**3GPP TSG-RAN4 Meeting #104-e *R4-2213364***

**Electronic Meeting, August 15-26, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | **1169** | **rev** | **-** | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *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:*** | Correction to RF requirements of NR\_RF\_FR1\_enh | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_RF\_FR1\_enh-Core | | | | |  | ***Date:*** | | | 2022-08-01 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)  Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. Based on the agreement in R4-2016909, RAN4 agreed to remove the restrictions on configuring UL MIMO for SUL bands. As agreed CR R4-2100799, UL MIMO has been introduced for SUL bands. The restriction on UL MIMO in clause 4.3 should be removed for SUL bands. And this CR is a resubmission of R4-2117708 due to the missing CR implementation. 2. The intra-band CA requirements needs to do some correction. 3. In 6.1F, there exists some incorrect reference tables in the specification | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. To remove the restrictions on configuring UL MIMO for SUL bands in clause 4.3.Correcting the references across the intra-band requirements 2. Making following changes to intra-band CA requirements    1. Adding PC2 references in A-MPR NS\_04 requirements    2. Aligning the title for CA with UL-MIMO requirements    3. In 6.4H.1.2, adding description of only RB allocation on PCC    4. In 6.4H.1.2.1, EVM is measured per layer. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The restriction on UL MIMO for SUL bands in clause 4.3 is not aligned with RAN4’s agreement.  The problems of intra-band CA remain in the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.3, 6.1F,6.2A.2.1, 6.2A.2.2.0, 6.2A.3.1.1.1, 6.2H, 6.3A, 6.3H, 6.4H, 6.5H | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Revision: To merge the document R4-2212567. | | | | | | | | |

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## 4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level clause, shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| Clause suffix | Variant |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplement Uplink (SUL) |
| D | UL MIMO |
| E | V2X |
| F | Shared spectrum channel access |
| G | Tx Diversity (TxD) |
| H | Carrier Aggregation(CA) with UL MIMO |
| I | RedCap |

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

A terminal which supports advanced V2X services, public safety services and other commercial use cases related to NR sidelink operation shall meet all of the separate corresponding requirements in suffix E.

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

For a terminal that supports public safety service using sidelink, the minimum requirements are applicable when

- The UE is associated with a serving cell on PS carrier, or

- The UE is not associated with a serving cell on the PS carrier and is provisioned with the preconfigured radio parameters for PS that are associated with known Geographical Area, or

- The UE is associated with a serving cell on a carrier different than the PS carrier, and the radio parameters for PS that are provided by the serving cell, or

- The UE is associated with a serving cell on a carrier different than the PS carrier, and has a non-serving cell selected on the PS carrier with the preconfigured radio parameters.

When the advanced-V2X or PS UE is not associated with a serving cell on the V2X or PS carrier, and the UE does not have knowledge of its geographical area, or is provisioned with preconfigured radio parameters that are not associated with any Geographical Area, V2X or PS UE’ transmissions are not allowed, and the requirements in Section 6.3E.2 apply.

For a terminal that supports operation in shared spectrum, the current version of this specification assumes in the uplink sub-bands within a wideband channel shall be contiguously allocated to the UE. The uplink requirements for one or more non-transmitted sub-bands between two transmitted sub-bands does not form a part of the current version of this specification.

### <Unchanged Text Skipped>

## 6.1F General

For wideband operations, the minimum requirements for the transmitter characteristics are specified for transmissions on one scheduled RB set or ≥ 1 scheduled contiguous RB set(s) within the UE channel. The requirements apply with configured UL intra-cell guard bands of non-zero size according to Table 5.3.3-2, with the union of the scheduled RB sets and the intra-cell guard bands.

### <Unchanged Text Skipped>

#### 6.2A.2.1 UE maximum output power reduction for Intra-band contiguous CA

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2A.1.1-1 with contiguous RB allocation is specified in Table 6.2A.2.1-1 for UE power class 3 CA bandwidth classes B and C. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1a for power class 2 CA bandwidth classes B and C when the signalling is absent for *dualPA-Architecture* IE, and for power class 2 CA bandwidth classe C when the signalling is indicated for *dualPA-Architecture* IE. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1b for power class 2 CA bandwidth classes B and C with TxD supported.

