**3GPP TSG-RAN4#95 R4-2008890**

**25th May –5th June 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-2** | **CR** | **0156** | **rev** | **1** | **Current version:** | **16.3.1** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | FR2 intra-band non-contiguous UL CA feature | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Qualcomm Inc, Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_RF\_FR2\_req\_enh  NR\_CA\_R16\_Intra | | | | |  | ***Date:*** | | | 2020-05-15 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction FR2 intra-band non-contiguous UL CA feature | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. CA\_n260(2A) and CA\_n260(3A) added which are only intraband non-contiguous UL CA configurations on WID RP-200101 which are in line with R4-1916022 2. Introduce MPR for NC CA 3. Modify contiguous MPR requirements so it depends on DL frequency separation instead of CABW, which has become obsolete due to DL-only spectrum definition 4. Original exception for CA operation that triggered single CC MPR was intended for contiguous UL and DL CA. The wording however depends on now obsolete CABW. Replace with DL aggregated BW. 5. Emissions requirements updates per agreed R4-1913043 6. Tx mod quality requirement updates per agreed R4-1913043 7. Necessary changes to output power dynamics | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | FR2 intra-band non-contiguous UL CA feature is not introduced | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 5.2A, 6.2A, 6.3A, 6.4A, 6.5A | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Aggregated Channel Bandwidth:** The RF bandwidth in which a UE is configured to transmit and receive multiple contiguously aggregated carriers.

**Beam correspondence:** the ability of the UE to select a suitable beam for UL transmission based on DL measurements with or without relying on UL beam sweeping.

**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.

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

**EIRP(Link=Link angle, Meas=Link angle):** measurement of the UE such that the link angle is aligned with the measurement angle. EIRP (indicator to be measured) can be replaced by EIS, Frequency, EVM, carrier Leakage, In-band eission and OBW. Beam peak search grids, TX beam peak direction, and RX beam peak direction can be selected to describe Link.

**EIRP(Link=Link angle, Meas=beam peak direction):** measurement of the EIRP of the UE such that the measurement angle is aligned with the beam peak direction within an acceptable measurement error uncertainty.

**EIS (equivalent isotropic sensitivity):** sensitivity for an isotropic directivity device equivalent to the sensitivity of the discussed device exposed to an incoming wave from a defined AoA

NOTE 1: The sensitivity is the minimum received power level at which specific requirement is met.

NOTE 2: Isotropic directivity is equal in all directions (i.e. 0 dBi).

**Fallback group:** Group of carrier aggregation bandwidth classes for which it is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group

**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.

**Link angle:** a DL-signal AoA from the view point of the UE, as described in Annex J.

**Measurement angle:** the angle of measurement of the desired metric from the view point of the UE, as described in Annex J

**radiated interface boundary**: operating band specific radiated requirements reference point where the radiated requirements apply

**RX beam peak direction**: direction where the maximum total component of RSRP and thus best total component of EIS is found

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

**TX beam peak direction:** direction where the maximum total component of EIRP is found

**TRP(Link=Link angle):** measurement of the TRP of the UE such that the measurement angle is aligned with the beam peak direction within an acceptable measurement uncertainty. TX beam peak direction and RX beam peak direction can be selected to describe Link.

NOTE: For requirements based on EIRP/EIS, the radiated interface boundary is associated to the far-field region

**UE transmission bandwidth configuration:** Set of resource blocks located within the UE channel bandwidth which may be used for transmitting or receiving by the UE.

**Vehicular UE:** A UE embedded in a vehicle

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## 5.2A Operating bands for CA

### 5.2A.1 Intra-band CA

NR intra-band contiguous carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.1-1, where all operating bands are within FR2.

Table 5.2A.1-1: Intra-band contiguous CA operating bands in FR2

|  |  |
| --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) |
| CA\_n257 | n257 |
| CA\_n258 | n258 |
| CA\_n260 | n260 |
| CA\_n261 | n261 |

NR intra-band non-contiguous carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.2-2, where all operating bands are within FR2.

Table 5.2A.2-2: Intra-band non-contiguous CA operating bands in FR2

|  |  |
| --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) |
| CA\_n260(\*) | n260 |
| NOTE 1: The minimum requirements only apply for non simultaneous Tx/Rx between all carriers for TDD combinations.  NOTE 2: The notation CA\_nX(\*) in this table indicates intra-band non-contiguous CA for band nX. The configurations for each CA band are in clause 5.5A.2. | |

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### 5.5A.2 Configurations for intra-band non-contiguous CA

Configurations listed in this clause apply to downlink carrier aggregation only.

NOTE: Sub-blocks belonging to a CA configuration can be in any order. In other words certain CA configuration acronym includes all sub-block arrangements which have exactly the same sub-block set. As an example, CA\_260(3O-2P) denotes CA\_260(2O-2P-O), CA\_260(P-3O-P) etc. but these are not listed in tables separately.

