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

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

## 4.2 Applicability of minimum requirements

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

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

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

d) Note: Receiver sensitivity degradation may occur when:

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

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

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

## 4.3 Void

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

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

a) Suffix A additional requirements need to support CA

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

c) Suffix C additional requirements need to support TBD

d) Suffix D additional requirements need to support TBD

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

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

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

## 4.4 RF requirements in later releases

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

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

# 5 Operating bands and channel arrangement

## 5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

## 5.2 Void

## 5.3 Void

## 5.4 Void

## 5.5 Operating bands

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

Table 5.5-1 E-UTRA operating bands

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | | Uplink (UL) operating band BS receive UE transmit | | | | Downlink (DL) operating band BS transmit  UE receive | | | | Duplex Mode | |
| FUL\_low – FUL\_high | | | | FDL\_low – FDL\_high | | | |
| 1 | | 1920 MHz | – | 1980 MHz | | 2110 MHz | – | 2170 MHz | | FDD | |
| 2 | | 1850 MHz | – | 1910 MHz | | 1930 MHz | – | 1990 MHz | | FDD | |
| 3 | | 1710 MHz | – | 1785 MHz | | 1805 MHz | – | 1880 MHz | | FDD | |
| 4 | | 1710 MHz | – | 1755 MHz | | 2110 MHz | – | 2155 MHz | | FDD | |
| 5 | | 824 MHz | – | 849 MHz | | 869 MHz | – | 894MHz | | FDD | |
| 61 | | 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 | |
| 2417 | | 1626.5 MHz | – | 1660.5 MHz | | 1525 MHz | – | 1559 MHz | | FDD | |
| 25 | | 1850 MHz | – | 1915 MHz | | 1930 MHz | – | 1995 MHz | | FDD | |
| ... | |  |  |  | |  |  |  | |  | |
| 33 | | 1900 MHz | – | 1920 MHz | | 1900 MHz | – | 1920 MHz | | TDD | |
| 34 | | 2010 MHz | – | 2025 MHz | | 2010 MHz | – | 2025 MHz | | TDD | |
| 35 | | 1850 MHz | – | 1910 MHz | | 1850 MHz | – | 1910 MHz | | TDD | |
| 36 | | 1930 MHz | – | 1990 MHz | | 1930 MHz | – | 1990 MHz | | TDD | |
| 37 | | 1910 MHz | – | 1930 MHz | | 1910 MHz | – | 1930 MHz | | TDD | |
| 38 | | 2570 MHz | – | 2620 MHz | | 2570 MHz | – | 2620 MHz | | TDD | |
| 39 | | 1880 MHz | – | 1920 MHz | | 1880 MHz | – | 1920 MHz | | TDD | |
| 40 | | 2300 MHz | – | 2400 MHz | | 2300 MHz | – | 2400 MHz | | TDD | |
| 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 | |
| NOTE 1: Band 6 is not applicable  NOTE 2:Void  NOTE 3:Void  NOTE 4:Void  NOTE 5:Void  NOTE 6:Void  NOTE 7:Void  NOTE 8:Void  NOTE 9:Void  NOTE 10:Void  NOTE 11:Void  NOTE 12:Void  NOTE 13:Void  NOTE 14:Void  NOTE 15:Void  NOTE 16:Void  NOTE 17:DL operation in this band is restricted to 1526 – 1536 MHz and UL operation is restricted to 1627.5 – 1637.5 MHz and 1646.5 – 1656.5 MHz. | | | | | | | | | | | |

## 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 | | | Downlink (DL) operating band | | | Duplex Mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| CA\_1 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| CA\_40 | 40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Band | E-UTRA Band | Uplink (UL) operating band | | | Downlink (DL) operating band | | | Duplex Mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| CA\_1-5 | 1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| 5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz |

## 5.5B Operating bands for UL-MIMO

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

Table 5.5B-1: Void

## 5.6 Channel bandwidth

Requirements in present document are specified for the channel bandwidths listed in Table 5.6-1.

Table 5.6-1: Transmission bandwidth configuration NRB in E-UTRA channel bandwidths

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth BWChannel [MHz] | 1.4 | 3 | 5 | 10 | 15 | 20 |
| Transmission bandwidth configuration NRB | 6 | 15 | 25 | 50 | 75 | 100 |

Figure 5.6-1 shows the relation between the Channel bandwidth (BWChannel) and the Transmission bandwidth configuration (NRB). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at FC +/- BWChannel /2.

Transmission

Center subcarrier (corresponds to DC in baseband) is not transmitted in downlink

Active Resource Blocks





Resource block

Transmission bandwidth configuration [NRB]

bandwidth [RB]

Channel bandwidth [MHz]

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 | Yes1 | Yes1 |
| 3 | Yes | Yes | Yes | Yes | Yes1 | Yes1 |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes1 |  |  |
| 6 |  |  | Yes | Yes1 |  |  |
| 7 |  |  | Yes | Yes | Yes2 | Yes1,2 |
| 8 | Yes | Yes | Yes | Yes1 |  |  |
| 9 |  |  | Yes | Yes | Yes1 | Yes1 |
| 10 |  |  | Yes | Yes | Yes | Yes |
| 11 |  |  | Yes | Yes1 |  |  |
| 12 | Yes | Yes | Yes1 | Yes1 |  |  |
| 13 |  |  | Yes1 | Yes1 |  |  |
| 14 |  |  | Yes1 | Yes1 |  |  |
| ... |  |  |  |  |  |  |
| 17 |  |  | Yes1 | Yes1 |  |  |
| 18 |  |  | Yes | Yes1 | Yes1 |  |
| 19 |  |  | Yes | Yes1 | Yes1 |  |
| 20 |  |  | Yes | Yes1 | Yes1 | Yes1 |
| 21 |  |  | Yes | Yes1 | Yes1 |  |
| 22 |  |  | Yes | Yes | Yes1 | Yes1 |
| 23 | Yes | Yes | Yes | Yes | Yes1 | Yes1 |
| 24 |  |  | Yes | Yes |  |  |
| 25 | Yes | Yes | Yes | Yes | Yes1 | Yes1 |
| ... |  |  |  |  |  |  |
| 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 | Yes2 | Yes2 |
| 39 |  |  | Yes | Yes | Yes | Yes |
| 40 |  |  | Yes | Yes | Yes | Yes |
| 41 |  |  | Yes | Yes | Yes | Yes |
| 42 |  |  | Yes | Yes | Yes | Yes |
| 43 |  |  | Yes | Yes | Yes | Yes |
| NOTE 1: 1 refers to the bandwidth for which a relaxation of the specified UE receiver sensitivity requirement (subclause 7.3) is allowed.  NOTE 2:refersto 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.

**FC,low**

**Lower Edge**

**Higher Edge**

**Lowest Carrier Transmission Bandwidth Configuration,** **NRB,low [RB]**

**FC,high**

**Foffset,low**

**Highest Carrier Transmission Bandwidth Configuration NRB,high [RB]**

**Resource block**

**Aggregated Channel Bandwidth, BWchannel\_CA [MHz]**

**Fedge,low**

**Fedge,high**

**For each carrier, the center sub carrier (corresponds to DC in baseband) is not transmitted in downlink**

**Foffset,high**

**Guard Band**

**Guard Band**

**Aggregated Transmission Bandwidth Configuration, NRB\_agg [RB]**

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

The *aggregated channel bandwidth,* BWChannel\_CA**,** is defined as

BWChannel\_CA = Fedge,high - Fedge,low  [MHz].

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

Fedge,low = FC,low - Foffset,low

Fedge,high = FC,high + Foffset,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

Foffset,low = (0.18NRB,low + f1)/2 + BWGB [MHz]

Foffset,high =( 0.18NRB,hig + f1)h/2 + BWGB [MHz]

wheref1 = f for the downlink with f the subcarrier spacing and f1 = 0 for the uplink, while NRB,low and NRB,high are the transmission bandwidth configurations according to Table 5.6-1 for the lowest and highest assigned component carrier, respectively. BWGB 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 BWChannel\_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).

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 BWGB |
| A | NRB,agg ≤ 100 | 1 | 0.05BWChannel(1) - 0.5f1 |
| B | NRB,agg ≤ 100 | 2 | FFS |
| C | 100 < NRB,agg ≤ 200 | 2 | 0.05 *max*(BWChannel(1),BWChannel(2))- 0.5f1 |
| D | 200 < NRB,agg ≤ 300 | 3 | NOTE 2 |
| E | 300 < NRB,agg ≤ 400 | 4 | NOTE 2 |
| F | 400 < NRB,agg ≤ 500 | 5 | NOTE 2 |
| NOTE 1: BWChannel(1) and BWChannel(2) are channel bandwidths of two E-UTRA component carriers according to Table 5.6-1 and f1 = f for the downlink with f the subcarrier spacing while f1 = 0 for the uplink.  NOTE 2: Applicaple for later releases. | | | |

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

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

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

For each carrier aggregation configuration, requirements are specified for all bandwidth combinations contained in a *bandwidth combination set*, which is indicated per supported band combination in the UE radio access capability. A UE can indicate support of several bandwidth combination sets per band combination. Requirements for intra-band contiguous carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-1. Requirements for inter-band carrier aggregation are defined for the carrier aggregation configurations and bandwidth combination sets specified in Table 5.6A.1-2.

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

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | |
| E-UTRA CA configuration | Uplink CA configurations (NOTE 3) | Component carriers in order of increasing carrier frequency | | Maximum aggregated  bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |
| CA\_1C | CA\_1C | 15 | 15 | 40 | 0 |
| 20 | 20 |
| CA\_40C | CA\_40C | 10 | 20 | 40 | 0 |
| 15 | 15 |
| 20 | 10, 20 |
| NOTE 1: The CA configuration refers to an operating band and a CA bandwidth class specified in Table 5.6A-1 (the indexing letter). Absence of a CA bandwidth class for an operating band implies support of all classes.  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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA configuration / Bandwidth combination set | | | | | | | | | | |
| E-UTRA CA configuration | Uplink CA configurations (NOTE 4) | E-UTRA bands | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_1A-5A | - | 1 |  |  |  | Yes |  |  | 20 | 0 |
| 5 |  |  |  | Yes |  |  |
| 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. | | | | | | | | | | |

## 5.6B Channel bandwidth for UL-MIMO

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

### 5.6B.1 Void

## 5.7 Channel arrangement

### 5.7.1 Channel spacing

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

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2

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

### 5.7.1A Channel spacing for CA

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



where BWChannel(1) and BWChannel(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.

### 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 FDL\_low and NOffs-DL are given in Table 5.7.3-1 and NDL is the downlink EARFCN.

FDL = FDL\_low + 0.1(NDL – NOffs-DL)

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where FUL\_low and NOffs-UL are given in Table 5.7.3-1 and NUL is the uplink EARFCN.

FUL = FUL\_low + 0.1(NUL – NOffs-UL)

Table 5.7.3-1: E-UTRA channel numbers

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Operating  Band | Downlink | | | Uplink | | |
| FDL\_low (MHz) | NOffs-DL | Range of NDL | FUL\_low (MHz) | NOffs-UL | Range of NUL |
| 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 |
| … |  |  |  |  |  |  |
| 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 |
| NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively. | | | | | | |

### 5.7.4 TX–RX frequency separation

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

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

| E-UTRA Operating Band | **TX - RX  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 | -101.51, -120.5 MHz |
| 25 | 80 MHz |
| NOTE 1: Default TX-RX carrier centre frequency separation. | |

b) The use of other TX channel to RX channel carrier centre frequency separation is not precluded and is intended to form part of a later release.