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.

Unless otherwise specified, pi/2 BPSK in following A-MPR tables refers to both variants of pi/2 BPSK referenced in 6.2.2 tables 6.2.2-1.

Table 6.2A.2.1-1: Contiguous RB allocation for Power Class 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Modulation | | MPR for bandwidth class B(dB) | | MPR for bandwidth class C(dB) | |
|  | | inner | outer | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 1.0 | 3.5 | 2.5 | 7 |
|  | QPSK | 1.0 | 3.5 | 2.5 | 7 |
|  | 16QAM | 1.5 | 3.5 | 2.5 | 7 |
|  | 64QAM | 3.0 | 4.0 | 5 | 7 |
|  | 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 2.0 | 4.0 | 3.5 | 8 |
|  | 16QAM | 2.5 | 4.0 | 3.5 | 8 |
|  | 64QAM | 3.5 | 4.0 | 5 | 8 |
|  | 256QAM | 6.5 | 6.5 | 7 | 8 |

Table 6.2A.2.1-1a: Contiguous RB allocation for Power Class 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Modulation | | MPR for bandwidth class B(dB) | | MPR for bandwidth class C(dB) | |
|  | | inner | Outer1 | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 2.0 | 4.01 | 2.5 | 7 |
|  | QPSK | 2.0 | 4.01 | 2.5 | 7 |
|  | 16QAM | 2.5 | 4.01 | 2.5 | 7 |
|  | 64QAM | 3.0 | 4.51 | 5 | 7 |
|  | 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 2.5 | 5.01 | 3.5 | 8 |
|  | 16QAM | 3.0 | 5.01 | 3.5 | 8 |
|  | 64QAM | 3.5 | 5.01 | 5 | 8 |
|  | 256QAM | 6.5 | 6.5 | 7 | 8 |
| NOTE 1: When 1 RB or 2 RB are allocated at the lower edge of lowest CC or upper edge of upper CC, MPR for outer is 5.5 dB. | | | | | |

Table 6.2A.2.1-1b: Contiguous RB allocation for Power Class 2 with dual Tx2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Modulation | | MPR for bandwidth class B(dB) | | MPR for bandwidth class C(dB) | |
|  | | inner | Outer1 | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 3.0 | 5.01 | 3.5 | 8 |
| QPSK | 3.0 | 5.01 | 3.5 | 8 |
| 16QAM | 3.5 | 5.01 | 3.5 | 8 |
| 64QAM | 4.0 | 5.51 | 6 | 8 |
| 256QAM | 6.5 | 7.0 | 8 | 8.5 |
| CP-OFDM | QPSK | 3.0 | 5.51 | 4.0 | 8.5 |
| 16QAM | 3.5 | 5.51 | 4.0 | 8.5 |
| 64QAM | 4.0 | 5.51 | 5.5 | 8.5 |
| 256QAM | 7.0 | 7.0 | 7.5 | 8.5 |
| NOTE 1: When 1 RB or 2 RB are allocated at the lower edge of lowest CC or upper edge of upper CC, MPR for outer is 5.5 dB.  NOTE 2: UE indicating TxDsupported | | | | | |

### <Unchanged Text Skipped>

##### 6.2A.2.2.0 General

For intra-band non-contiguous CA, the allowed Maximum Power Reduction (MPR) for the maximum output power is specified into 2 types: MPR to meet -30dBm/MHz and -13dBm/MHz. The UE determins the MPR type as follows:

For UE indicating *dualPA-Architecture* supported

If OR (LCRB1 = 0, LCRB2 = 0)

MPR defined in Table 6.2.2-1 and Table 6.2.2-2 for PC3 and PC2 UE respectively

Else If AND( FIM3,low\_block,low > SEM-13,low , FIM3,high\_block,high < SEM-13,high )

MPR defined in Clause 6.2A.2.2.2.1 and Clause 6.2A.2.2.2.2 for PC3 and PC2 UE respectively.