Table 5.5A.2-1: NR CA configurations with single CA bandwidth class defined for intra-band non-contiguous CA

| NR CA configuration / Bandwidth combination set | | | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR configuration** | **Uplink CA configurations** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | **Sub-block** | (BWChannel,block) (MHz) | **BCS** |
|
| CA\_n257(2A) | - | n257A | n257A |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n258(2A) | - | n258A | n258A |  |  |  |  |  |  |  |  |  |  |  |  |  | 0 |
| CA\_n258(3A) | - | n258A | n258A | n258A |  |  |  |  |  |  |  |  |  |  |  |  | 0 |
| CA\_n258(4A) | - | n258A | n258A | n258A | n258A |  |  |  |  |  |  |  |  |  |  |  | 0 |
| CA\_n258(5A) | - | n258A | n258A | n258A | n258A | n258A |  |  |  |  |  |  |  |  |  |  | 0 |
| CA\_n260(2A) | CA\_n260(2A) | n260A | n260A |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n260(3A) | CA\_n260(3A) | n260A | n260A | n260A |  |  |  |  |  |  |  |  |  |  |  | 1200 | 0 |
| CA\_n260(4A) | - | n260A | n260A | n260A | n260A |  |  |  |  |  |  |  |  |  |  | 1600 | 0 |
| CA\_n260(5A) | - | n260A | n260A | n260A | n260A | n260A |  |  |  |  |  |  |  |  |  | 2000 | 0 |
| CA\_n260(6A) | - | n260A | n260A | n260A | n260A | n260A | n260A |  |  |  |  |  |  |  |  | 2400 | 0 |
| CA\_n260(7A) | - | n260A | n260A | n260A | n260A | n260A | n260A | n260A |  |  |  |  |  |  |  | 2600 | 0 |
| CA\_n260(8A) | - | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A |  |  |  |  |  |  | 2650 | 0 |
| CA\_n260(9A) | - | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A |  |  |  |  |  | 26004 | 0 |
| CA\_n260(10A) | - | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A | n260A |  |  |  |  | 25504 | 0 |
| CA\_n260(2D) | - | CA\_n260D | CA\_n260D |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n260(2G) | - | CA\_n260G | CA\_n260G |  |  |  |  |  |  |  |  |  |  |  |  | 400 | 0 |
| CA\_n260(3G) | - | CA\_n260G | CA\_n260G | CA\_n260G |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n260(4G) | - | CA\_n260G | CA\_n260G | CA\_n260G | CA\_n260G |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n260(2H) | - | CA\_n260H | CA\_n260H |  |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n260(2O) | - | CA\_n260O | CA\_n260O |  |  |  |  |  |  |  |  |  |  |  |  | 400 | 0 |
| CA\_n260(3O) | - | CA\_n260O | CA\_n260O | CA\_n260O |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n260(4O) | - | CA\_n260O | CA\_n260O | CA\_n260O | CA\_n260O |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n260(2P) | - | CA\_n260P | CA\_n260P |  |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n260(3P) | - | CA\_n260P | CA\_n260P | CA\_n260P |  |  |  |  |  |  |  |  |  |  |  | 900 | 0 |
| CA\_n260(4P) | - | CA\_n260P | CA\_n260P | CA\_n260P | CA\_n260P |  |  |  |  |  |  |  |  |  |  | 1200 | 0 |
| CA\_n260(2Q) | - | CA\_n260Q | CA\_n260Q |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n261(2A) | - | n261A | n261A |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n261(3A) | - | n261A | n261A | n261A |  |  |  |  |  |  |  |  |  |  |  | 750 | 0 |
| CA\_n261(4A) | - | n261A | n261A | n261A | n261A |  |  |  |  |  |  |  |  |  |  | 700 | 0 |
| CA\_n261(2D) | - | CA\_n261D | CA\_n261D |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| CA\_n261(2G) | - | CA\_n261G | CA\_n261G |  |  |  |  |  |  |  |  |  |  |  |  | 400 | 0 |
| CA\_n261(3G) | - | CA\_n261G | CA\_n261G | CA\_n261G |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(4G) | - | CA\_n261G | CA\_n261G | CA\_n261G | CA\_n261G |  |  |  |  |  |  |  |  |  |  | 700 | 0 |
| CA\_n261(2H) | - | CA\_n261H | CA\_n261H |  |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(2I) | - | CA\_n261I | CA\_n261I |  |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(2O) | - | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  |  |  |  |  |  | 400 | 0 |
| CA\_n261(3O) | - | CA\_n261O | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(4O) | - | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  |  |  |  | 700 | 0 |
| CA\_n261(5O) | - | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  |  |  | 650 | 0 |
| CA\_n261(6O) | - | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(7O) | - | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O | CA\_n261O |  |  |  |  |  |  |  | 550 | 0 |
| CA\_n261(2P) | - | CA\_n261P | CA\_n261P |  |  |  |  |  |  |  |  |  |  |  |  | 600 | 0 |
| CA\_n261(2Q) | - | CA\_n261Q | CA\_n261Q |  |  |  |  |  |  |  |  |  |  |  |  | 800 | 0 |
| NOTE 1: Void  NOTE 2: Void  NOTE 3: Void  NOTE 4: Void  NOTE 5: Channel bandwidth per operating band defined in Table 5.3.5-1  NOTE 6: Unless otherwise stated, BCS0 is referred in each constituent CA configuration | | | | | | | | | | | | | | | | | |

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### 5.3A.4 UE channel bandwidth per operating band for CA

For intra-band contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting a carrier aggregation bandwidth class with associated bandwidth combination sets specified in clause 5.5A.1. For each carrier aggregation configuration, requirements are specified for all aggregated channel bandwidths contained in a bandwidth combination set, UE can indicate support of several bandwidth combination sets per carrier aggregation configuration. The requirements are applicable only when Uplink CCs are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier.

For intra-band non-contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting two or more sub-blocks, each supporting a carrier aggregation bandwidth class. The requirements are applicable only when Uplink CCs in each UL sub-block are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier of a DL sub-block.

Frequency separation class specified in Table 5.3A.4-2 indicates the maximum frequency span between lower edge of lowest component carrier and upper edge of highest component carrier that UE can support per band in downlink or uplink respectively in non-contiguous intra-band operation.