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

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

# 6 Transmitter characteristics

## 6.1 General

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

## 6.2 Transmit power

### 6.2.1 Void

### 6.2.2 UE maximum output power

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non CA configuration and UL-MIMO unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

Table 6.2.2-1: UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EUTRA band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| 1 |  |  |  |  | 23 | ±2 |  |  |
| 2 |  |  |  |  | 23 | ±22 |  |  |
| 3 |  |  |  |  | 23 | ±22 |  |  |
| 4 |  |  |  |  | 23 | ±2 |  |  |
| 5 |  |  |  |  | 23 | ±2 |  |  |
| 6 |  |  |  |  | 23 | ±2 |  |  |
| 7 |  |  |  |  | 23 | ±22 |  |  |
| 8 |  |  |  |  | 23 | ±22 |  |  |
| 9 |  |  |  |  | 23 | ±2 |  |  |
| 10 |  |  |  |  | 23 | ±2 |  |  |
| 11 |  |  |  |  | 23 | ±2 |  |  |
| 12 |  |  |  |  | 23 | ±22 |  |  |
| 13 |  |  |  |  | 23 | ±2 |  |  |
| 14 |  |  |  |  | 23 | ±2 |  |  |
|  |  |  |  |  |  |  |  |  |
| 17 |  |  |  |  | 23 | ±2 |  |  |
| 18 |  |  |  |  | 23 | ±2 |  |  |
| 19 |  |  |  |  | 23 | ±2 |  |  |
| 20 |  |  |  |  | 23 | ±22 |  |  |
| 21 |  |  |  |  | 23 | ±2 |  |  |
| 22 |  |  |  |  | 23 | +2/-3.52 |  |  |
| 23 |  |  |  |  | 235 | ±25 |  |  |
| 24 |  |  |  |  | 23 | +2/-32 |  |  |
| 25 |  |  |  |  | 23 | ±22 |  |  |
| … |  |  |  |  |  |  |  |  |
| 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 | ±22 |  |  |
| 42 |  |  |  |  | 23 | +2/-3 |  |  |
| 43 |  |  |  |  | 23 | +2/-3 |  |  |
| NOTE 1: Void  NOTE 2: 2 refers to the transmission bandwidths (Figure 5.6-1) confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_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: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 5: When NS\_20 is signalled, the total output power within 2000-2005 MHz shall be limited to 7 dBm. | | | | | | | | |

### 6.2.2A UE maximum output power for CA

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

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

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

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

Table 6.2.2A-1: CA UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| CA\_1C |  |  |  |  | 23 | +2/-2 |  |  |
| CA\_40C |  |  |  |  | 23 | +2/-2 |  |  |
| NOTE 1: Void  NOTE 2: If all transmitted resource blocks (Figure 5.6 A -1) over all component carriers are confined within FUL\_low and FUL\_low + 4 MHz or/and FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB  NOTE 3: PPowerClass 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). | | | | | | | | |

### 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/-32 |  |  |
| 3 |  |  |  |  | 23 | +2/-32 |  |  |
| 4 |  |  |  |  | 23 | +2/-3 |  |  |
| 5 |  |  |  |  | 23 | +2/-3 |  |  |
| 6 |  |  |  |  | 23 | +2/-3 |  |  |
| 7 |  |  |  |  | 23 | +2/-32 |  |  |
| 8 |  |  |  |  | 23 | +2/-32 |  |  |
| 9 |  |  |  |  | 23 | +2/-3 |  |  |
| 10 |  |  |  |  | 23 | +2/-3 |  |  |
| 11 |  |  |  |  | 23 | +2/-3 |  |  |
| 12 |  |  |  |  | 23 | +2/-32 |  |  |
| 13 |  |  |  |  | 23 | +2/-3 |  |  |
| 14 |  |  |  |  | 23 | +2/-3 |  |  |
|  |  |  |  |  |  |  |  |  |
| 17 |  |  |  |  | 23 | +2/-3 |  |  |
| 18 |  |  |  |  | 23 | +2/-3 |  |  |
| 19 |  |  |  |  | 23 | +2/-3 |  |  |
| 20 |  |  |  |  | 23 | +2/-32 |  |  |
| 21 |  |  |  |  | 23 | +2/-3 |  |  |
| 22 |  |  |  |  | 23 | +2/-4.52 |  |  |
| … |  |  |  |  |  |  |  |  |
| 23 |  |  |  |  | 23 | +2/-3 |  |  |
| 24 |  |  |  |  | 23 | +2/-42 |  |  |
| 25 |  |  |  |  | 23 | +2/-32 |  |  |
| … |  |  |  |  |  |  |  |  |
| 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/-32 |  |  |
| 42 |  |  |  |  | 23 | +2/-4 |  |  |
| 43 |  |  |  |  | 23 | +2/-4 |  |  |
| NOTE 1: Void  NOTE 2: 2 refers to the transmission bandwidths (Figure 5.6-1) confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_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: PPowerClass 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 3, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2-1due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1.

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Modulation | Channel bandwidth / Transmission bandwidth (NRB) | | | | | | 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 the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5 apply.

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

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

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

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | CA bandwidth Class C | | | MPR (dB) |
| 50 RB + 100 RB | 75 RB + 75 RB | 100 RB + 100 RB |
| QPSK | > 12 and ≤ 50 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 1 |
| QPSK | > 50 | > 75 | > 100 | ≤ 2 |
| 16 QAM | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 |
| 16 QAM | > 12 and ≤ 50 | > 16 and ≤ 75 | > 18 and ≤ 100 | ≤ 2 |
| 16 QAM | > 50 | > 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 {MA, 0.5}

Where MA is defined as follows

MA = 8.2 ; 0 ≤ A < 0.025

9.2 - 40A ; 0.025 ≤ A < 0.05

8 – 16A ; 0.05 ≤ A < 0.25

4.83 – 3.33A ; 0.25 ≤ A ≤ 0.4,

3.83 – 0.83A ; 0.4 ≤ A ≤ 1,

Where

A = NRB\_alloc / NRB\_agg.

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

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

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

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

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

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

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

### 6.2.4 UE maximum output power with additional requirements

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

For UE Power Class 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 6.2.4-6 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 | 41 | 5 | >6 | ≤ 1 |
| 10, 15, 20 | Table 6.2.4-4 | |
| NS\_05 | 6.6.3.3.1 | 1 | 10,15,20 | ≥ 50 | ≤ 1 |
| NS\_06 | 6.6.2.2.3 | 12, 13, 14, 17 | 1.4, 3, 5, 10 | Table 5.6-1 | N/A |
| NS\_07 | 6.6.2.2.3  6.6.3.3.2 | 13 | 10 | Table 6.2.4-2 | Table 6.2.4-2 |
| NS\_08 | 6.6.3.3.3 | 19 | 10, 15 | > 44 | ≤ 3 |
| NS\_09 | 6.6.3.3.4 | 21 | 10, 15 | > 40 | ≤ 1 |
| > 55 | ≤ 2 |
| NS\_10 |  | 20 | 15, 20 | Table 6.2.4-3 | Table 6.2.4-3 |
| NS\_11 | 6.6.2.2.1  6.6.3.3.13 | 23 | 1.4, 3, 5, 10, 15, 20 | Table 6.2.4-5 | Table 6.2.4-5 |
| .. |  |  |  |  |  |
| NS\_20 | 6.2.2  6.6.2.2.1  6.6.3.3.14 | 23 | 5, 10, 15, 20 | Table 6.2.4-6 | Table 6.2.4-6 |
| NS\_22 | 6.6.3.3.15 | 42, 43 | 5, 10, 15, 20 | Table 6.2.4-7 | |
| NS\_23 | 6.6.3.3.16 | 42, 43 | 5, 10, 15, 20 | N/A | |
| .. |  |  |  |  |  |
| NS\_32 | - | - | - | - | - |
| .. |  |  |  |  | |
| NS\_56 | 6.6.3.3.35 | 24 | 5, 10 | Table 6.2.4-34a | |

Table 6.2.4-2: A-MPR for “NS\_07”

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameters** | **Region A** | | **Region B** | | **Region C** |
| RBstart | 0 - 12 | | 13 – 18 | 19 – 42 | 43 – 49 |
| LCRB [RBs] | 6-8 | 1 to 5 and 9-50 | ≥8 | ≥18 | ≤2 |
| A-MPR [dB] | ≤ 8 | ≤ 12 | ≤ 12 | ≤ 6 | ≤ 3 |
| NOTE 1; RBstart indicates the lowest RB index of transmitted resource blocks  NOTE 2; LCRB is the length of a contiguous resource block allocation  NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.  NOTE 4; For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. | | | | | |

Table 6.2.4-3: A-MPR for “NS\_10”

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

**Table 6.2.4-4: A-MPR requirements for "NS\_04" with bandwidth >5MHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth [MHz] | Parameters | Region A | Region B | Region C |
| 10 | RBstart | 0 – 12 | 13 – 36 | 37 – 49 |
| RBstart+ LCRB [RBs] | N/A | >37 | N/A 3 |
| A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |
| 15 | RBstart | 0 – 18 | 19 – 55 | 56 – 74 |
| RBstart+ LCRB [RBs] | N/A | >56 | N/A 3 |
| A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |
| 20 | RBstart | 0 – 24 | 25 – 74 | 75 – 99 |
| RBstart+ LCRB [RBs] | N/A | >75 | N/A 3 |
| A-MPR [dB] | ≤3dB | ≤2dB | ≤3dB |
| NOTE 1: RBstart indicates the lowest RB index of transmitted resource blocks  NOTE 2: LCRB is the length of a contiguous resource block allocation  NOTE 3: 3 refers to any RB allocation that starts in Region A or C is allowed the specified A-MPR  NOTE 4: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis  NOTE 5: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe | | | | |

Table 6.2.4-5: A-MPR for "NS\_11"

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel Bandwidth [MHz] | Parameters | | | | | | | | | | | | | | |
| 3 | Fc (MHz) | <2004 | | | ≥2004 | | | | | | |  | | | |
| LCRB [RBs] | 1-15 | | | >5 | | | | | | |  | | | |
| A-MPR [dB] | ≤5 | | | ≤ 1 | | | | | | |  | | | |
| 5 | Fc [MHz] | <2004 | | | 2004 ≤ Fc <2007 | | | | | | | ≥2007 | | | |
| LCRB [RBs] | 1-25 | | | 1-6 & 15-25 | | | | 8-12 | | | >6 | | | |
| A-MPR [dB] | ≤7 | | | ≤ 4 | | | | 0 | | | ≤ 1 | | | |
| 10 | Fc [MHz] | 2005 ≤ Fc <2015 | | | | | | | 2015 | | | | | | |
| RBstart | 0-49 | | | | | | | 0-49 | | | | | | |
| LCRB [RBs] | 1-50 | | | | | | | 1-50 | | | | | | |
| A-MPR [dB] | ≤ 12 | | | | | | | 0 | | | | | | |
| 15 | Fc [MHz] | <2012.5 | | | | | | | | | | | | | |
| RBstart | 0-4 | 5-21 | | | | | | | | 22-56 | | | | 57-74 |
| LCRB [RBs] | ≥1 | 7-50 | | | 0-6 & ≥50 | | | | | ≤25 | | >25 | | >0 |
| A-MPR [dB] | ≤15 | ≤7 | | | ≤10 | | | | | 0 | | ≤6 | | ≤15 |
| Fc [MHz] | 2012.5 | | | | | | | | | | | | | |
| RBstart | 0-12 | | 13-39 | | | | | | 40-65 | | | | 66-74 | |
| LCRB [RBs] | ≥1 | | ≥30 | | | | <30 | | ≥ (69 – RBstart) | | | | ≥1 | |
| A-MPR [dB] | ≤10 | | ≤6 | | | | 0 | | ≤2 | | | | ≤6.5 | |
| 20 | Fc [MHz] | 2010 | | | | | | | | | | | | | |
| RBstart | 0-12 | 13-29 | | | | | | | 30-68 | | | | | 69-99 |
| LCRB [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\_20"