Else

MPR defined in Clause 6.2A.2.2.1.1 and Clause 6.2A.2.2.1.2 for PC3 and PC2 UE respectively.

For UE without indicating *dualPA-Architecture* supported

If OR( LCRB1 = 0, LCRB2 = 0 )

For PC3 UE, MPR defined in Table 6.2.2-1, except for B < **9** MHz where **5.5** dB MPR is used;

For PC2 UE without indicating *TxD*, MPR defined in Table 6.2.2-2 is used, except for B < 11.52 MHz where 6.5 dB MPR is used;

For PC2 UE indicating *TxD*, MPR defined in Table 6.2D.2-1 is used, except for B < 11.52 MHz where the maximum value between 6.5 dB and MPR defined in Table 6.2D.2-1 is used.

Else If AND( FIM3,low\_block,low > SEM-13,low , FIM3,high\_block,high < SEM-13,high )

MPR defined in Clause 6.2A.2.2.2.3 and Clause 6.2A.2.2.2.4 for PC3 and PC2 UE respectively.

Else

MPR defined in Clause 6.2A.2.2.1.3 and Clause 6.2A.2.2.1.4 for PC3 and PC2 UE respectively.

where

- LCRB1 is for CC1 which is the component carrier with lower frequency

- LCRB2 is for CC2 which is the component carrier with higher frequency

- B = (LCRB1\* 12\* SCS1 + LCRB2 \* 12 \* SCS2)/1,000,000

- FIM3,high\_block,high =(2 \* Fhigh\_alloc,high\_edge ) – Flow\_alloc,low\_edge

- FIM3,low\_block,low = (2 \* Flow\_alloc,low\_edge) – Fhigh\_alloc,high\_edge

- Flow\_alloc,low\_edge is the lowermost frequency of the lower transmission bandwidth allocation.

- Flow\_alloc,high\_edge is the uppermost frequency of the lower transmission bandwidth allocation.

- Fhigh\_alloc,low\_edge is the lowermost frequency of the upper transmission bandwidth allocation.

- Fhigh\_alloc,high\_edge is the uppermost frequency of the upper transmission bandwidth allocation.

- SEM-13,low = Threshold frequency where lower spectral emission mask below the lower channel drops from -13 dBm / MHz to -25 dBm / MHz, as specified in Clause 6.5A.2.2.2.

- SEM-13,high = Threshold frequency where upper spectral emission mask above the upper channel drops from -13 dBm / MHz to -25 dBm / MHz, as specified in Clause 6.5A.2.2.2.

MPRs in section 6.2A.2.2.1.3, 6.2A.2.2.1.4, 6.2A.2.2.2.3 and 6.2A.2.2.2.4 are applicable only when the Gap between the component carriers is ≤ the overall channel bandwidth summed across all the component carriers and when UE declares *intraBandFreqSeparationUL-v1620* value ≤ 200 MHz.

The definition of the gap is between the component carriers in a spectrum that is not part of any configured component carrier that is located in between the lowest edge of the component carrier with higher center frequency and the highest edge of the component carrier with center frequency that is located lower in frequency.

### <Unchanged Text Skipped>

##### 6.2A.3.1.1.1 A-MPR for CA\_NS\_04

6.2A.3.1.1.1.1 Contiguous allocations

For all waveform type, modulations and scs when Fedge, low - BWChannel\_CA ≥ 2490.5 MHz, A-MPR = MPR

For all modulations and scs when Fedge, low - BWChannel\_CA < 2490.5 MHz

if the RB allocation is an inner allocation as defined in Table 6.2A.2.4-1 then A-MPR = MPR

Except for RBstart ≤ 0.33\*BWchannel\_CA/0.18MHz, AMPR= max (MPR, AMPRcc).

if the RB allocation is an outer allocation as defined in Table 6.2A.2.4-2,

then A-MPR = MPR+1.5dB for BW Class B A-MPR = MPR for BW class C.