For inter-band carrier aggregation, a carrier aggregation configuration is a combination of operating bands, each supporting a carrier aggregation bandwidth class.

**Table 5.3A.4-1: CA bandwidth classes**

|  |  |  |  |
| --- | --- | --- | --- |
| **NR CA bandwidth class** | **Aggregated channel bandwidth** | **Number of contiguous CC** | **Fallback group** |
| A | BWChannel ≤ 400 MHz | 1 | 1,2,3,4 |
| B | 400 MHz < BWChannel\_CA ≤ 800 MHz | 2 | 1 |
| C | 800 MHz < BWChannel\_CA ≤ 1200 MHz | 3 |
| D | 200 MHz < BWChannel\_CA ≤ 400 MHz | 2 | 2 |
| E | 400 MHz < BWChannel\_CA ≤ 600 MHz | 3 |
| F | 600 MHz < BWChannel\_CA ≤ 800 MHz | 4 |
| G | 100 MHz < BWChannel\_CA ≤ 200 MHz | 2 | 3 |
| H | 200 MHz < BWChannel\_CA ≤ 300 MHz | 3 |
| I | 300 MHz < BWChannel\_CA ≤ 400 MHz | 4 |
| J | 400 MHz < BWChannel\_CA ≤ 500 MHz | 5 |
| K | 500 MHz < BWChannel\_CA ≤ 600 MHz | 6 |
| L | 600 MHz < BWChannel\_CA ≤ 700 MHz | 7 |
| M | 700 MHz < BWChannel\_CA ≤ 800 MHz | 8 |
| O | 100 MHz ≤ BWChannel\_CA ≤ 200 MHz | 2 | 4 |
| P | 150 MHz ≤ BWChannel\_CA ≤ 300 MHz | 3 |
| Q | 200 MHz ≤ BWChannel\_CA ≤ 400 MHz | 4 |
| NOTE 1: Maximum supported component carrier bandwidths for fallback groups 1, 2, 3 and 4 are 400 MHz, 200 MHz, 100 MHz and 100 MHz respectively except for CA bandwidth class A.  NOTE 2: It is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group. | | | |

**Table 5.3A.4-2: Frequency separation classes for non-contiguous intra-band operation**

|  |  |
| --- | --- |
| **Frequency separation class** | **Frequency separation (Fs)** |
| I | Fs ≤ 800 MHz |
| II | Fs ≤ 1200 MHz |
| III | Fs ≤ 1400 MHz |

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6.2A Transmitter power for CA

6.2A.1 UE maximum output power for CA

For downlink intra-band contiguous and non-contiguous carrier aggregation with a single uplink component carrier configured in the NR band, the maximum output power is specified in clause 6.2.1.

For uplink intra-band contiguous and non-contiguous carrier aggregation for any CA bandwidth class, the maximum output power is specified in clause 6.2.1.

Power class 3 is default power class.

6.2A.2 UE maximum output power reduction for CA

6.2A.2.1 General

The UE is defined to be configured for CA operation when it has at least one of UL or DL configured for CA. In CA operation, the UE may reduce its maximum output power due to higher order modulations and transmit bandwidth configurations. This Maximum Power Reduction (MPR) is defined in clauses below.

When the maximum output power of a UE is modified by MPR, the power limits specified in clause 6.2A.4 apply.

The requirements in the following clauses are only applicable to intra-band contiguous uplink CA, with the aggregated channel bandwidth no greater than 800 MHz and intra-band non-contiguous uplink CA with UL frequency separation no greater than 1400 MHz.

6.2A.2.2 Maximum output power reduction for power class 1

##### 6.2A.2.2.1 Maximum output power reduction for power class 1 intra-band contiguous CA

For power class 1, MPR for intra-band contiguous UL CA with contiguous allocations is defined as:

MPRC\_CA = max(MPRWT\_C\_CA, MPRnarrow)

Where,

MPRnarrow = 14.4 dB, when BWalloc,RB is less than or equal to 1.44 MHz, MPRnarrow = 10 dB, when 1.44 MHz < BWalloc,RB ≤ 10.8 MHz, where BWalloc,RB is the bandwidth of the RB allocation size.

MPRWT\_C\_CA is the maximum power reduction due to modulation orders, transmit bandwidth configurations, and waveform types. MPRWT\_C\_CA is defined in Table 6.2A.2.2-1.

**Table 6.2A.2.2-1: Maximum power reduction (MPR** WT\_**C\_CA) for UE power class 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Waveform Type** | | **DL frequency separation** | | |
| **< 400 MHz** | **≥ 400 MHz and < 800 MHz** | **≥ 800 MHz and ≤ 1400 MHz** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 5.5 | 7.7 | 8.2 |
| QPSK | ≤ 6.5 | 8.7 | 9.2 |
| 16 QAM | ≤ 6.5 | 8.7 | 9.2 |
| 64 QAM | ≤ 9.0 | 10.7 | 11.2 |
| CP-OFDM | QPSK | ≤ 6.5 | 8.7 | 9.2 |
| 16 QAM | ≤ 6.5 | 8.7 | 9.2 |
| 64 QAM | ≤ 9.0 | 10.7 | 11.2 |
| NOTE 1: (Void) | | | | |

In case of a contiguous RB, DFT-s-BPSK or DFT-s-QPSK UL allocation in a single CC of a CA configuration whose DL BWchannel\_CA ≤ 400 MHz, MPRWT\_C\_CA shall be derived instead as MAX(MPR1, MPR2), where:

MPR1 shall be determined from Table 6.2.2.1-1 if the DL BWchannel\_CA ≤ 200 MHz, from Table 6.2.2.1-2 if the DL BWchannel\_CA > 200 MHz.