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel Bandwidth [MHz] | Parameters | | | | | | | | | | | | | | | | | | | |
| 5 | Fc [MHz] | < 2007.5 | | | 2007.5 ≤ Fc < 2012.5 | | | | | | | | | | | | 2012.5 ≤ Fc ≤ 2017.5 | | | |
| RBstart | ≤24 | | | 0-3 | | | | | | | | 4-6 | | | | ≤24 | | | |
| LCRB [RBs] | >0 | | | 15-19 | | | | ≥20 | | | | ≥18 | | | | 1-25 | | | |
| A-MPR [dB] | ≤17 | | | ≤1 | | | | ≤4 | | | | ≤2 | | | | ≤ 0 | | | |
| 10 | Fc [MHz] | 2005 | | | | | | | | | | | | | | | | | | |
| RBstart | 0-25 | | | | | 26-34 | | | | | | | | | 35-49 | | | | |
| LCRB [RBs] | >0 | | | | | 8-15 | | | | | >15 | | | | >0 | | | | |
| A-MPR [dB] | ≤16 | | | | | ≤2 | | | | | ≤5 | | | | ≤ 6 | | | | |
| Fc [MHz] | 2015 | | | | | | | | | | | | | | | | | | |
| RBstart | 0-5 | | | | | | | | | 6-10 | | | | | | | | | |
| LCRB [RBs] | ≥32 | | | | | | | | | ≥40 | | | | | | | | | |
| A-MPR [dB] | ≤4 | | | | | | | | | ≤2 | | | | | | | | | |
| 15 | Fc [MHz] | 2012.5 | | | | | | | | | | | | | | | | | | |
| RBstart | 0-14 | | | | | | 15-24 | | | | | | | | | 25-39 | | 61-74 | |
| LCRB [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 | | | | | | | | | | | | | | | | | | |
| RBstart | 0-21 | 22-31 | | | | | | | 32-38 | | | | | 39-49 | | | 50-68 | | 69-99 |
| LCRB [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 6.2.4-7: 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 | RBstart | 0-13 | 0-17 | ≤ 6 | ≥12 |
| LCRB [RBs] | > 36 | 33-36 | ≤ 32 | ≤ 32 |
| RBstart + LCRB [RBs] | N/A | N/A | N/A | ≥44 |
| A-MPR [dB] | ≤ 4 | ≤ 3 | ≤ 3 | ≤ 3 |
| 15 | RBstart | 0-24 | 0-38 | ≤ 14 | ≥ 23 |
| LCRB [RBs] | > 50 | 37-50 | ≤ 36 | ≤ 36 |
| RBstart + LCRB [RBs] | N/A | N/A | N/A | ≥59 |
| A-MPR [dB] | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 3 |
| 20 | RBstart | 0-35 | 0-51 | ≤ 21 | ≥ 31 |
| LCRB [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; RBstart indicates the lowest RB index of transmitted resource blocks  NOTE 2; LCRB is the length of a contiguous resource block allocation  NOTE 3: For intra-subframe frequency hopping between two regions, notes 1 and 2 apply on a per slot basis.  NOTE 4; For intra-subframe frequency hopping between two regions, the larger A-MPR value of the two regions may be applied for both slots in the subframe. | | | | | |

Table 6.2.4-8: Void

Table 6.2.4-9: Void

Table 6.2.4-10: Void

Table 6.2.4-11: Void

Table 6.2.4-12: Void

Table 6.2.4-13: Void

Table 6.2.4-14: Void

Table 6.2.4-15: Void

Table 6.2.4-16: Void

Table 6.2.4-17: Void

Table 6.2.4-18: Void

Table 6.2.4-18E: Void

Table 6.2.4-19: Void

Table 6.2.4-20: Void

Table 6.2.4-21: Void

Table 6.2.4-22: Void

Table 6.2.4-23: Void

Table 6.2.4-24: Void

Table 6.2.4-25: Void

Table 6.2.4-26: Void

Table 6.2.4-27: Void

Table 6.2.4-28: Void

Table 6.2.4-29: Void

Table 6.2.4-30a: Void

Table 6.2.4-30b: Void

Table 6.2.4-31: Void

Table 6.2.4-32: Void

Table 6.2.4-32a: Void

Table 6.2.4-32b: Void

Table 6.2.4-33: Void

Table 6.2.4-34: Void

Table 6.2.4-34a: A-MPR for "NS\_56"

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth confined to 1627.5- 1637.5MHz | | | | | | | | | | |
| Channel bandwidth | Carrier centre frequency (FC)  (MHz) | Parameters | Region A | Region B | | Region C | Region D | Region E | Region F | Region G |
| 5 MHz | 1630.0, 1630.3 | RBstart | ≤ 8 | ≤ 8 | | N/A | N/A | N/A | N/A | N/A |
| LCRB [RBs] | ≤ 8 | > 8 | | N/A | N/A | N/A | N/A | N/A |
| A-MPR [dB] | 8 | 2 | | N/A | N/A | N/A | N/A | N/A |
| 1635.0 | No A-MPR needed | | | | | | | | |
| 1649.0 |
| 1654.0 |
| 10 MHz | 1632.5 | RBstart | ≤ 5 | ≤ 5 | 6 to18 | ≤ 18 | 35 to 39 | 35 to 39 | ≥ 40 | ≥ 40 |
| LCRB [RBs] | ≤ 5 | 6 to 12 | ≤ 12 | > 12 | ≤ 7 | > 7 | ≤ 7 | > 7 |
| A-MPR [dB] | 7 | 5 | | 7 | 4 | 2 | 5 | 3 |
| 1651.5 | No A-MPR needed | | | | | | | | |
|  | | | | | | | | | | |

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

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

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

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

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

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

For intra-band contiguous aggregation with the UE configured for transmissions on two serving cells, the maximum output power reduction specified in Table 6.2.4A-1 is allowed for all serving cells of the applicable uplink CA configurations according to the CA network signalling value indicated by the field *additionalSpectrumEmissionSCell-r10*. Then clause 6.2.3A does not apply, i.e. the carrier aggregation MPR = 0 dB, unless the value indicated is CA\_NS\_31.

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

|  |  |  |  |
| --- | --- | --- | --- |
| CA Network Signalling value | Requirements  (subclause) | Uplink CA Configuration | A-MPR [dB]  (subclause) |
| CA\_NS\_01 | 6.6.3.3A.1 | CA\_1C | 6.2.4A.1 |
| CA\_NS\_02 | 6.6.3.3A.2 | CA\_1C | 6.2.4A.2 |
| CA\_NS\_03 | 6.6.3.3A.3 | CA\_1C | 6.2.4A.3 |
| … |  |  |  |
| CA\_NS\_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.  NOTE 2: The index of the sequence CA\_NS corresponds to the value of *additionalSpectrumEmissionSCell-r10*. | | | |

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

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

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

#### 6.2.4A.1 A-MPR for CA\_NS\_01 for CA\_1C

If the UE is configured to CA\_1C and it receives IE CA\_NS\_01 the allowed maximum output power reduction applied to transmissions on the PCC and the SCC for contiguously aggregated signals is specified in table 6.2.4A.1-1.

Table 6.2.4A.1-1: Contiguous allocation A-MPR for CA\_NS\_01

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CA\_1C: CA\_NS\_01 | RBstart | LCRB [RBs] | RBstart +  LCRB [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 < LCRB  ≤ 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: RBstart indicates the lowest RB index of transmitted resource blocks  NOTE 2: LCRB 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

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = -22.5 A + 17 ; 0 ≤ A < 0.20

-11.0 A + 14.7 ; 0.20 ≤ A < 0.70

-1.7 A + 8.2 ; 0.70 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_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 | RBend | LCRB [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 | > RBend – 20 | ≤ 3 dB |
| 100 - 184 | >75 | ≤ 6 dB |
| 185 – 199 | > 0 | ≤ 10 dB |
| 75 RB / 75 RB | 0 - 48 | > 0 | ≤ 2 dB |
| 49 – 80 | > RBend - 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:

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = -22.5 A + 17 ; 0 ≤ A < 0.20

-11.0 A + 14.7 ; 0.20 ≤ A < 0.70

-1.7 A + 8.2 ; 0.70 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_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 | RBend | LCRB [RBs] | A-MPR for QPSK and 16-QAM [dB] |
| 100 RB / 100 RB | 0 - 26 | > 0 | ≤ 10 dB |
| 27 - 63 | ≥ RBend - 27 | ≤ 6 dB |
| 27 - 63 | < RBend - 27 | ≤ 1 dB |
| 64 – 100 | > RBend – 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 | > RBend – 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-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = -23.33A + 17.5 ; 0 ≤ A < 0.15

-7.65A + 15.15 ; 0.15 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_agg.

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

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

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

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

### 6.2.5 Configured transmitted power

The UE is allowed to set its configured maximum output power PCMAX,*c* for serving cell *c*. The configured maximum output power PCMAX,*c* is set within the following bounds:

PCMAX\_L *c* ≤ PCMAX *c* ≤ PCMAX\_H *c*

with

PCMAX\_L,*c* = MIN {PEMAX,*c*– TC,*c*, PPowerClass – MAX(MPR,*c* + A-MPR,*c* + ΔTIB,c + TC,*c*, P-MPR,*c*)}

PCMAX\_H,*c* = MIN {PEMAX,*c*, PPowerClass}

where

- PEMAX,*c* is the value given by IE *P-Max* for serving cell *c,* defined in [7];

- PPowerClass is the maximum UE power specified in Table 6.2.2-1 without taking into account the tolerance specified in the Table 6.2.2-1.

- MPR*c* and A-MPR*c* for serving cell *c* are specified in subclause 6.2.3 and subclause 6.2.4, respectively;

- TIB,c is the additional tolerance for serving cell *c* as specified in Table 6.2.5-2; TIB,c = 0 dB otherwise;

- TC,*c* = 1.5 dB when Note 2 in Table 6.2.2-1 applies;

- TC,*c* = 0 dB when Note 2 in Table 6.2.2-1 does not apply.

P-MPR*c* is the allowed maximum output power reduction for

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

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

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

NOTE 1: P-MPR*c* was introduced in the PCMAX*c* equation such that the UE can report to the eNB the available maximum output transmit power. This information can be used by the eNB for scheduling decisions.

NOTE 2: P-MPR*c* may impact the maximum uplink performance for the selected UL transmission path.

For each subframe, the PCMAX\_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 PCMAX\_ L,*c* over the two slots is then applied for the entire subframe. PPowerClass shall not be exceeded by the UE during any period of time.

The measured configured maximum output power PUMAX,*c* shall be within the following bounds:

PCMAX\_L,*c*– MAX{TL,*c*, T(PCMAX\_L,*c*)} ≤ PUMAX,*c* ≤ PCMAX\_H,*c*+ T(PCMAX\_H,*c*)

where the tolerance T(PCMAX,*c*) for applicable values of PCMAX,*c* is specified in Table 6.2.5-1. The tolerance TL,*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: PCMAX,*c* tolerance

|  |  |
| --- | --- |
| PCMAX,*c* (dBm) | Tolerance T(PCMAX,*c*) (dB) |
| 21 ≤ PCMAX,*c* ≤ 23 | 2.0 |
| 20 ≤ PCMAX,*c* < 21 | 2.5 |
| 19 ≤ PCMAX,*c* < 20 | 3.5 |
| 18 ≤ PCMAX,*c* < 19 | 4.0 |
| 13 ≤ PCMAX,*c* < 18 | 5.0 |
| 8 ≤ PCMAX,*c* < 13 | 6.0 |
| -40 ≤ PCMAX,*c* < 8 | 7.0 |

For the UE which supports inter-band carrier aggregation configurations with the uplink assigned to one E-UTRA band the ΔTIB,c is defined for applicable bands in Table 6.2.5-2.

**Table 6.2.5-2: ΔTIB,c**

| **Inter-band CA Configuration** | **E-UTRA Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_1A-5A | 1 | 0.3 |
| 5 | 0.3 |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations  NOTE 2: The above additional tolerances also apply in non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations  NOTE 3: In case the UE supports more than one of the above inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one inter-band carrier aggregation configurations then:  - When the E-UTRA operating band frequency range is ≤ 1GHz, the applicable additional tolerance shall be the average of the tolerances in Table 6.2.5A-3, truncated to one decimal place for that operating band among the supported CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported carrier aggregation configurations involving such band shall be applied  - When the E-UTRA operating band frequency range is >1GHz, the applicable additional tolerance shall be the maximum tolerance in Table 6.2.5A-3 that applies for that operating band among the supported CA configurations | | |

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

### 6.2.5A Configured transmitted power for CA

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

The configured maximum output power PCMAX,*c* on serving cell *c* shall be set as specified in subclause 6.2.5.

For uplink intra-band contiguous carrier aggregation, MPR*c* = MPR and A-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-MPR*c* = P-MPR. PCMAX,*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 PCMAX shall be set within the following bounds:

PCMAX\_L ≤ PCMAX  ≤ PCMAX\_H

For uplink intra-band contiguous carrier aggregation,

PCMAX\_L  = MIN{10 log10 ∑ pEMAX,c  - TC , PPowerClass – MAX(MPR + A-MPR + ΔTIB,c + TC, P-MPR) }

PCMAX\_H  = MIN{10 log10 ∑ pEMAX,c , PPowerClass}

where

- pEMAX,c is the linear value of PEMAX, *c* which is given by IE *P-Max* for serving cell *c* in [7];

- PPowerClass 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;

- TIB,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;

- TC is the highest value TC,c among all serving cells *c* in the subframe over both timeslots. TC,c = 1.5 dB when Note 2 in Table 6.2.2A-1 applies to the serving cell *c*, otherwise TC,c = 0 dB*.*

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

In case PC2 and uplink intra-band contiguous CA capable UE receives pEMAX,c in Scell then that applies both to Scell and Pcell once the Scell is activated.