Where

- MPR is the MPR as defined in Table 6.2A.2.4-1, Table 6.2A.2.1-1a and Table 6.2A.2.1-1b for PC3 and PC2 respectively and the respective CA bandwidth class

- AMPRcc is defined as the PC3\_A2 or PC2\_A4 AMPR in table 6.2.3.2-2 for PC3 and PC2 respectively.

6.2A.3.1.1.1.2 Non-contiguous allocations

For intra-band contiguous CA\_n41B and CA\_n41C and it receives IE CA\_ NS\_04, the UE determines the allowed Additional Maximum Power Reduction (AMPR) for the maximum output power as specified in this clause. The AMPR is specified by AMPRIM3 to meet -25dBm/MHz when IM3 falls in -25dBm/MHz region of Table 6.5A.2.3.1.1-1 or Table 6.5A.3.3.1.1-1. And uses MPR for all other cases.

The UE determines the AMPR type as follows:

For all waveform types, modulations and SCS when Fedge, low - BWChannel\_CA ≥ 2490.5 MHz,

if allocation is an inner or outer 1 allocation as defined in Table 6.2A.2.4-2 then A-MPR = MPR

if allocation is an outer 2 allocation as defined in Table 6.2A.2.4-2 then A-MPR = MPR-1dB

For all waveform types, modulations and SCS when Fedge, low - BWChannel\_CA < 2490.5 MHz

If AND( MIN(FIM3,low\_block,high, SEM-13,low) < Ffilter,low , MAX( SEM-13,high, FIM3,high\_block,low ) > Ffilter,high )

if RB allocation is an inner or outer 1 allocation as defined in Table 6.2A.2.4-1 then A-MPR = MPR

if RB allocation is an outer 2 allocation as defined in Table 6.2A.2.4-2 then A-MPR = MPR-1dB

Else

A-MPR = A-MPRIM3 defined in Clause 6.2A.3.1.2.2.1

where

- MPR is the MPR as defined in Table 6.2A.2.4-2, Table 6.2A.2.1-3 and Table 6.2A.2.1-4 for PC3 and PC2 respectively and the respective CA bandwidth class

- FIM3,low\_block,high =(2 \* Flow\_alloc,high\_edge ) – Fhigh\_alloc,low\_edge

- FIM3,high\_block,low = (2 \* Fhigh\_alloc,low\_edge) – Flow\_alloc,high\_edge

- Flow\_alloc,low\_edge is the lowermost frequency of lower transmission bandwidth allocation.

- Flow\_alloc,high\_edge is the uppermost frequency of lower transmission bandwidth allocation.

- Fhigh\_alloc,low\_edge is the lowermost frequency of upper transmission bandwidth allocation.

- Fhigh\_alloc,high\_edge is the uppermost frequency of upper transmission bandwidth allocation.

- Ffilter,low = 2480 MHz

- Ffilter,high = 2745 MHz

- SEM-13,high = Threshold frequency where upper spectral emission mask for upper channel drops from -13 dBm / 1MHz to -25 dBm / 1MHz, as specified in Clause 6.5A.2.3.1.1

- SEM-13,low = Threshold frequency where lower spectral emission mask below the lower channel drops from -13 dBm / MHz to -25 dBm / MHz, as specified in Clause 6.5A.2.3.1.1

6.2A.3.1.1.1.3 AMPRIM3 to meet -25dBm/MHz

AMPR in this clause is for intra-band contiguous CA\_n41B and CA\_n41C. The allowed maximum output power reduction is defined as:

AMPRIM3=MA, Where MA is defined as follows

MA = 13; 0 ≤ B < 2.16

11.5; 2.16 ≤ B < 3.24

10.5; 3.24 ≤ B < 5.04

9.5; 5.04 ≤ B < 10.08

8; 10.08 ≤ B < 16.56

7; 16.56 ≤ B < 21.96

6; 21.96 ≤ B

Where:

B=(LCRB1\* 12\* SCS1 + LCRB2 \* 12 \* SCS2)/1,000,000

and LCRB1, SCS1 are for CC1, LCRB2, SCS2 are for CC2, CC1 is the component carrier with lower frequency.