MPR2 shall be determined from Table 6.2.2.1-1 if UL BWchannel\_CA ≤ 200 MHz, from Table 6.2.2.1-2 if UL BWchannel\_CA > 200 MHz.

and assume all UL CCs use the same SCS for the purpose of determination of inner and outer RB allocations in Table 6.2.2.1-1 and Table 6.2.2.1-2:

NRB shall be chosen as the sum of NRB of all constituent UL CCs in the CA configuration.

LCRB shall be chosen as BWalloc,RB

RBstart shall be derived as: RBstart\_allocatedCC+NRB\_unallocatedCC\_low

RBstart\_allocatedCC is the index of the first unallocated RB in the CC with allocation

NRB\_unallocatedCC\_low is the sum of NRB in all UL CCs lower in frequency compared to the CC with allocation

BWchannel\_CA is the aggregated channel bandwidth of the CA configuration

When different waveform types exist across CCs, the requirement is set by the waveform type used in the configuration with the largest MPRC\_CA.

For intra-band contiguous UL CA with non-contiguous RB allocations, the following rule for MPR applies:

MPR = max(MPRC\_CA, -10\*A + 14.4)

Where:

A = NRB\_alloc / NRB\_agg\_C.

NRB\_alloc is the total number of allocated UL RBs

NRB\_agg\_C is the number of the aggregated RBs within the fully allocated UL CA configuration

6.2A.2.2.2 Maximum output power reduction for power class 1 intra-band non-contiguous CA

For intra-band non-contiguous UL CA, the following rule for MPR applies:

MPR = max(MPRNC\_CA, -10\*A + 14.4)

Where:

MPRNC\_CA is derived from table 6.2A.2.2.2-1

**Table 6.2A.2.2.2-1: MPRNC\_CA for UE power class 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Waveform Type** | | **DL frequency separation** | | | |
| **< 400 MHz** | **≥ 400 MHz and < 800 MHz** | **≥ 800 MHz and ≤ 1400 MHz** | **> 1400 MHz and ≤ 2400 MHz** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 5.5 | 7.7 | 8.2 | 8.2 |
| QPSK | ≤ 6.5 | 8.7 | 9.2 | 9.2 |
| 16 QAM | ≤ 6.5 | 8.7 | 9.2 | 9.2 |
| 64 QAM | ≤ 9.0 | 10.7 | 11.2 | 11.2 |
| CP-OFDM | QPSK | ≤ 6.5 | 8.7 | 9.2 | 9.2 |
| 16 QAM | ≤ 6.5 | 8.7 | 9.2 | 9.2 |
| 64 QAM | ≤ 9.0 | 10.7 | 11.2 | 11.2 |

6.2A.2.3 Maximum output power reduction for power class 2

For power class 2, MPR specified in sub-clause 6.2A.2.4.1 applies for intra-band contiguous CA and sub-clause 6.2A.2.4.2 applies for intra-band non-contiguous CA.

**Table 6.2A.2.3-1: (Void)**

6.2A.2.4 Maximum output power reduction for power class 3

##### 6.2A.2.4.1 Maximum output power reduction for power class 3 intra-band contiguous CA

For power class 3, MPR for intra-band contiguous UL CA with contiguous allocations is denoted as MPRC\_CA and is defined in Table 6.2A.2.4-1.

**Table 6.2A.2.4-1: Maximum power reduction (MPRC\_CA) for UE power class 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | **DL frequency separation** | | |
| **≤ 400 MHz** | **> 400 MHz and < 800 MHz** | **≥ 800 MHz and ≤ 1400 MHz** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 5.01 | ≤ 7.71 | ≤ [8.2] |
| QPSK | ≤ 5.01 | ≤ 7.71 | ≤ [8.2] |
| 16 QAM | ≤ 6.5 | ≤ 8.7 | ≤ [9.3] |
| 64 QAM | ≤ 9.0 | ≤ 10.7 | ≤ [11.2] |
| CP-OFDM | QPSK | ≤ 5.0 | ≤ 7.5 | ≤ [8.0] |
| 16 QAM | ≤ 6.5 | ≤ 8.7 | ≤ [9.2] |
| 64 QAM | ≤ 9.0 | ≤ 10.7 | ≤ [11.2] |
| NOTE 1: (Void). | | | | |

In case of a contiguous RB, DFT-s-BPSK or DFT-s-QPSK UL allocation in a single CC of a CA configuration whose DL BWchannel\_CA ≤ 400 MHz, MPRC\_CA shall be derived instead as MAX(MPR1, MPR2), where:

MPR1 shall be determined from Table 6.2.2.3-1 if the DL BWchannel\_CA ≤ 200 MHz, from Table 6.2.2.3-2 if the DL BWchannel\_CA > 200 MHz.

MPR2 shall be determined from Table 6.2.2.3-1 if UL BWchannel\_CA ≤ 200 MHz, from Table 6.2.2.3-2 if UL BWchannel\_CA > 200 MHz.

and assume all UL CCs use the same SCS for the purpose of determination of inner and outer RB allocations in Table 6.2.2.3-1 and Table 6.2.2.3-2:

NRB shall be chosen as the sum of NRB of all constituent UL CCs in the CA configuration.

LCRB shall be chosen as BWalloc,RB

RBstart shall be derived as: RBstart\_allocatedCC+NRB\_unallocatedCC\_low

RBstart\_allocatedCC is the index of the first unallocated RB in the CC with allocation

NRB\_unallocatedCC\_low is the sum of NRB in all UL CCs lower in frequency compared to the CC with allocation

BWchannel\_CA is the aggregated channel bandwidth of the CA configuration

When different waveform types exist across CCs, the requirement is set by the waveform type used in the configuration with the highest contiguous MPR.