The measured maximum output power PUMAX over all serving cells shall be within the following range:

PCMAX\_L – MAX{TL, TLOW(PCMAX\_L)} ≤ PUMAX  ≤ PCMAX\_H + THIGH(PCMAX\_H)

PUMAX = 10 log10 ∑ pUMAX,c

where pUMAX,c  denotes the measured maximum output power for serving cell *c* expressed in linear scale. The tolerances TLOW(PCMAX) and THIGH(PCMAX) for applicable values of PCMAX are specified in Table 6.2.5A-2 for intra-band carrier aggregation. The tolerance TL is the absolute value of the lower tolerance for applicable E-UTRA CA configurations as specified in Table 6.2.2A-1 for intra-band contiguous carrier aggregation.

Table 6.2.5A-2: PCMAX tolerance for dual uplink intra-band contiguous CA

|  |  |  |
| --- | --- | --- |
| PCMAX (dBm) | Tolerance  TLOW(PCMAX)  (dB) | Tolerance  THIGH(PCMAX)  (dB) |
| 21 ≤ PCMAX ≤ 23 | 2.0 | |
| 20 ≤ PCMAX < 21 | 2.5 | |
| 19 ≤ PCMAX < 20 | 3.5 | |
| 18 ≤ PCMAX < 19 | 4.0 | |
| 13 ≤ PCMAX < 18 | 5.0 | |
| 8 ≤ PCMAX < 13 | 6.0 | |
| -40 ≤ PCMAX < 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 PCMAX,*c*, the lower bound PCMAX\_L,*c*, and the higher bound PCMAX\_H,*c* specified in subclause 6.2.5 shall apply to UE supporting UL-MIMO, where

- PPowerClass and TC,*c* are specified in subclause 6.2.2B;

- MPR,*c* is specified in subclause 6.2.3B;

- A-MPR,*c* is specified in subclause 6.2.4B.

The measured configured maximum output power PUMAX,*c* for serving cell *c* shall be within the following bounds:

PCMAX\_L,*c*– MAX{TL, T LOW(PCMAX\_L,*c*)} ≤ PUMAX,*c* ≤ PCMAX\_H,*c*+ T HIGH(PCMAX\_H,*c*)

where TLOW(PCMAX\_L,*c*) and THIGH(PCMAX\_H,*c*) are defined as the tolerance and applies to PCMAX\_L,*c* and PCMAX\_H,*c* separately, while TL 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: PCMAX,*c* tolerance in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| PCMAX,*c* (dBm) | Tolerance  TLOW(PCMAX\_L,*c*) (dB) | Tolerance  THIGH(PCMAX\_H,*c*) (dB) |
| PCMAX**,*c*** = 23 | 3.0 | 2.0 |
| 22 ≤ PCMAX**,*c*** < 23 | 5.0 | 2.0 |
| 21 ≤ PCMAX**,*c*** < 22 | 5.0 | 3.0 |
| 20 ≤ PCMAX**,*c*** < 21 | 6.0 | 4.0 |
| 16 ≤ PCMAX**,*c*** < 20 | 5.0 | |
| 11 ≤ PCMAX**,*c*** < 16 | 6.0 | |
| -40 ≤ PCMAX**,*c*** < 11 | 7.0 | |

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

## 6.3 Output power dynamics

### 6.3.1 (Void)

### 6.3.2 Minimum output power

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

#### 6.3.2.1 Minimum requirement

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

Table 6.3.2.1-1: Minimum output power

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

### 6.3.2A UE Minimum output power for CA

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

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

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

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

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

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

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

#### 6.3.2B.1 Minimum requirement

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

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

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

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

### 6.3.3 Transmit OFF power

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

#### 6.3.3.1. Minimum requirement

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

Table 6.3.3.1-1: Transmit OFF power

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

### 6.3.3A UE Transmit OFF power for CA

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

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

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

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

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

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

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

#### 6.3.3B.1 Minimum requirement

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

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

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

### 6.3.4 ON/OFF time mask

#### 6.3.4.1 General ON/OFF time mask

The General ON/OFF time mask defines the observation period between Transmit OFF and ON power and between Transmit ON and OFF power. ON/OFF scenarios include; the beginning or end of DTX, measurement gap, contiguous, and non contiguous transmission

The OFF power measurement period is defined in a duration of at least one sub-frame excluding any transient periods. The ON power is defined as the mean power over one sub-frame excluding any transient period.

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



Figure 6.3.4.1-1: General ON/OFF time mask

#### 6.3.4.2 PRACH and SRS time mask

##### 6.3.4.2.1 PRACH time mask

The PRACH ON power is specified as the mean power over the PRACH measurement period excluding any transient periods as shown in Figure 6.3.4.2-1. The measurement period for different PRACH preamble format is specified in Table 6.3.4.2-1.

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

Table 6.3.4.2-1: PRACH ON power measurement period

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



Figure 6.3.4.2-1: PRACH ON/OFF time mask

##### 6.3.4.2.2 SRS time mask

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

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

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



Figure 6.3.4.2.2-1: Single SRS time mask



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

#### 6.3.4.3 Slot / Sub frame boundary time mask

The sub frame boundary time mask defines the observation period between the previous/subsequent sub–frame and the (reference) sub-frame. A transient period at a slot boundary within a sub-frame is only allowed in the case of Intra-sub frame frequency hopping. For the cases when the subframe contains SRS the time masks in subclause 6.3.4.4 apply.

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



Figure 6.3.4.3-1: Transmission power template

#### 6.3.4.4 PUCCH / PUSCH / SRS time mask

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

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



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



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



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



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

### 6.3.4A ON/OFF time mask for CA

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

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

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

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

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

### 6.3.5 Power Control

#### 6.3.5.1 Absolute power tolerance

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

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

##### 6.3.5.1.1 Minimum requirements

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

For operating bands under Note 2 in Table 6.2.2-1, the absolute power tolerance as specified in Table 6.3.5.1.1-1 is relaxed by reducing the lower limit by 1.5 dB when the transmission bandwidth is confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_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 P (Up or down)  [dB] | All combinations of PUSCH and PUCCH transitions [dB] | All combinations of PUSCH/PUCCH and SRS transitions between sub-frames [dB] | PRACH [dB] |
| ΔP < 2 | ±2.5 (Note 3) | ±3.0 | ±2.5 |
| 2 ≤ ΔP < 3 | ±3.0 | ±4.0 | ±3.0 |
| 3 ≤ ΔP < 4 | ±3.5 | ±5.0 | ±3.5 |
| 4 ≤ ΔP ≤ 10 | ±4.0 | ±6.0 | ±4.0 |
| 10 ≤ ΔP < 15 | ±5.0 | ±8.0 | ±5.0 |
| 15 ≤ ΔP | ±6.0 | ±9.0 | ±6.0 |
| NOTE 1: For extreme conditions an additional ± 2.0 dB relaxation is allowed  NOTE 2: For operating bands under Note 2 in Table 6.2.2-1, the relative power tolerance is relaxed by increasing the upper limit by 1.5 dB if the transmission bandwidth of the reference sub-frames is confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_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 FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high and the reference sub-frame is not confined within any one of these frequency ranges, then the tolerance is relaxed by reducing the lower limit by 1.5 dB.  NOTE 3: For PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods for TDD: for a power step ΔP ≤ 1 dB, the relative power tolerance for transmission is ±1.0 dB. | | | |

The power step (ΔP) is defined as the difference in the calculated setting of the UE Transmit power between the target and reference sub-frames with the power setting according to subclause 5.1 of [TS 36.213]. The error is the difference between ΔP and the power change measured at the UE antenna port with the power of the cell-specific reference signals kept constant. The error shall be less than the relative power tolerance specified in Table 6.3.5.2.1-1.

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

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

#### 6.3.5.3 Aggregate power control tolerance

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

##### 6.3.5.3.1 Minimum requirement

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

Table 6.3.5.3.1-1: Aggregate power control tolerance

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Aggregate power tolerance within 21 ms |
| 0 dB | PUCCH | ±2.5 dB |
| 0 dB | PUSCH | ±3.5 dB |
| NOTE: The UE transmission gap is 4 ms. TPC command is transmitted via PDCCH 4 subframes preceding each PUCCH/PUSCH transmission. | | |

### 6.3.5A Power control for CA

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

#### 6.3.5A.1 Absolute power tolerance

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

##### 6.3.5A.1.1 Minimum requirements

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

#### 6.3.5A.2 Relative power tolerance

##### 6.3.5A.2.1 Minimum requirements

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

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

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

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

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

For a) and b) above, the power step P 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 PUMAX,c as defined in subclause 6.2.5. For these exceptions the power tolerance limit is ±6.0 dB in Table 6.3.5.2.1-1.

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

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

##### 6.3.5A.3.1 Minimum requirements

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

### 6.3.5B Power control for UL-MIMO

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

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

- The Maximum output power requirements for UL-MIMO are specified in subclause 6.2.2B

- The Minimum output power requirements for UL-MIMO are specified in subclause 6.3.2B

- The requirements for configured transmitted power for UL-MIMO are specified in subclause 6.2.5B.

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

## 6.4 Void

## 6.5 Transmit signal quality

### 6.5.1 Frequency error

The UE modulated carrier frequency shall be accurate to within ±0.1 PPM observed over a period of one time slot (0.5 ms) compared to the carrier frequency received from the E-UTRA Node B

### 6.5.1A Frequency error for CA

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

### 6.5.1B Frequency error for UL-MIMO

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

### 6.5.2 Transmit modulation quality

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the UE. The transmit modulation quality is specified in terms of:

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

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage

- In-band emissions for the non-allocated RB

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

#### 6.5.2.1 Error Vector Magnitude

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

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

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH and is one slot for the PUCCH and PUSCH in the time domain.. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the EVM measurement interval is reduced by one symbol, accordingly. The PUSCH or PUCCH EVM measurement interval is also reduced when the mean power, modulation or allocation between slots is expected to change. In the case of PUSCH transmission, the measurement interval is reduced by a time interval equal to the sum of 5 μs and the applicable exclusion period defined in subclause 6.3.4, adjacent to the boundary where the power change is expected to occur. The PUSCH exclusion period is applied to the signal obtained after the front-end IDFT. In the case of PUCCH transmission with power change, the PUCCH EVM measurement interval is reduced by one symbol adjacent to the boundary where the power change is expected to occur.

##### 6.5.2.1.1 Minimum requirement

The RMS average of the basic EVM measurements for 10 sub-frames excluding any transient period for the average EVM case, and 60 sub-frames excluding any transient period for the reference signal EVM case, for the different modulations schemes shall not exceed the values specified in Table 6.5.2.1.1-1 for the parameters defined in Table 6.5.2.1.1-2. For EVM evaluation purposes, [all PRACH preamble formats 0-4 and] all PUCCH formats 1, 1a, 1b, 2, 2a and 2b are considered to have the same EVM requirement as QPSK modulated.

Table 6.5.2.1.1-1: Minimum requirements for Error Vector Magnitude

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

Table 6.5.2.1.1-2: Parameters for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| UE Output Power | dBm | ≥ -40 |
| Operating conditions |  | Normal conditions |

#### 6.5.2.2 Carrier leakage

Carrier leakage is an additive sinusoid waveform that has the same frequency as amodulated waveform carrier frequency. The measurement interval is one slot in the time domain.

##### 6.5.2.2.1 Minimum requirements

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

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

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

#### 6.5.2.3 In-band emissions

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

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

##### 6.5.2.3.1 Minimum requirements

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

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (Note 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (Note 2) |
| IQ Image | dB | -25 | | Image frequencies (Notes 2, 3) |
| Carrier leakage | dBc | -25 | Output power > 0 dBm | Carrier frequency (Notes 4, 5) |
| -20 | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* 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  is odd, or in the two RBs immediately adjacent to the DC frequency if  is even, but excluding any allocated RB.  NOTE 6: is the Transmission Bandwidth (see Figure 5.6-1).  NOTE 7:  is the Transmission Bandwidth Configuration (see Figure 5.6-1).  NOTE 8:  is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  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] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_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] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1 | |



**f**

**FUL\_High**

**FUL\_High – 3(5) MHz**

**< 4(4) dBp-p**

**Range 1**

**Range 2**

**max(Range 1)-min(Range 2) < 5(6) dB**

**max(Range 2)-min(Range 1) < 7(10) dB**

**< 8(12) dBp-p**

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

### 6.5.2A Transmit modulation quality for CA

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

#### 6.5.2A.1 Error Vector Magnitude

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

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

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

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

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

#### 6.5.2A.2 Carrier leakage for CA

Carrier leakage is an additive sinusoid waveform that is confined within the 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  at the edge of the aggregated transmission bandwidth configuration.