### <Unchanged Text Skipped>

## 6.2H Transmitter power for CA with UL MIMO

### 6.2H.1 Transmitter power for intra-band UL contiguous CA with UL MIMO

#### 6.2H.1.1 UE maximum output power for intra-band UL contiguous CA with UL MIMO

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power is defined as the sum of the maximum output power from both UE antenna connectors and all UL CCs. The period of measurement shall be at least one sub frame (1 ms), as specifed in Table 6.2H.1.1-1. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively.

Table 6.2H.1.1-1: UE Power Class for intra-band UL contiguous CA with UL MIMO in closed loop spatial multiplexing scheme

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| CA\_n41C |  |  | 26 | +2/-31 | 23 | +2/-31 |  |  |
| CA\_n78C |  |  | 26 | +2/-3 | 23 | +2/-3 |  |  |
| NOTE 1: If all transmitted resource blocks 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 2: PPowerClass is the maximum UE power specified without taking into account the tolerance | | | | | | | | |

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2A.1.1 apply for at least one antenna connector for the power class as indicated by the *ue-PowerClass* field in capability signalling.

#### 6.2H.1.2 UE maximum output power reduction for intra-band UL contiguous CA with UL MIMO

For intra-band UL contiguous CA and 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 6.2H.1.1-1 is specified in Table 6.2A.2.1-1, Table 6.2A.2.1-2 for power class 3 CA; Table 6.2A.2.1-1b, Table 6.2A.2.1-4 for power class 2 CA.

The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively. For the UE maximum output power modified by MPR, the power limits specified in clause 6.2H.1.4 apply.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2A.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signaling.

#### 6.2H.1.3 UE additional maximum output power reduction for intra-band UL contiguous CA with UL MIMO

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in clause 6.2A.3 shall apply to the maximum output power specified in Table 6.2H.1.1-1. The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively.

For the UE maximum output power modified by A-MPR, the power limits specified in clause 6.2H.1.4 apply.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2A.3.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signaling.

#### 6.2H.1.4 Configured transmitted power for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA with 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 clause 6.2A.4.1.1 shall apply to UE supporting intra-band UL contiguous CA with UL MIMO, where

- ΔPPowerClass and ∆TC,c are specified in clause 6.2A.4 unless otherwise stated;

- PPowerClass,CA is the maximum UE power specified in Table 6.2H.1.1-1 without taking into account the tolerance;

- MPR, AMPR is specified in clause 6.2H.1.2 and 6.2H.1.3;

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 6.2.1-1 for the applicable operating band.

For UE supporting intra-band UL contiguous CA with UL MIMO, the tolerance is specified in Table 6.2H.4-1.

Table 6.2H.1.4-1: PCMAX,*c* tolerance for intra-band UL contiguous CA with UL MIMO

|  |  |  |
| --- | --- | --- |
| 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 | |

### <Unchanged Text Skipped>

## 6.3A Output power dynamics for CA

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

#### 6.3A.1.1 Minimum output power for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the minimum output power is defined per carrier and the requirement is specified in clause 6.3.1.

### <Unchanged Text Skipped>

## 6.3H Output power dynamics for CA with UL MIMO

### 6.3H.1 Output power dynamics for intra-band UL contiguous CA with UL MIMO

#### 6.3H.1.1 Minimum output power for intra-band UL contiguous CA with UL MIMO

For intra-band UL contiguous CA and 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 from both transmit connector in one sub-frame (1 ms) on each CC. The minimum output power shall not exceed the values specified in clause 6.3A.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.3A.1 apply.