For intra-band contiguous UL CA with non-contiguous RB allocations, the following rule for MPR applies:

MPR = max(MPRC\_CA, -10\*A +7.0)

Where:

A = NRB\_alloc / NRB\_agg\_C.

NRB\_alloc is the total number of allocated UL RBs

NRB\_agg\_C is the number of the aggregated RBs within the fully allocated UL CA configuration

6.2A.2.4.2 Maximum output power reduction for power class 3 intra-band non-contiguous CAFor intra-band non-contiguous UL CA, the following rule for MPR applies:

MPR = max(MPRNC\_CA, -10\*A +10.0)

Where:

MPRNC\_CA is derived from table 6.2A.2.4.2-1

**Table 6.2A.2.4.2-1: MPRNC\_CA for UE power class 3**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **DL frequency separation** | | | |
| **≤ 400 MHz** | **> 400 MHz and < 800 MHz** | **≥ 800 MHz and ≤ 1400 MHz** | **> 1400 MHz and ≤ 2400 MHz** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 5.0 | ≤ 7.7 | ≤ [8.2] | ≤ [8.2] |
| QPSK | ≤ 5.0 | ≤ 7.7 | ≤ [8.2] | ≤ [8.2] |
| 16 QAM | ≤ 6.5 | ≤ 8.7 | ≤ [9.3] | ≤ [9.3] |
| 64 QAM | ≤ 9.0 | ≤ 10.7 | ≤ [11.2] | ≤ [11.2] |
| CP-OFDM | QPSK | ≤ 5.0 | ≤ 7.5 | ≤ [8.0] | ≤ [8.0] |
| 16 QAM | ≤ 6.5 | ≤ 8.7 | ≤ [9.2] | ≤ [9.2] |
| 64 QAM | ≤ 9.0 | ≤ 10.7 | ≤ [11.2] | ≤ [11.2] |

6.2A.2.5 Maximum output power reduction for power class 4

For power class 4, MPR specified in sub-clause 6.2A.2.4.1 applies for intra-band contiguous CA and sub-clause 6.2A.2.4.2 applies for intra-band non-contiguous CA.

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## 6.3A Output power dynamics for CA

### 6.3A.1 Minimum output power for CA

Table 6.3A.1-1: Void

#### 6.3A.1.0 General

For intra-band contiguous and non-contiguous carrier aggregation, the minimum controlled output power of the UE is defined as the transmit power of the UE per component carrier, i.e., EIRP 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.

#### 6.3A.1.1 Minimum output power for power class 1

The minimum output power shall not exceed the values specified in Table 6.3A.1.1-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3A.1.1-1: Minimum output power for power class 1

|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| n257, n258, n260, n261 | 50 | 4 | 47.52 |
| 100 | 4 | 95.04 |
| 200 | 4 | 190.08 |
| 400 | 4 | 380.16 |

#### 6.3A.1.2 Minimum output power for power class 2, 3, and 4

The minimum output power shall not exceed the values specified in Table 6.3A.1.2-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3A.1.2-1: Minimum output power for CA for power class 2, 3, and 4

|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| n257, n258, n260, n261 | 50 | -13 | 47.52 |
| 100 | -13 | 95.04 |
| 200 | -13 | 190.08 |
| 400 | -13 | 380.16 |
| NOTE 1: n260 is not applied for power class 2. | | | |

### 6.3A.2 Transmit OFF power for CA

For intra-band contiguous and non-contiguous carrier aggregation, the transmit OFF power is defined as the TRP in the channel bandwidth per component carrier when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of it sports.

The transmit OFF power shall not exceed the values specified in Table 6.3A.2-1 for each operating band supported.

Table 6.3A.2-1: Transmit OFF power for CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating band | Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth | | | |
| 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| n257, n258, n260, n261 | -35 | -35 | -35 | -35 |
| 47.52 MHz | 95.04 MHz | 190.08 MHz | 380.16 MHz |

### 6.3A.3 Transmit ON/OFF time mask for CA

For intra-band contiguous and non-contiguous carrier aggregation, the general output power ON/OFF time mask specified in clause 6.3.3.2 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in clause 6.3.3.2 shall only be applicable for each component carrier when all the component carriers are OFF.

### 6.3A.4 Power control for CA

#### 6.3A.4.1 General

The requirements in this clause apply to a UE when it has at least one of UL or DL configured for CA operation. The requirements on power control accuracy in CA operation apply under normal conditions and are defined as a directional requirement. The requirements are verified in beam locked mode on beam peak direction. The requirements apply for one single PUCCH, PUSCH or SRS transmission of contiguous PRB allocation per configured UL CC with power setting in accordance with Clause 7.1 of [10]

6.3A.4.2 Absolute power tolerance

For intra-band contiguous and non-contiguous carrier aggregation 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 20 ms. For SRS switching, 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 component carriers (to which SRS switching occurs) larger than 20 ms. The requirement can be tested by time aligning any transmission gaps on the component carriers. For intra-band contiguous CA, the absolute power control tolerance per configured UL CC is given in Tables 6.3.4.2-1 and 6.3.4.2-2.

6.3A.4.3 Relative power tolerance

For intra-band contiguous and non-contiguous carrier aggregation the relative power tolerance is the ability of the UE transmitter to set its output power in a target sub-frame relative to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is <20ms.