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

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Limit | | Applicable Frequencies |
| General | dB |  | | 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 *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* 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 +1 RBs within a contiguous width of  +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: is the Transmission Bandwidth (see Figure 5.6-1) not exceeding  NOTE 6:  is the Transmission Bandwidth Configuration (see Figure 5.6-1) of the component carrier with RBs allocated.  NOTE 7:  is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.  NOTE 8:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth).  NOTE 9:  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 (non-allocated component carrier)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Para-meter | Unit | Meas BW  Note 1 | Limit | | remark | Applicable Frequencies |
| General | dB | BW of 1 RB (180KHz rectangular) |  | | The reference value is the average power per allocated RB in the allocated component carrier | Any RB in the non allocated component carrier.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| IQ Image | dB | BW of 1 RB (180KHz rectangular) | -25  Note 2 | | The reference value is the average power per allocated RB in the allocated component carrier | The frequencies of thecontiguous non-allocated RBs are unknown.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| Carrier leakage | dBc | BW of 1 RB (180KHz rectangular) | Note 3 | | The reference value is the total power of the allocated RBs in the allocated component carrier | The frequencies of the up to 2 non-allocated RBs are unknown.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| -25 | Output power > 0 dBm |
| -20 | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 | -40 dBm ≤ Output power < -30 dBm |
| NOTE1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.  NOTE 2: Exceptions to the general limit are allowed for up to  +1 RBs within a contiguous width of  +1 non-allocated RBs.  NOTE 3: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs  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.  NOTE 5:  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. | | | | | | |

### 6.5.2B Transmit modulation quality for UL-MIMO

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

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

The transmit modulation quality is specified in terms of:

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

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage (caused by IQ offset)

- In-band emissions for the non-allocated RB

#### 6.5.2B.1 Error Vector Magnitude

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

#### 6.5.2B.2 Carrier leakage

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

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

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

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

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

## 6.6 Output RF spectrum emissions

The output UE transmitter spectrum consists of the three components; the emission within the occupied bandwidth (channel bandwidth), the Out Of Band (OOB) emissions and the far out spurious emission domain.

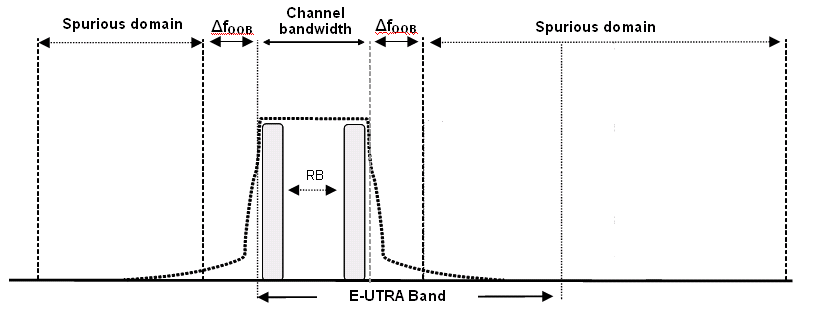


Figure 6.6-1: Transmitter RF spectrum

### 6.6.1 Occupied bandwidth

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.6.1-1

Table 6.6.1-1: Occupied channel bandwidth

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

### 6.6.1A Occupied bandwidth for CA

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

### 6.6.1B Occupied bandwidth for UL-MIMO

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

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

Table 6.6.1B-1: Occupied channel bandwidth

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

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

### 6.6.2 Out of band emission

The Out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an Adjacent Channel Leakage power Ratio.

#### 6.6.2.1 Spectrum emission mask

The spectrum emission mask of the UE applies to frequencies (ΔfOOB) starting from the ± edge of the assigned E-UTRA channel bandwidth. For frequencies greater than (ΔfOOB) 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** | | | | | | | |
| **ΔfOOB**  **(MHz)** | **1.4**  **MHz** | **3.0**  **MHz** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **Measurement bandwidth** |
| ± 0-1 | -10 | -13 | -15 | -18 | -20 | -21 | 30 kHz |
| ± 1-2.5 | -10 | -10 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 2.5-2.8 | -25 | -10 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 2.8-5 |  | -10 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 5-6 |  | -25 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 6-10 |  |  | -25 | -13 | -13 | -13 | 1 MHz |
| ± 10-15 |  |  |  | -25 | -13 | -13 | 1 MHz |
| ± 15-20 |  |  |  |  | -25 | -13 | 1 MHz |
| ± 20-25 |  |  |  |  |  | -25 | 1 MHz |

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

#### 6.6.2.1A Spectrum emission mask for CA

For intra-band contiguous carrier aggregation the spectrum emission mask of the UE applies to frequencies (ΔfOOB) 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]/BWChannel\_CA | | | | |
| ΔfOOB  (MHz) | 50RB+100RB  (29.9 MHz) | 75RB+75RB  (30 MHz) | 100RB+100RB  (39.8 MHz) | Measurement bandwidth |
| ± 0-1 | -22.5 | -22.5 | -24 | 30 kHz |
| ± 1-5 | -10 | -10 | -10 | 1 MHz |
| ± 5-29.9 | -13 | -13 | -13 | 1 MHz |
| ± 29.9-30 | -25 | -13 | -13 | 1 MHz |
| ± 30-34.9 | -25 | -25 | -13 | 1 MHz |
| ± 34.9-35 |  | -25 | -13 | 1 MHz |
| ± 35-39.8 |  |  | -13 | 1 MHz |
| ± 39.8-44.8 |  |  | -25 | 1 MHz |

#### 6.6.2.2 Additional spectrum emission mask

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

##### 6.6.2.2.1 Minimum requirement (network signalled value "NS\_03", “NS\_11”, and “NS\_20”)

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

When "NS\_03", "NS\_11" or "NS\_20" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.1-1.

Table 6.6.2.2.1-1: Additional requirements

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

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

##### 6.6.2.2.3 Minimum requirement (network signalled value "NS\_06" or “NS\_07”)

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

When "NS\_06" or “NS\_07” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.3-1.

Table 6.6.2.2.3-1: Additional requirements

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Spectrum emission limit (dBm)/ Channel bandwidth | | | | |
| ΔfOOB  (MHz) | 1.4  MHz | 3.0  MHz | 5  MHz | 10  MHz | Measurement bandwidth |
| ± 0-0.1 | -13 | -13 | -15 | -18 | 30 kHz |
| ± 0.1-1 | -13 | -13 | -13 | -13 | 100 kHz |
| ± 1-2.5 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 2.5-2.8 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 2.8-5 |  | -13 | -13 | -13 | 1 MHz |
| ± 5-6 |  | -25 | -13 | -13 | 1 MHz |
| ± 6-10 |  |  | -25 | -13 | 1 MHz |
| ± 10-15 |  |  |  | -25 | 1 MHz |

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

#### 6.6.2.3 Adjacent Channel Leakage Ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. ACLR requirements for one E-UTRA carrier are specified for two scenarios for an adjacent E-UTRA and /or UTRAchannel 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-UTRAACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned E-UTRA channel power and adjacent E-UTRA channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.6.2.3.1-1. If the measured adjacent channel power is greater than –50dBm then the E-UTRAACLR shall be higher than the value specified in Table 6.6.2.3.1-1.

Table 6.6.2.3.1-1: General requirements for E-UTRAACLR

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Channel bandwidth / E-UTRAACLR1 / Measurement bandwidth** | | | | | |
| **1.4**  **MHz** | **3.0**  **MHz** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** |
| E-UTRAACLR1 | 30 dB | 30 dB | 30 dB | 30 dB | 30 dB | 30 dB |
| E-UTRA channel Measurement bandwidth | 1.08 MHz | 2.7 MHz | 4.5 MHz | 9.0 MHz | 13.5 MHz | 18 MHz |
| Adjacent channel centre frequency offset [MHz] | +1.4  /  -1.4 | +3.0  /  -3.0 | +5  /  -5 | +10  /  -10 | +15  /  -15 | +20  /  -20 |

##### 6.6.2.3.1A Void

##### 6.6.2.3.2 Minimum requirements UTRA

UTRA Adjacent Channel Leakage power Ratio (UTRAACLR) 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 (UTRAACLR1) and the 2nd UTRA adjacent channel (UTRAACLR2). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor =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 UTRAACLR shall be higher than the value specified in Table 6.6.2.3.2-1.

Table 6.6.2.3.2-1: Requirements for UTRAACLR1/2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / UTRAACLR1/2  / Measurement bandwidth | | | | | |
| **1.4**  **MHz** | **3.0**  **MHz** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** |
| UTRAACLR1 | 33 dB | 33 dB | 33 dB | 33 dB | 33 dB | 33 dB |
| Adjacent channel centre frequency offset [MHz] | 0.7+BWUTRA/2  /  -0.7-BWUTRA/2 | 1.5+BWUTRA/2  /  -1.5-BWUTRA/2 | +2.5+BWUTRA/2  /  -2.5-BWUTRA/2 | +5+BWUTRA/2  /  -5-BWUTRA/2 | +7.5+BWUTRA/2  /  -7.5-BWUTRA/2 | +10+BWUTRA/2  /  -10-BWUTRA/2 |
| UTRAACLR2 | - | - | 36 dB | 36 dB | 36 dB | 36 dB |
| Adjacent channel centre frequency offset [MHz] | - | - | +2.5+3\*BWUTRA/2  /  -2.5-3\*BWUTRA/2 | +5+3\*BWUTRA/2  /  -5-3\*BWUTRA/2 | +7.5+3\*BWUTRA/2  /  -7.5-3\*BWUTRA/2 | +10+3\*BWUTRA/2  /  -10-3\*BWUTRA/2 |
| E-UTRAchannel 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.  NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | | | | | | |

##### 6.6.2.3.2A Minimum requirement UTRA for CA

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

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA adjacent channel (UTRAACLR1) and the 2nd UTRA adjacent channel (UTRAACLR2). The UTRA channel power is measured with a RRC bandwidth filter with roll-off factor =0.22. The assigned aggregated channel bandwidth power is measured with a rectangular filter with measurement bandwidth specified in Table 6.6.2.3.2A-1. If the measured UTRA channel power is greater than –50dBm then the UTRAACLR shall be higher than the value specified in Table 6.6.2.3.2A-1.

Table 6.6.2.3.2A-1: Requirements for UTRAACLR1/2

|  |  |
| --- | --- |
|  | CA bandwidth class / UTRAACLR1/2 / measurement bandwidth |
| CA bandwidth class C |
| UTRAACLR1 | 33 dB |
| Adjacent channel centre frequency offset (in MHz) | + BWChannel\_CA /2 + BWUTRA/2  /  - BWChannel\_CA / 2 - BWUTRA/2 |
| UTRAACLR2 | 36 dB |
| Adjacent channel centre frequency offset (in MHz) | + BWChannel\_CA /2 + 3\*BWUTRA/2  /  - BWChannel\_CA /2 – 3\*BWUTRA/2 |
| CA E-UTRAchannel Measurement bandwidth | BWChannel\_CA - 2\* BWGB |
| UTRA 5MHz channel Measurement bandwidth (Note 1) | 3.84 MHz |
| UTRA 1.6MHz channel measurement bandwidth (Note 2) | 1.28 MHz |
| NOTE 1: Applicable for E-UTRA FDD co-existence with UTRA FDD in paired spectrum.  NOTE 2: Applicable for E-UTRA TDD co-existence with UTRA TDD in unpaired spectrum. | |

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

For intra-band contiguous carrier aggregation the carrier aggregation E-UTRA Adjacent Channel Leakage power Ratio (CA E-UTRAACLR) 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-UTRAACLR 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-UTRAACLR

|  |  |
| --- | --- |
|  | CA bandwidth class / CA E-UTRAACLR / Measurement bandwidth |
| CA bandwidth class C |
| CA E-UTRAACLR | 30 dB |
| CA E-UTRAchannel Measurement bandwidth | BWChannel\_CA - 2\* BWGB |
| Adjacent channel centre frequency offset (in MHz) | + BWChannel\_CA  /  - BWChannel\_CA |

#### 6.6.2.4 Void

##### 6.6.2.4.1 Void

### 6.6.2A Void

<reserved for future use>

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

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

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

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.6.2 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 FOOB (MHz) | 2.8 | 6 | 10 | 15 | 20 | 25 |

Table 6.6.3.1-2: Spurious emissions limits

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency Range** | **Maximum Level** | **Measurement bandwidth** | **Note** |
| 9 kHz ≤ f < 150 kHz | -36 dBm | 1 kHz |  |
| 150 kHz ≤ f < 30 MHz | -36 dBm | 10 kHz |  |
| 30 MHz ≤ f < 1000 MHz | -36 dBm | 100 kHz |  |
| 1 GHz ≤ f < 12.75 GHz | -30 dBm | 1 MHz |  |
| 12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz | -30 dBm | 1 MHz | 1 |
| NOTE 1: Applies for Band 22, Band 42 and Band 43 | | | |

#### 6.6.3.1A Minimum requirements for CA

This clause specifies the spurious emission requirements for carrier aggregation.