#### 6.3H.1.2 Transmit OFF power for intra-band UL contiguous CA with UL MIMO

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1 ms) excluding any transient periods.

The transmit OFF power at each transmit antenna connector on each CC shall not exceed the values specified in clause 6.3A.2.1.

#### 6.3H.1.3 Transmit ON/OFF time mask for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the ON/OFF time mask requirements in clause 6.3A.3.1 apply at each transmit antenna connector on each CC. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.3A.3 apply.

#### 6.3H.1.4 Power control for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the power control tolerance in clause 6.3A.4.1 applies to the sum of output powers from both transmit antenna connector on each CC. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.3A.4 apply.

### <Unchanged Text Skipped>

## 6.4H Transmit signal quality for CA with UL MIMO

### 6.4H.1 Transmit signal quality for intra-band UL contiguous CA with UL MIMO

#### 6.4H.1.1 Frequency error for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency at each transmit antenna connector on each CC shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency of primary component carrier received from the NR Node B.

#### 6.4H.1.2 Transmit modulation quality for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector on each CC.

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.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.4A.2 apply.

The transmit modulation quality is specified in terms as specified in 6.4D.2.

In case the parameter 3300 or 3301 is reported from UE via the parameter *txDirectCurrentLocation-r16* in *UplinkTxDirectCurrentTwoCarrierList* IE (as defined in TS 38.331 [7]), carrier leakage measurement requirement in clause 6.4H.1.2.2 and 6.4H.1.2.3 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.

##### 6.4H.1.2.1 Error Vector Magnitude

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in clause 6.4A.2.1.1 apply per layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2H.1.1-2

##### 6.4H.1.2.2 Carrier leakage

For UE supporting intra-band UL contiguous CA and UL MIMO, the relative carrier leakage power requirements specified in clause 6.4A.2.1.3 apply at each transmit antenna connector.

##### 6.4H.1.2.3 In-band emissions

For UE supporting intra-band UL contiguous CA and UL MIMO, the In-band emission requirements specified in clause 6.4A.2.1.2 apply at each transmit antenna connector.

#### 6.4H.1.3 Time alignment error for intra-band UL contiguous CA with UL MIMO

For intra-band UL contiguous CA and UE(s) with multiple transmit antenna connectors supporting UL MIMO, this requirement applies as specified in 6.4D.3: The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors for each CC. For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

#### 6.4H.1.4 Coherent UL MIMO requirement for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the coherent UL MIMO requirement are specified on each CC as in 6.4D.4.

### <Unchanged Text Skipped>

## 6.5H Output RF spectrum emissions for CA with UL MIMO

### 6.5H.1 Output RF spectrum emissions for intra-band UL contiguous CA with UL MIMO

#### 6.5H.1.1 Occupied bandwidth for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for occupied bandwidth specified in clause 6.5A.1.1a apply to the sum of the powers from both UE transmit antenna connectors and all UL CCs. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.1.1.1a apply.

#### 6.5H.1.2 Out of band emission for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters is defined as the sum of the emissions from both UE transmit antenna connectors and all UL CCs, the requirements in subclasuse 6.5A.2.2.1, 6.5A.2.3.1 and 6.5A.2.4.1.1 apply. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.2.2.1, 6.5A.2.3.1 and 6.5A.2.4.1.1 apply.

#### 6.5H.1.3 Spurious emission for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for Spurious emissions is defined as the sum of the emissions from both UE transmit antenna connectors and all UL CCs, the requirements specified in subclasuse 6.5A.3.1, 6.5A.3.2.1 and 6.5A.3.3.1 apply. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.3.1, 6.5A.3.2.1 and 6.5A.3.3.1 apply.

#### 6.5H.1.4 Transmit intermodulation for intra-band UL contiguous CA with UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output powers from both UE transmit antenna connectors, the requirements specified in clause 6.5A.4.2.1 apply. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.4.2.1 apply.

### <End of Changes >