For intra-band contiguous CA, the requirements apply when the power of the target and reference sub-frames on each component carrier exceed the minimum output power as defined in clause 6.3A.1 and the total power is limited by PUMAX as defined in clause 6.2A.4. For the purpose of these requirements, the power in each component carrier is specified over only the transmitted resource blocks. The UE shall meet the requirements in tables 6.3.4.3-1 and 6.3.4.3-2 for transmission on each assigned component carrier, when the average PSDs over each CC are aligned with each other in the reference sub-frame. The requirements apply per component carrier to:

a. All possible combinations of PUSCH and PUCCH transitions

b. SRS and PUSCH/PUCCH transitions, only with simultaneous SRS of constant SRS bandwidth allocated in the target and reference subrames

c. RACH, primary component carrier

When applicable, 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.

6.3A.4.4 Aggregate power tolerance

For intra-band contiguous and non-contiguous carrier aggregation the aggregate power control tolerance is the ability of the UE transmitter to maintain its power during non-contiguous transmissions within 21 ms in response to 0 dB TPC commands with respect to the first UE transmission and all other power control parameters as specified in [10] kept constant.

For intra-band contiguous CA, the aggregate power tolerance per CC is given in Tables 6.3.4.4.1-1 and 6.3.4.4.1-2, with simultaneous PUSCH configured. The average PSDs over each assigned CC shall be aligned before the start of the test. The requirement can be tested with the transmission gaps time aligned between component carriers.

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6.4A Transmit signal quality for CA

The requirements in this clause apply if the UE has at least one of UL or DL configured for CA.

6.4A.1 Frequency error

The requirements in this clause apply to UEs of all power classes.

For intra-band contiguous and non-contiguous carrier aggregation, the UE basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequencies per band shall be accurate to within ± 0.1 PPM observed over a period of 1ms of cumulated measurement intevals compared to the carrier frequency of primary component carrier received from the gNB.

The frequency error is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

6.4A.2 Transmit modulation quality

6.4A.2.0 General

For intra-band contiguous and non-contiguous carrier aggregation, the requirements in clauses 6.4A.2.1, 6.4A.2.2, and 6.4A.2.3.

All the parameters defined in clause 6.4A.2 are defined using the measurement methodology specified in Annex F.

All the requirements in 6.4A.2 are defined as directional requirement. The requirements are verified in beam locked mode on beam peak direction, with both UL polarizations active.

6.4A.2.1 Error Vector magnitude

The requirements in this clause apply to UEs of all power classes. For intra-band contiguous and non-contiguous carrier aggregation, the Error Vector Magnitude requirement of clause 6.4.2.2 is 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 case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [13]), carrier leakage measurement requirement in clause 6.4A.2.2 and 6.4A.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

The UE is defined to be configured for CA operation when it has at least one of UL or DL configured for CA.

6.4A.2.2 Carrier leakage

6.4A.2.2.1 General

Carrier leakage is an additive sinusoid waveform. 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.

Note: When UE has DL configured for non-contiguous CA, carrier leakage may land outside the spectrum occupied by all configured UL and DL CC.

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The requirement is verified with the test metric of Carrier Leakage (Link=TX beam peak direction, Meas=Link angle).

6.4A.2.2.2 Carrier leakage for power class 1

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.2-1 for power class 1 UEs.

**Table 6.4A.2.2.2-1: Minimum requirements for relative carrier leakage for power class 1**

|  |  |
| --- | --- |
| **Parameters** | **Relative Limit (dBc)** |
| EIRP > 17 dBm | -25 |
| 4 dBm ≤ EIRP ≤ 17 dBm | -20 |

6.4A.2.2.3 Carrier leakage for power class 2

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.3-1 for power class 2.

**Table 6.4A.2.2.3-1: Minimum requirements for relative carrier leakage power class 2**

|  |  |
| --- | --- |
| **Parameters** | **Relative limit (dBc)** |
| EIRP > 6 dBm | -25 |
| -13 dBm ≤ EIRP ≤ 6 dBm | -20 |

6.4A.2.2.4 Carrier leakage for power class 3

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.4-1 for power class 3 UEs.

**Table 6.4A.2.2.4-1: Minimum requirements for relative carrier leakage power class 3**

|  |  |
| --- | --- |
| **Parameters** | **Relative limit (dBc)** |
| Output power > 0 dBm | -25 |
| -13 dBm ≤ Output power EIRP ≤ 0 dBm | -20 |

6.4A.2.2.5 Carrier leakage for power class 4

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.5-1 for power class 4 UEs.

**Table 6.4A.2.2.5-1: Minimum requirements for relative carrier leakage power class 4**

|  |  |
| --- | --- |
| **Parameters** | **Relative limit (dBc)** |
| Output power > 11 dBm | -25 |
| -13 dBm ≤ Output power EIRP ≤ 11 dBm | -20 |

6.4A.2.3 Inband emissions

6.4A.2.3.1 General

Inband emission requirement is defined over the spectrum occupied by all configured UL and DL CCs. The measurement interval is as defined in clause 6.4.2.4. The requirement is verified with the test metric of In-band emission (Link=TX beam peak direction, Meas=Link angle).

For intra-band contiguous and non-contiguous carrier aggregation, the requirements in this clause apply with all component carriers active and with one single contiguous PRB allocation in one of uplink component carriers. The inband emission is defined as the interference falling into the non-allocated resource blocks for all component carriers.

6.4A.2.3.2 Inband emissions for power class 1

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.2-1 for power class 1 UEs.