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

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

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

|  |  |
| --- | --- |
| CA Bandwidth Class | OOB boundary FOOB  (MHz) |
| A | Table 6.6.3.1-1 |
| B | FFS |
| C | BWChannel\_CA + 5 |

#### 6.6.3.2 Spurious emission band UE co-existence

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

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

Table 6.6.3.2-1: Requirements

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | Note |
| 1 | E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 38, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 34 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 15,19 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 15,19,20 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 15,19,20 |
| 2 | E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 23, 24, 41, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 3 | E-UTRA Band 1, 7, 8, 11, 18, 19, 20, 21, 33, 34, 38, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 22, 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 |  |
| 4 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 41, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 5 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 6 | E-UTRA Band 1, 9, 11, 34 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 860 | - | 875 | -37 | 1 |  |
| Frequency range | 875 | - | 895 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1919.6 | -41 | 0.3 | 7 |
| 1884.5 | - | 1915.7 | 8 |
| 7 | E-UTRA Band 1, 3, 7, 8, 20, 22, 33, 34, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 15, 16, 20 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 15, 16, 20 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 15, 16 |
| 8 | E-UTRA Band 1, 20, 33, 34, 38, 39, 40 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA band 7 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 8 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 22, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 18 |
| Frequency range | 860 |  | 890 | -40 | 1 | 15, 18 |
| Frequency range | 1884.5 |  | 1915.7 | -41 | 0.3 | 8, 18 |
| 9 | E-UTRA Band 1, 3, 11, 18, 19, 21, 34 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| 10 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 41, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 22, 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 11 | E-UTRA Band 1, 3, 11, 18, 19, 21, 34, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| 12 | E-UTRA Band 2, 5, 13, 14, 17, 23, 24, 25, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 12 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| 13 | E-UTRA Band 2, 4, 5, 10, 12, 13, 17, 23, 25, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 769 | - | 775 | -35 | 0.00625 | 15 |
| Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 15 |
| E-UTRA Band 14 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 24 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 14 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 41 | FDL\_low | - | FDL\_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, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 12 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| 18 | E-UTRA Band 1, 3, 11, 21, 34, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 860 | - | 890 | -40 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| 19 | E-UTRA Band 1, 3, 11, 21, 34, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| 20 | E-UTRA Band 1, 3, 7, 8, 20, 22, 33, 34, 40, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 20 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 38, 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 21 | E-UTRA Band 1, 3, 18, 19, 34, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| 22 | E-UTRA Band 1, 3, 7, 8, 20, 33, 34, 38, 39, 40, 43 | FDL\_low | - | FDL\_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, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| 24 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| 25 | E-UTRA Band 4, 5, 10,12, 13, 14, 17, 23, 24, 41, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 25 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| … |  |  |  |  |  |  |  |
| 33 | E-UTRA Band 1, 7, 8, 20, 22, 34, 38, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| 34 | E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 33, 38,39, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| 35 |  |  |  |  |  |  |  |
| 36 |  |  |  |  |  |  |  |
| 37 |  |  | - |  |  |  |  |
| 38 | E-UTRA Band 1,3, 8, 20, 22, 33, 34, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 15, 17, 20 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 15, 17 |
| 39 | E-UTRA Band 22, 34, 40, 42 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| 40 | E-UTRA Band 1, 3, 7, 8, 20, 22, 33, 34, 38, 39, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| 41 | E-UTRA Band 2, 4, 5, 10, 12, 13 , 14, 17, 23, 24, 25 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| 42 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 11, 18, 19, 20, 21, 25, 33, 34, 38, 40 | FDL\_low | - | FDL\_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, 33, 34, 38, 40 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NOTE 1:FDL\_low and FDL\_high refer to each E-UTRA frequency band specified in Table 5.5-1  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 LCRB x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th ] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3:N/A  NOTE 4: N/A  NOTE 5:For non synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band  NOTE 6:N/A.  NOTE 7:Applicable when co-existence with PHS system operating in 1884.5 -1919.6MHz.  NOTE 8:Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE 9:N/A.  NOTE 10:N/A.  NOTE 11:Whether the applicable frequency range should be 793-805MHz instead of 799-805MHz is TBD  NOTE 12:The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB  NOTE 13:N/A.  NOTE 14: N/A.  NOTE 15:These requirements also apply 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.  NOTE16: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.  NOTE17: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 18: This requirement is applicable only for the following cases: - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 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 (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth. - for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.  NOTE 19: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 20:For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 21 N/A.  NOTE 22 N/A. | | | | | | | |

NOTE: The restriction on the maximum uplink transmission to 54 RB in Notes 16, 17, and 19 of Table 6.6.3.2-1 is intended for conformance testing and may be applied to network operation to facilitate coexistence when the aggressor and victim bands are deployed in the same geographical area. The applicable spurious emission requirement of -15.5 dBm/5MHz is a least restrictive technical condition for FDD/TDD coexistence and may have to be revised in the future.

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

This clause specifies the requirements for the specified carrier aggregation configurations for coexistence with protected bands.

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

Table 6.6.3.2A-1: Requirements

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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, 38, 40, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 8 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| CA\_40C | E-UTRA Band 1, 3, 7, 8, 20, 22, 33, 34, 38, 39, 42, 43 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NOTE1: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 LCRB 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: 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.  NOTE 9: N/A | | | | | | | |

#### 6.6.3.3 Additional spurious emissions

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

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

##### 6.6.3.3.1 Minimum requirement (network signalled value "NS\_05")

When "NS\_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.1-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

Table 6.6.3.3.1-1: Additional requirements (PHS)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Frequency band**  **(MHz)** | **Channel bandwidth / Spectrum emission limit (dBm)** | | | | **Measurement bandwidth** | **Note** |
| **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** |
| 1884.5 f 1915.7 | -41 | -41 | -41 | -41 | 300 KHz | 1 |
| NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. Additional restrictions apply for operations below this point. | | | | | | |

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| 15 MHz channel bandwidth with fc = 1932.5 MHz | | | |
| RBstart | 0-7 | 8-66 | 67-74 |
| LCRB | N/A | ≤ MIN(30, 67 – RBstart) | N/A |
| 20 MHz channel bandwidth with fc = 1930 MHz | | | |
| RBstart | 0-23 | 24-75 | 76-99 |
| LCRB | N/A | ≤ MIN(24, 76 – RBstart) | N/A |

##### 6.6.3.3.2 Minimum requirement (network signalled value “NS\_07”)

When “NS\_07” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.2-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 from the edge of the channel bandwidth.

Table 6.6.3.3.2-1: Additional requirements

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

##### 6.6.3.3.6 Void

##### 6.6.3.3.7 Void

##### 6.6.3.3.8 Void

##### 6.6.3.3.9 Void

##### 6.6.3.3.10 Void

##### 6.6.3.3.11 Void

##### 6.6.3.3.12 Void

##### 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 FOOB (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 FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.

Table 6.6.3.3.14-1: Additional requirements

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

##### 6.6.3.3.15 Minimum requirement (network signalled value "NS\_22")

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

Table 6.6.3.3.15-1: Additional requirement

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

##### 6.6.3.3.16 Minimum requirement (network signalled value "NS\_23")

When "NS 23" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.16-1. This requirement also applies for the frequency ranges that are less than FOOB (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) | MBW |
| 5, 10, 15, 20 MHz |
| 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 + Foffset\_NS\_23 and 25 MHz + Foffset\_NS\_23 from the lower and from the upper edges of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.  NOTE 2: This requirement applies from 3400 MHz to 25 MHz + Foffset\_NS\_23 below the lower E-UTRA channel edge and from 25 MHz + Foffset\_NS\_23 above the upper E-UTRA channel edge to 3800 MHz.  NOTE 3: Foffset\_NS\_23 is:  0 MHz for 5 MHz channel BW,  5 MHz for 10 MHz channel BW,  9 MHz for 15 MHz channel BW and  12 MHz for 20 MHz channel BW.  NOTE 4: This emission limit might imply risk of harmful interference to UE(s) operating in the protected operating band. | | |

##### 6.6.3.3.17 Void

Table 6.6.3.3.17-1: Void

##### 6.6.3.3.18 Void

Table 6.6.3.3.18-1: Void

##### 6.6.3.3.19 Void

Table 6.6.3.3.19-1: Void

##### 6.6.3.3.20 Void

Table 6.6.3.3.20-1: Void

##### 6.6.3.3.21 Void

Table 6.6.3.3.21-1: Void

##### 6.6.3.3.22 Void

Table 6.6.3.3.22-1: Void

##### 6.6.3.3.23 Void

Table 6.6.3.3.23-1: Void

##### 6.6.3.3.24 Void

Table 6.6.3.3.24-1: Void

##### 6.6.3.3.25 Void

Table 6.6.3.3.25-1: Void

##### 6.6.3.3.26 Void

Table 6.6.3.3.26-1: Void

Table 6.6.3.3.26-2: Void

Table 6.6.3.3.26-3: Void

##### 6.6.3.3.27 Void

Table 6.6.3.3.27-1: Void

Table 6.6.3.3.27-2: Void

Table 6.6.3.3.27-3: Void

Table 6.6.3.3.27-4: Void

##### 6.6.3.3.28 Void

Table 6.6.3.3.28-1: Void

##### 6.6.3.3.29 Void

Table 6.6.3.3.29-1: Void

##### 6.6.3.3.30 Void

Table 6.6.3.3.30-1: Void

##### 6.6.3.3.31 Void

Table 6.6.3.3.31-1: Void

##### 6.6.3.3.32 Void

Table 6.6.3.3.32-1: Void

##### 6.6.3.3.33 Void

Table 6.6.3.3.33-1: Void

##### 6.6.3.3.34 Void

Table 6.6.3.3.34-1: Void

Table 6.6.3.3.34-2: Void

##### 6.6.3.3.35 Minimum requirement (network signalled value “NS\_56”)

When "NS\_56" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.35-1. 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 6.6.3.3.35-1: Additional requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency band  (MHz) | Channel bandwidth / Spectrum emission limit1 (dBm) | Measurement bandwidth | NOTE |
| 5 MHz, 10MHz |
| 1541 ≤ f ≤ 1559 | -102 | 2kHz | Averaged over any 2 millisecond active transmission interval |
| 1559≤ f ≤ 1608 | -85 | 700Hz |
| 1608≤ f ≤ 1610 | -85 +5/2 (f-1608) | 700Hz |
| 1610≤ f ≤ 1625 | -80+ 66/15 (f-1610) | 700Hz |
| 1541 ≤ f ≤ 1608 | -75 | 1MHz | Averaged over any 2 millisecond active transmission interval |
| 1608≤ f ≤ 1610 | -75 + 5/2 (f-1608) | 1MHz |
| 1610≤ f ≤ 1627.5 | -70+ 57/17.5 (f-1610) | 1MHz |
| 1627.5 | -37 | 4kHz |
| 1638.5 ≤f ≤ 1645.5 | -28 | 4kHz |
| 1657.5 ≤f ≤ 1660.5 | -28 | 4kHz |
| NOTE 1: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna. | | | |

#### 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) |
| E-UTRA band 34 | FDL\_low | - | FDL\_high | -50 | 1 |
| Frequency range | 1900 | - | 1915 | -15.5 | 5 |
| Frequency range | 1915 | - | 1920 | +1.6 | +1.6 |

##### 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 | FDL\_low | - | FDL\_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.  NOTE 2: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band | | | | | | |

### 6.6.3A 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 requirements in subclause 6.6.3 apply.

## 6.6A Void

## 6.6B Void

## 6.7 Transmit intermodulation

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

### 6.7.1 Minimum requirement

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

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

Table 6.7.1-1: Transmit Intermodulation

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

### 6.7.1A Minimum requirement for CA

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

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

Table 6.7.1A-1: Transmit Intermodulation

|  |  |  |
| --- | --- | --- |
| CA bandwidth class(UL) | C | |
| Interference Signal  Frequency Offset | BWChannel\_CA | 2\*BWChannel\_CA |
| Interference CW Signal  Level | -40dBc | |
| Intermodulation Product | -29dBc | -35dBc |
| Measurement bandwidth | BWChannel\_CA- 2\* BWGB | |

### 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

## 7.2 Diversity characteristics

The requirements in Section 7 assume that the receiver is equipped with two Rx port as a baseline. These requirements apply to all UE categories unless stated otherwise. Requirements for 4 ports are FFS. With the exception of subclause 7.9 all requirements shall be verified by using both (all) antenna ports simultaneously.