**Table 6.4A.2.3.2-1: Requirements for in-band emissionsfor power class 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter description** | **Unit** | **Limit (NOTE 1)** | | **Applicable Frequencies** |
| **General** | dB |  | | Any non-allocated RB in allocated component carrier and not allocated component carriers  (NOTE 2) |
| **IQ Image** | dB | -25 | Output power > 27 dBm | Image frequencies (NOTES 2, 3) |
| -20 | Output power ≤ 27 dBm |
| **Carrier leakage** | dBc | -25 | Output power > 17 dBm | Carrier frequency (NOTES 4, 5) |
| -20 | 4 dBm ≤ Output power ≤ 17 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* - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 9.  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. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.  NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.  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, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.  NOTE 6: is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).  NOTE 7: EVM s the limit 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. = 1 or = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 9: PRB is the transmitted power per allocated RB, measured in dBm.  NOTE 10: All powers are EIRP in beam peak direction. | | | | |

6.4A.2.3.3 Inband emissions for power class 2

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.3-1 for power class 2.

**Table 6.4A.2.3.3-1: Requirements for in-band emissions for power class 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter description** | **Unit** | **Limit (NOTE 1)** | | **Applicable Frequencies** |
| **General** | dB |  | | Any non-allocated RB in allocated component carrier and not allocated component carriers  (NOTE 2) |
| **IQ Image** | dB | -25 | Output power > 16 dBm | Image frequencies (NOTES 2, 3) |
| -20 | Output power ≤ 16 dBm |
| **Carrier leakage** | dBc | -25 | Output power > 6 dBm | Carrier frequency (NOTES 4, 5) |
| -20 | -13 dBm ≤ Output power ≤ 6 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* - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 9.  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. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.  NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.  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, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.  NOTE 6: is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).  NOTE 7: EVM s the limit 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. = 1 or = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 9: PRB is the transmitted power per allocated RB, measured in dBm.  NOTE 10: All powers are EIRP in beam peak direction. | | | | |

6.4A.2.3.4 Inband emissions for power class 3

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.4-1 for power class 3 UEs.

**Table 6.4A.2.3.4-1: Requirements for in-band emissions for power class 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter description** | **Unit** | **Limit (NOTE 1)** | | **Applicable Frequencies** |
| **General** | dB |  | | Any non-allocated RB in allocated component carrier and not allocated component carriers  (NOTE 2) |
| **IQ Image** | dB | -25 | Output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -20 | Output power ≤ 10 dBm |
| **Carrier leakage** | dBc | -25 | Output power > 0 dBm | Carrier frequency (NOTES 4, 5) |
| -20 | -13 dBm ≤ Output power ≤ 0 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* - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 9.  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. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.  NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.  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, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.  NOTE 6: is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).  NOTE 7: EVM s the limit 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. = 1 or = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 9: PRB is the transmitted power per allocated RB, measured in dBm.  NOTE 10: All powers are EIRP in beam peak direction. | | | | |

6.4A.2.3.5 Inband emissions for power class 4

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.5-1 for power class 4 UEs.

**Table 6.4A.2.3.5-1: Requirements for in-band emissions for power class 4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter description** | **Unit** | **Limit (NOTE 1)** | | **Applicable Frequencies** |
| **General** | dB |  | | Any non-allocated RB in allocated component carrier and not allocated component carriers  (NOTE 2) |
| **IQ Image** | dB | -25 | Output power > 21 dBm | Image frequencies (NOTES 2, 3) |
| -20 | Output power ≤ 21 dBm |
| **Carrier leakage** | dBc | -25 | Output power > 11 dBm | Carrier frequency (NOTES 4, 5) |
| -20 | -13 dBm ≤ Output power ≤ 11 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* - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 9.  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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.  NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.  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, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.  NOTE 6: is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).  NOTE 7: EVM s the limit 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. = 1 or = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 9: PRB is the transmitted power per allocated RB, measured in dBm.  NOTE 10: All powers are EIRP in beam peak direction. | | | | |

6.4A.2.4 EVM equalizer spectrum flatness

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6.5A Output RF spectrum emissions for CA

6.5A.1 Occupied bandwidth for CA

6.5A.1.1 Occupied bandwidth for intra-band contiguous 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 occupied bandwidth for CA shall be less than the aggregated channel bandwidth defined in clause 5.3A.

The occupied bandwidth for CA is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

6.5A.1.2 Occupied bandwidth for intra-band non-contiguous CAFor intra-band non-contiguous carrier aggregation, the OBW requirement is met when the ratio of the transmitted power in all sub-blocks of the uplink CA configuration to the total integrated power of the transmitted spectrum is greater than 99%.

The occupied bandwidth for CA is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

6.5A.2 Out of band emissions

6.5A.2.1 Spectrum emission mask for CA

6.5A.2.1.1 Spectrum emission mask for intra-band contiguous CA

The requirement specified in this clause shall apply if the UE has at least one of UL or DL configured for CA or if the UE is configured for single CC operation with different channel bandwidths in UL and DL carriers.

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 5.3A.5-1). For any bandwidth class defined in Table 5.3A.5-1, the UE emission shall not exceed the levels specified in Table 6.5A.2.1-1. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

**Table 6.5A.2.1.1-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2**

|  |  |  |
| --- | --- | --- |
| **ΔfOOB**  **(MHz)** | **Any carrier aggregation bandwidth class** | **Measurement bandwidth** |
| ± 0-0.1\*BWChannel\_CA | -5 | 1 MHz |
| ± 0.1\*BWChannel\_CA -2\*BWChannel\_CA | -13 | 1 MHz |
| NOTE 1: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in clause 6.4A.2.2 shall apply. For I/Q image the requirements specified in clause 6.4A.2.3 shall apply. | | |

6.5A.2.2.1 Spectrum emission mask for intra-band non-contiguous CAFor intra-band non-contiguous carrier aggregation, the spectrum emission mask requirement is defined as a composite spectrum emissions mask. Composite spectrum emission mask applies to frequencies up to ± ΔfOOB starting from the edge of each sub-block. Composite spectrum emission mask is defined as follows:

1. Composite spectrum emission mask is a combination of individual spectrum emissions masks defined for each sub-block. If for some frequency, spectrum emission masks from multiple sub-blocks overlap, the spectrum emission mask allowing the highest power spectral density applies for that frequency
2. In case a sub-block comprises of multiple component carriers, the spectrum emissions mask is defined in subclause 6.5A.2.1 or in case of a single component carrier, the sub-block spectrum emission mask is defined in subclause 6.5.2.1
3. If for some frequency the spectrum emission mask of one sub-block overlaps another sub-block, the emission mask does not apply for that frequency.
4. If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2 shall apply. For I/Q image the requirements specified in section 6.4A.2.3 shall apply.

6.5A.2.3 Adjacent channel leakage ratio for CA

6.5A.2.3.1 Adjacent channel leakage ratio for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the carrier aggregation NR adjacent channel leakage power ratio (CA NRACLR) 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 spacing equal to the aggregated channel bandwidth. The assigned aggregated channel bandwidth power and adjacent aggregated channel bandwidth power are measured with rectangular filters with measurement bandwidths specified in 6.5A.2.3.1-1. If the measured adjacent channel power is greater than -35 dBm then the NRACLR shall be higher than the value specified in Table 6.5A.2.3.1-1.

**Table 6.5A.2.3.1-1: General requirements for CA NRACLR**

|  |  |
| --- | --- |
|  | **CA bandwidth class / CA NRACLR / Measurement bandwidth** |
| **Any CA bandwidth class** |
| CA NRACLR for band n257, n258, n261 | 17 dB |
| CA NRACLR for band n260 | 16 dB |
| NR channel measurement bandwidth1 | BWChannel\_CA – 2\*BWGB |
| Adjacent channel centre frequency offset (in MHz) | + BWChannel\_CA  /  - BWChannel\_CA |
| NOTE 1: BWGB is defined in clause 5.3A.2. | |

6.5A.2.3.2 Adjacent channel leakage ratio for intra-band contiguous CA

For intra-band non-contiguous carrier aggregation, adjacent channel leakage power ratio is the ratio of the sum of the filtered mean powers centred on each sub-block bandwidth to the filtered mean power centred on an adjacent sub-block frequency at nominal spacing equal to the sub-block bandwidth. No requirement applies in the gap between neighbouring sub-blocks if the frequency span between the lowest edge of the upper sub-block and the highest edge of the lower sub-block is smaller than the bandwidth of either sub-block.

6.5A.3 Spurious emissions for CA

#### 6.5A.3.0 Spurious emissions for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) from the edge of the aggregated channel bandwidth, where FOOB is defined as the twice the aggregated channel bandwidth. For frequencies ΔfOOB greater than FOOB, the spurious emission requirements in Table 6.5.3-2 are applicable. If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the spurious emissions requirement applies. For carrier leakage the requirements specified in clause 6.4A.2.2 shall apply. For I/Q image the requirements specified in clause 6.4A.2.3 shall apply.

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.

6.5A.3.0a Spurious emissions for intra-band non-contiguous CAFor intra-band non-contiguous carrier aggregation, the spurious emission requirement is defined as a composite spurious emission requirement which is a combination of individual spurious emission requirements defined for each sub-block. The limits in Table 6.5.3-2 apply for the frequency ranges that are more than FOOB (MHz) from the edge of each sub-block but excludes frequency ranges that coincide with another sub-block. No spurious emission limit applies in the gap between neighbouring sub-blocks if the frequency span between the lowest edge of the upper sub-block and the highest edge of the lower sub-block is smaller than FOOB\_L + FOOB\_H. If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the spurious emissions requirement applies. For carrier leakage the requirements specified in section 6.4A.2.2 shall apply. For I/Q image the requirements specified in section 6.4A.2.3 shall apply.

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.

6.5A.3.1 Spurious emission band UE co-existence for CA

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

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

For intra-band contiguous and non-contiguous carrier aggregation, the requirements in Table 6.5A.3-1 apply.

**Table 6.5A.3-1: Requirements for CA**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CA band** | **Spurious emission** | | | | | | |
| **Protected band / frequency range** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n257 | NR Band n260 | FDL\_low | - | FDL\_high | -2 | 100 |  |
| Frequency range | 23600 | - | 24000 | -8 | 200 | 2 |
| Frequency range | 57000 | - | 66000 | 2 | 100 |  |
| CA\_n258 | Frequency range | 23600 | - | 24000 | -8 | 200 | 2 |
| Frequency range | 57000 | - | 66000 | 2 | 100 |  |
| CA\_n260  CA\_n260(\*) | NR Band 257 | FDL\_low | - | FDL\_high | -5 | 100 |  |
| NR Band 261 | FDL\_low | - | FDL\_high | -5 | 100 |  |
| Frequency range | 23600 | - | 24000 | -8 | 200 | 2 |
| Frequency range | 57000 | - | 66000 | 2 | 100 |  |
| CA\_n261 | NR Band 260 | FDL\_low | - | FDL\_high | -2 | 100 |  |
| Frequency range | 23600 | - | 24000 | -8 | 200 | 2 |
| Frequency range | 57000 | - | 66000 | 2 | 100 |  |
| NOTE 1: FDL\_low and FDL\_high refer to each NR frequency band specified in Table 5.2-1  NOTE 2: The protection of frequency range 23600 - 24000 MHz is meant for protection of satellite passive services. | | | | | | | |

< end of changes >