## 7.3 Reference sensitivity power level

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

### 7.3.1 Minimum requirements (QPSK)

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

Table 7.3.1-1: Reference sensitivity QPSK PREFSENS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | |
| E-UTRA Band | 1.4 MHz  (dBm) | 3 MHz  (dBm) | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | Duplex Mode |
| 1 |  |  | -100 | -97 | -95.2 | -94 | FDD |
| 2 | -102.7 | -99.7 | -98 | -95 | -93.2 | -92 | FDD |
| 3 | -101.7 | -98.7 | -97 | -94 | -92.2 | -91 | FDD |
| 4 | -104.7 | -101.7 | -100 | -97 | -95.2 | -94 | FDD |
| 5 | -103.2 | -100.2 | -98 | -95 |  |  | FDD |
| 6 |  |  | -100 | -97 |  |  | FDD |
| 7 |  |  | -98 | -95 | -93.2 | -92 | FDD |
| 8 | -102.2 | -99.2 | -97 | -94 |  |  | FDD |
| 9 |  |  | -99 | -96 | -94.2 | -93 | FDD |
| 10 |  |  | -100 | -97 | -95.2 | -94 | FDD |
| 11 |  |  | -100 | -97 |  |  | FDD |
| 12 | -101.7 | -98.7 | -97 | -94 |  |  | FDD |
| 13 |  |  | -97 | -94 |  |  | FDD |
| 14 |  |  | -97 | -94 |  |  | FDD |
| … |  |  |  |  |  |  |  |
| 17 |  |  | -97 | -94 |  |  | FDD |
| 18 |  |  | -100 | -97 | -95.2 |  | FDD |
| 19 |  |  | -100 | -97 | -95.2 |  | FDD |
| 20 |  |  | -97 | -94 | -91.2 | -90 | FDD |
| 21 |  |  | -100 | -97 | -95.2 |  | FDD |
| 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 |
| … |  |  |  |  |  |  |  |
| 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 |
| NOTE 1: The transmitter shall be set to PUMAX 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. | | | | | | | |

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

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

For the UE which supports inter-band carrier aggregation configuration in Table 7.3.1-1A with uplink in one E-UTRA band, the minimum requirement for reference sensitivity in Table 7.3.1-1 shall be increased by the amount given in ΔRIB,c in Table 7.3.1-1A for the applicable E-UTRA bands.

Table 7.3.1-1A: ΔRIB,c

| Inter-band CA Configuration | E-UTRA Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_1A-5A | 1 | 0 |
| 5 | 0 |
| NOTE 1: The above additional tolerances are only applicable for the E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations  NOTE 2: The above additional tolerances also apply in intra-band CA and non-aggregated operation for the supported E-UTRA operating bands that belong to the supported inter-band carrier aggregation configurations  NOTE 3: In case the UE supports more than one of the above inter-band carrier aggregation configurations and a E-UTRA operating band belongs to more than one inter-band carrier aggregation configurations then:  - When the E-UTRA operating band frequency range is ≤ 1GHz, the applicable additional tolerance shall be the average of the tolerances in Table 7.3.1-1A, truncated to one decimal place that would apply for that operating band among the supported CA configurations. In case there is a harmonic relation between low band UL and high band DL, then the maximum tolerance among the different supported carrier aggregation configurations involving such band shall be applied  - When the E-UTRA operating band frequency range is >1GHz, the applicable additional tolerance shall be the maximum tolerance in Table 7.3.1-1A that would apply for that operating band among the supported CA configurations | | |

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

Table 7.3.1-2: Uplink configuration for reference sensitivity

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Band / Channel bandwidth / NRB / Duplex mode | | | | | | | |
| E-UTRA Band | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | Duplex Mode |
| 1 |  |  | 25 | 50 | 75 | 100 | FDD |
| 2 | 6 | 15 | 25 | 50 | 501 | 501 | FDD |
| 3 | 6 | 15 | 25 | 50 | 501 | 501 | FDD |
| 4 | 6 | 15 | 25 | 50 | 75 | 100 | FDD |
| 5 | 6 | 15 | 25 | 251 |  |  | FDD |
| 6 |  |  | 25 | 251 |  |  | FDD |
| 7 |  |  | 25 | 50 | 75 | 751 | FDD |
| 8 | 6 | 15 | 25 | 251 |  |  | FDD |
| 9 |  |  | 25 | 50 | 501 | 501 | FDD |
| 10 |  |  | 25 | 50 | 75 | 100 | FDD |
| 11 |  |  | 25 | 251 |  |  | FDD |
| 12 | 6 | 15 | 201 | 201 |  |  | FDD |
| 13 |  |  | 201 | 201 |  |  | FDD |
| 14 |  |  | 151 | 151 |  |  | FDD |
| ... |  |  |  |  |  |  |  |
| 17 |  |  | 201 | 201 |  |  | FDD |
| 18 |  |  | 25 | 251 | 251 |  | FDD |
| 19 |  |  | 25 | 251 | 251 |  | FDD |
| 20 |  |  | 25 | 201 | 203 | 203 | FDD |
| 21 |  |  | 25 | 251 | 251 |  | FDD |
| 22 |  |  | 25 | 50 | 501 | 501 | FDD |
| 23 | 6 | 15 | 25 | 50 | 75 | 100 | FDD |
| 24 |  |  | 25 | 50 |  |  | FDD |
| 25 | 6 | 15 | 25 | 50 | 501 | 501 | 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 |
| 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 RBstart 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RBstart 16 | | | | | | | |

Unless given by Table 7.3.1-3, the minimum requirements specified in Tables 7.3.1-1 and 7.3.1-2 shall be verified with the network signalling value NS\_01 (Table 6.2.4-1) configured.

Table 7.3.1-3: Network signalling value for reference sensitivity

|  |  |
| --- | --- |
| E-UTRA Band | Network Signalling value |
| 2 | NS\_03 |
| 4 | NS\_03 |
| 10 | NS\_03 |
| 12 | NS\_06 |
| 13 | NS\_06 |
| 14 | NS\_06 |
| 17 | NS\_06 |
| 19 | NS\_08 |
| 21 | NS\_09 |
| 23 | NS\_03 |
| 25 | NS\_03 |

### 7.3.1A Minimum requirements (QPSK) for CA

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

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| CA configuration / CC combination / NRB\_agg / Duplex mode | | | | | | | |
| Uplink CA configuration | 100RB+50RB | | 75RB+75RB | | 100RB+100RB | | Duplex Mode |
| PCC | SCC | PCC | SCC | PCC | SCC |
| CA\_1C | N/A | N/A | 75 | 54 | 100 | 30 | FDD |
| CA\_40C | 100 | 50 | 75 | 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 PUMAX 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). | | | | | | | |

### 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 PUMAX is the total transmitter power over the two transmit antenna connectors.

### 7.3.2 Void

## 7.4 Maximum input level

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

### 7.4.1 Minimum requirements

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

Table 7.4.1-1: Maximum input level

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth | | | | | |
| 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | -25 | | | | | |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_L as defined in subclause 6.2.5.  NOTE 2: Reference measurement channel is Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | |

### 7.4.1A Minimum requirements for CA

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

For intra-band contiguous carrier aggregation maximum input level is defined as the powers received at the UE antenna port over the Transmission bandwidth configuration of each CC, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel over each component carrier. The downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.4.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2.

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | | |
| A | B | C | D | E | F |
|  |  |  |  |  |  |  |  |
| Power in largest Transmission Bandwidth Configuration CC | dBm |  |  | -25 |  |  |  |
| Power in each other CC | dBm |  |  | -25 + 10log(NRB,c /NRB,largest BW) |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L or PCMAX\_L\_CA 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. | | | | | | | |

### 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 PCMAX\_L is defined as the total transmitter power over the two transmit antenna connectors.

## 7.4A Void

### 7.4A.1 Void

## 7.5 Adjacent Channel Selectivity (ACS)

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

### 7.5.1 Minimum requirements

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

Table 7.5.1-1: Adjacent channel selectivity

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Channel bandwidth | | | | | |
| Rx Parameter | Units | 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| ACS | dB | 33 | 33 | 33 | 33 | 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 | | | | | |
| PInterferer | dBm | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +45.5dB | REFSENS +42.5dB | REFSENS +39.5dB |
| BWInterferer | MHz | 1.4 | 3 | 5 | 5 | 5 | 5 |
| FInterferer (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 PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_L as defined in subclause 6.2.5.  NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | | | | | | | |

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth | | | | | |
| 1.4 MHz | 3 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | -56.5 | -56.5 | -56.5 | -56.5 | -53.5 | -50.5 |
| PInterferer | dBm | -25 | | | | | |
| BWInterferer | MHz | 1.4 | 3 | 5 | 5 | 5 | 5 |
| FInterferer (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 PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_L as defined in subclause 6.2.5.  NOTE 2: The interferer consists of the Reference measurement channel specified in Annex 3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | | | | | | | |

### 7.5.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band, the adjacent channel requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.5.1 for each component carrier while both downlink carriers are active.

For intra-band contiguous carrier aggregation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.5.1A-2 or 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.

Table 7.5.1A-1: Adjacent channel selectivity

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

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC |  |  | REFSENS + 14 dB |  |  |  |
| PInterferer | dBm |  | Aggregated power + 22.5 dB |  |  |  |
| BWInterferer | MHz |  | 5 |  |  |  |
| FInterferer (offset) | MHz |  | 2.5 + Foffset  /  -2.5 - Foffset |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_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 Finterferer (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 MHz to be offset from the sub-carrier raster. | | | | | | |

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm |  | -47.5+10 log10(NRB,c/ NRB agg) |  |  |  |
| PInterferer | dBm | -25 | | | | |
| BWInterferer | MHz |  | 5 |  |  |  |
| FInterferer (offset) | MHz |  | 2.5+ Foffset  /  -2.5- Foffset |  |  |  |
| NOTE 1: The transmitter shall be set to 24dB below PCMAX\_L,c or PCMAX\_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 Finterferer (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 MHz to be offset from the sub-carrier raster. | | | | | | |

### 7.5.1B Minimum requirements for UL-MIMO

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

## 7.6 Blocking characteristics

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

### 7.6.1 In-band blocking

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels..

#### 7.6.1.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.1.1-1 and 7.6.1.1-2.

Table 7.6.1.1-1: In band blocking parameters

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Rx parameter** | **Units** | **Channel bandwidth** | | | | | |
| **1.4 MHz** | **3 MHz** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + channel bandwidth specific value below | | | | | |
| 6 | 6 | 6 | 6 | 7 | 9 |
| BWInterferer | MHz | 1.4 | 3 | 5 | 5 | 5 | 5 |
| FIoffset, 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 |
| FIoffset, 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 PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_L as defined in subclause 6.2.5.  NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | | | | | | | |

Table 7.6.1.1-2: In-band blocking

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| E-UTRA band | Parameter | Unit | Case 1 | Case 2 | Case 3 | Case 4 |
| PInterferer | dBm | -56 | -44 | Void | Void |
| FInterferer (offset) | MHz | =-BW/2 – FIoffset,case 1  &  =+BW/2 + FIoffset,case 1 | ≤-BW/2 – FIoffset,case 2  &  ≥+BW/2 + FIoffset,case 2 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23,  25, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43 | FInterferer | MHz | (Note 2) | FDL\_low – 15  to  FDL\_high + 15 |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band  NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  a. the carrier frequency -BW/2 - FIoffset, case 1 and  b. the carrier frequency +BW/2 + FIoffset, case 1  NOTE 3: FInterferer 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, PInterferer power defined in Table 7.6.1.1-2 is increased by the amount given by ΔRIB,c in Table 7.3.1-1A.

#### 7.6.1.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the in-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.1.1 for each component carrier while both downlink carriers are active. For the UE which supports inter band CA configuration in Table 7.3.1-1A , PInterferer power defined in Table 7.6.1.1-2 is increased by the amount given by ΔRIB,c in Table 7.3.1-1A .

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

Table 7.6.1.1A-1: In band blocking parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
|  | 12 |  |  |  |
| BWInterferer | MHz |  | 5 |  |  |  |
| FIoffset, case 1 | MHz |  | 7.5 |  |  |  |
| FIoffset, case 2 | MHz |  | 12.5 |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_L as defined in subclause 6.2.5A  NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1 | | | | | | |

Table 7.6.1.1A-2: In-band blocking

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CA configuration | Parameter | | Unit | Case 1 | Case 2 |
| PInterferer | | dBm | -56 | -44 |
| FInterferer  (offset) | | MHz | =-Foffset– FIoffset,case 1  &  =+Foffset + FIoffset,case 1 | ≤-Foffset– FIoffset,case 2  &  ≥+Foffset + FIoffset,case 2 |
| CA\_1C, CA\_40C | FInterferer (Range) | | MHz | (Note 2) | FDL\_low – 15  to  FDL\_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 - Foffset - FIoffset, case 1 and  b. the carrier frequency + Foffset + FIoffset, case 1  NOTE 3: Foffset is the frequency offset from the center frequency of the CC being tested to the edge of aggregated channel bandwidth.  NOTE 4: The Finterferer (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 MHz to be offset from the sub-carrier raster. | | | | |

### 7.6.2 Out-of-band blocking

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

#### 7.6.2.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1-1 and 7.6.2.1-2.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  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 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where  is the number of resource blocks in the downlink transmission bandwidth configurations (see Figure 5.6-1) and  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 PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_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 |
| PInterferer | 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, 33, 34, 35, 36, 37, 38, 39, 40, 41,  42 (NOTE 2),  43 (NOTE 2) | FInterferer (CW) | MHz | FDL\_low -15 to  FDL\_low -60 | FDL\_low -60 to  FDL\_low -85 | FDL\_low -85 to  1 MHz | - |
| FDL\_high +15 to  FDL\_high + 60 | FDL\_high +60 to  FDL\_high +85 | FDL\_high +85 to  +12750 MHz | - |
| 2, 5, 12, 17 | FInterferer | MHz | - | - | - | FUL\_low**-** FUL\_high |
| NOTE 1: For the UE which supports both Band 11 and Band 21 the out of blocking is FFS.  NOTE 2: The power level of the interferer (PInterferer) for Range 3 shall be modified to -20 dBm for FInterferer > 2800 MHz and FInterferer < 4400 MHz. | | | | | | |

#### 7.6.2.1A Minimum requirements for CA

For inter-band carrier aggregation with the uplink assigned to one E-UTRA band, the out-of-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The throughput in the downlink measured shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.6.2.1-1 and 7.6.2.1A-0. The UE shall meet these requirements for each component carrier while both downlink carriers are active.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Range 1 | Range 2 | Range 3 |
| Pw | dBm | Table 7.6.2.1-1 for both component carriers | | |
| Pinterferer | dBm | -44 + RIB,c | -30 + RIB,c | -15 + RIB,c |
| Finterferer  (CW) | MHz | -60 < f – FDL\_Low(1) < -15  or  -60 < f – FDL\_Low(2) < -15  or  15 < f – FDL\_High(1) < 60  or  15 < f – FDL\_High(2) < 60 | -85 < f – FDL\_Low(1) ≤ -60  or  -85 < f – FDL\_Low(2) ≤ -60  or  60 ≤ f – FDL\_High(1) < 85  or  60 ≤ f – FDL\_High(2) < 85 | 1 ≤ f ≤ FDL\_Low(1) – 85  or  FDL\_High(1) + 85 ≤ f  ≤ FDL\_Low(2) – 85  or  FDL\_High(2) + 85 ≤ f  ≤ 12750 |
| NOTE 1: FDL\_Low(1) and FDL\_High(1) denote the respective lower and upper frequency limits of the lower operating band, FDL\_Low(2) and FDL\_High(2) the respective lower and upper frequency limits of the upper operating band.  NOTE 2: For FDL\_Low(2) – FDL\_High(1) < 145 MHz and FInterferer in FDL\_High(1) < f < FDL\_Low(2), FInterferer can be in both Range 1 and Range 2. Then the lower of the PInterferer applies.  NOTE 3: For FDL\_Low(1) – 15 MHz ≤ f ≤ FDL\_High(1) + 15 MHz and FDL\_Low(2) – 15 MHz ≤ f ≤ FDL\_High(2) + 15 MHz the appropriate adjacent channel selectivity and in-band blocking in the respective subclauses 7.5.1A and 7.6.1.1A shall be applied.  NOTE 4: RIB,c according to Table 7.3.1-1A applies when serving cell *c* is measured. | | | | |

For Table 7.6.2.1A-0 in frequency ranges 1, 2 and 3, up to  exceptions per downlink are allowed for spurious response frequencies when measured using a step size of 1 MHz. For these exceptions the requirements in clause 7.7.1A apply.

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

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

For Table 7.6.2.1A-2 in frequency range 1, 2 and 3, up to exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7 Spurious response are applicable.

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
|  | 9 |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_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. | | | | | | |

Table 7.6.2.1A-2: Out of band blocking

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CA configuration | Parameter | Units | Frequency | | |
| Range 1 | Range 2 | Range 3 |
| PInterferer | dBm | -44 | -30 | -15 |
| CA\_1C, CA\_40C | FInterferer (CW) | MHz | FDL\_low -15 to  FDL\_low -60 | FDL\_low -60 to  FDL\_low -85 | FDL\_low -85 to  1 MHz |
| FDL\_high +15 to  FDL\_high + 60 | FDL\_high +60 to  FDL\_high +85 | FDL\_high +85 to  +12750 MHz |

### 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 |
| Pw | dBm | PREFSENS + channel-bandwidth specific value below | | | | | |
| 22 | 18 | 16 | 13 | 14 | 16 |
| Puw (CW) | dBm | -55 | -55 | -55 | -55 | -55 | -55 |
| Fuw (offset for  *f* = 15 kHz) | MHz | 0.9075 | 1.7025 | 2.7075 | 5.2125 | 7.7025 | 10.2075 |
| Fuw (offset for**  *f* = 7.5 kHz) | MHz |  |  |  |  |  |  |
| NOTE 1: The transmitter shall be set a 4 dB below PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_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. | | | | | | | |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A, PUW power defined in Table 7.6.3.1-1 is increased by the amount given by ΔRIB,c in Table 7.3.1-1A.

#### 7.6.3.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the narrow-band blocking requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.6.3.1 for each component carrier while both downlink carriers are active.

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

Table 7.6.3.1A-1: Narrow-band blocking

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
|  | 164 |  |  |  |
| Puw (CW) | dBm |  | -55 |  |  |  |
| Fuw (offset for  *f* = 15 kHz) | MHz |  | - Foffset – 0.2  /  + Foffset + 0.2 |  |  |  |
| Fuw (offset for**  *f* = 7.5 kHz) | MHz |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_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 Fuw (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 MHz to be offset from the sub-carrier raster.  NOTE 4: The requirement is applied for the band combinations whose component carriers’ BW≥5 MHz. | | | | | | |

## 7.6A Void

<Reserved for future use>

## 7.6B Blocking characteristics for UL-MIMO

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.6 shall be met with the UL-MIMO configurations specified in Table 6.2.2B-2. For UL-MIMO, the parameter PCMAX\_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 PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2.  N OTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1. | | | | | | | | |

Table 7.7.1-2: Spurious response

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer  (CW) | dBm | -44 |
| FInterferer | MHz | Spurious response frequencies |

For the UE which supports inter-band CA configuration in Table 7.3.1-1A, Pinterferer power defined in Table 7.7.1-2 is increased by the amount given by ΔRIB,c in Table 7.3.1-1A.

### 7.7.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the spurious response requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The throughput measured in each downlink with Finterferer in Table 7.6.2.1A-0 at spurious response frequencies shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7.1-1 and 7.7.1-2. The UE shall meet these requirements for each component carrier while both downlink carriers are active.

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

Table 7.7.1A-1: Spurious response parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
|  | 9 |  |  |  |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_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. | | | | | | |

Table 7.7.1A-2: Spurious response

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer  (CW) | dBm | -44 |
| FInterferer | MHz | Spurious response frequencies |

### 7.7.1B Minimum requirements for UL-MIMO

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

## 7.8 Intermodulation characteristics

Intermodulation response rejection is a measure of the capability of the receiver to receiver a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

### 7.8.1 Wide band intermodulation

The wide band intermodulation requirement is defined following the same principles using modulated E-UTRA carrier and CW signal as interferer.

#### 7.8.1.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.8.1.1 for the specified wanted signal mean power in the presence of two interfering signals

Table 7.8.1.1-1: Wide band intermodulation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth | | | | | | | |
| 1.4 MHz | | 3 MHz | | 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + channel bandwidth specific value below | | | | | | | |
| 12 | | | 8 | 6 | 6 | 7 | 9 |
| PInterferer 1  (CW) | dBm | -46 | | | | | | | |
| PInterferer 2  (Modulated) | dBm | -46 | | | | | | | |
| BWInterferer 2 |  | 1.4 | 3 | | | 5 | | | |
| FInterferer 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 | | | |
| FInterferer 2  (Offset) | MHz | 2\*FInterferer 1 | | | | | | | |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L at the minimum uplink configuration specified in Table 7.3.1-2 with PCMAX\_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, Pinterferer1 and Pinterferer2 powers defined in Table 7.8.1.1-1 are increased by the amount given by ΔRIB,c in Table 7.3.1-1A.

### 7.8.1A Minimum requirements for CA

For inter-band carrier aggregation with uplink assigned to one E-UTRA band the wide band intermodulation requirements are defined with the uplink active on the band other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.8.1.1 for each component carrier while both downlink carriers are active.

For intra-band contiguous carrier aggegation the downlink SCC shall be configured at nominal channel spacing to the PCC with the PCC configured closest to the uplink band. Downlink PCC and SCC are both activated. The uplink output power shall be set as specified in Table 7.8.1A-1 with the uplink configuration set according to Table 7.3.1A-1 for the applicable carrier aggreagation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.1-2. The UE shall fulfil the minimum requirement in presence of an interfering signal specified in Table 7.8.1A-1 being on either side of the aggregated signal. The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.8.1A-1

Table 7.8.1A-1: Wide band intermodulation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx parameter | Units | CA Bandwidth Class | | | | |
| B | C | D | E | F |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + CA Bandwidth Class specific value below | | | | |
|  | 12 |  |  |  |
| PInterferer 1  (CW) | dBm | -46 | | | | |
| PInterferer 2  (Modulated) | dBm | -46 | | | | |
| BWInterferer 2 | MHz |  | 5 |  |  |  |
| FInterferer 1  (Offset) | MHz |  | –Foffset-7.5  /  + Foffset+7.5 |  |  |  |
| FInterferer 2  (Offset) | MHz | 2\*FInterferer 1 | | | | |
| NOTE 1: The transmitter shall be set to 4dB below PCMAX\_L,c or PCMAX\_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 Finterferer 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 Finterferer 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. | | | | | | |

### 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 PCMAX\_L is defined as the total transmitter power over the two transmit antenna connectors.

### 7.8.2 Void

## 7.9 Spurious emissions

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

### 7.9.1 Minimum requirements

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

Table 7.9.1-1: General receiver spurious emission requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency band | Measurement  bandwidth | Maximum level | Note |
| 30MHz ≤ f < 1GHz | 100 kHz | -57 dBm |  |
| 1GHz ≤ f ≤ 12.75 GHz | 1 MHz | -47 dBm |  |
| 12.75 GHz ≤ f ≤ 5th harmonic of the upper frequency edge of the DL operating band in GHz | 1 MHz | -47 dBm | 1 |
| NOTE 1: Applies only for Band 22, Band 42 and Band 43  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. | | | |

## 7.10 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 |  |  |  |