**3GPP TSG-RAN WG4 Meeting #100-eR4-211xxxx**

**Electronic Meeting, August 16-27, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | 0890 | **rev** | **1** | **Current version:** | **17.2.0** |  |
|  | | | | | | | | |
| *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:*** | CR to 38.101-1 Introduce SAR solution for UE power class 2 NR inter-band CA and SUL configurations | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | China Telecom | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SAR\_PC2\_interB\_SUL\_2BUL | | | | |  | ***Date:*** | | | 2021-08-25 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | WF of R4-2107741 was approved in RAN4 #99-e meeting, in which the agreements for dutycycle based SAR solution were achieved. Based on the agreements, this CR is to introduce SAR solution for UE power class 2 NR inter-band CA with 2UL and SUL configurations | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The changes include introducing the dutycycle based SAR solution procedure for both NR power class 2 CA and SUL, changing the configured transmitted power formula by adding the factor ΔPPowerClass to control power backoff machinism for NR power class 2 CA. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | UE power class 2 for NR inter-band CA and SUL configurations will not be supported | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.2A.1.3, 6.2A.4.1.3, 6.2C.1, 6.2.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.521-1 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## <Start of Changes>

### 6.2.4 Configured transmitted power

The UE is allowed to set its configured maximum output power PCMAX,f,c for carrier f of serving cell c in each slot. The configured maximum output power PCMAX,f,c is set within the following bounds:

PCMAX\_L,f,c ≤ PCMAX,f,c ≤ PCMAX\_H,f,c with

PCMAX\_L,f,c = MIN {PEMAX,c– ∆TC,c, (PPowerClass – ΔPPowerClass) – MAX(MAX(MPRc+∆MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c +∆TRxSRS, P-MPRc) }

PCMAX\_H,f,c = MIN {PEMAX,c, PPowerClass – ΔPPowerClass }

where

PEMAX,c is the value given by either the *p-Max* IE or the field *additionalPmax* of the *NR-NS-PmaxList IE*, whichever is applicable according to TS 38.331[7];

PPowerClass is the maximum UE power specified in Table 6.2.1-1 without taking into account the tolerance specified in the Table 6.2.1-1;

When the IE *powerBoostPi2BPSK* is set to 1, PEMAX,c is increased by +3 dB for a power class 3 capable UE operating in TDD bands n40, n41, n77, n78, and n79 with PI/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and 40% or less symbols in certain evaluation period are used for UL transmission when PEMAX,c ≥ 20 dBm (The exact evaluation period is no less than one radio frame).

When the IE *powerBoostPi2BPSK* is set to 1, ΔPPowerClass = -3 dB for a power class 3 capable UE operating in TDD bands n40, n41, n77, n78, and n79 with Pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and 40% or less slots in radio frame are used for UL transmission.

ΔPPowerClass =

* 3 dB for a power class 2 capable UE or 6 dB for a power class 1.5 UE when P-max of 23 dBm or lower is indicated; or when the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 50%; or when the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-PC2-FR1* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame);
* 3 dB for a power class 1.5 capable UE when P-max of between 23 dBm and 26 dB is indicated; or when the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is between 25% and 50%; or when the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is between *maxUplinkDutyCycle-PC2-FR1* and *maxUplinkDutyCycle-PC2-FR1/2* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame);
* 3dB when the UE is configured with SUL configurations and the requirements of default power class are applied as specified in sub-clause 6.2C.1 on the band where UE indicates power class 2;
* 0 dB otherwise;

∆TIB,c is the additional tolerance for serving cell c as specified in clause 6.2A.4.2 for NR CA, clause 6.2C.2 for SUL, or TS 38.101-3 clause 6.2B.4.2 for EN-DC; ∆TIB,c = 0 dB otherwise; In case the UE supports more than one of band combinations for CA, SUL or DC, and an operating band belongs to more than one band combinations then

a) When the operating band frequency range is ≤ 1 GHz, the applicable additional ∆TIB,c shall be the average value for all band combinations defined in clause 6.2A.4.2, 6.2C.2 in this specification and 6.2B.4.2 in TS 38.101-3 [3], truncated to one decimal place that apply for that operating band among the supported band combinations. In case there is a harmonic relation between low band UL and high band DL, then the maximum ∆TIB,c among the different supported band combinations involving such band shall be applied

b) When the operating band frequency range is > 1 GHz, the applicable additional ∆TIB,c shall be the maximum value for all band combinations defined in clause 6.2A.4.2, 6.2C.2 in this specification and 6.2B.4.2 in TS 38.101-3 [3] for the applicable operating bands.

∆TC,c = 1.5dB when NOTE 3 in Table 6.2.1-1 in 38.101-1 applies for a serving cell c, otherwise ∆TC,c = 0 dB ;

MPRc and A-MPRc for serving cell c are specified in clause 6.2.2 and clause 6.2.3, respectively;

∆MPRc for serving cell c is specified in clause 6.2.2.

∆TRxSRS is applied when

a) UE transmits SRS to other than first SRS port when the *SRS-TxSwitch* capability is indicated as '1T2R', '1T4R' or, '1T4R/2T4R'

b) UE transmits SRS to other than first or second SRS port when the *SRS-TxSwitch* capabilityis indicated as '2T4R' or '1T4R/2T4R', or

c) UE transmits SRS to a DL-only carrier

The value of ∆TRxSRS is 4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 3 in the band. The value of ∆TRxSRS is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 2 in the band.

For other SRS transmissions ∆TRxSRS is zero;

P-MPRc is the power management maximum 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-MPRc for serving cell c only for the above cases. For UE conducted conformance testing P-MPRc shall be 0 dB

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

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

TREF and Teval are specified in Table 6.2.4-1. For each TREF, the PCMAX,L,c for serving cell c are evaluated per Teval and given by the minimum value taken over the transmission(s) within the Teval; the minimum PCMAX\_L,f,c over one or more Teval is then applied for the entire TREF

Table 6.2.4-1: Evaluation and reference periods for Pcmax

|  |  |  |
| --- | --- | --- |
| TREF | Teval | Teval with frequency hopping |
| Physical channel length | Physical channel length | Min(*Tno\_hopping*, Physical Channel Length) |

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

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

where the tolerance T(PCMAX,f,c) for applicable values of PCMAX,f,c is specified in Table 6.2.4-1. The tolerance TL,c is the absolute value of the lower tolerance for the applicable operating band as specified in Table 6.2.1-1.

Table 6.2.4-1: PCMAX tolerance

|  |  |
| --- | --- |
| PCMAX,f,c (dBm) | Tolerance T(PCMAX,f,c) (dB) |
| 23 < PCMAX,c ≤ 33 | 2.0 |
| 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 |

## <Next Changes>

#### 6.2A.1.3 UE maximum output power for Inter-band CA

For power class 3 inter-band downlink carrier aggregation with one uplink carrier assigned to one NR band, the transmitter power requirements power class 3 in clause 6.2 apply.

For other power class except class 3 inter-band downlink carrier aggregation with one uplink carrier assigned to one NR band, the maximum output power is specified in Table 6.2A.1.3-2. The period of measurement shall be at least one sub frame (1 ms).

For inter-band uplink carrier aggregation with uplink assigned to two NR bands, UE maximum output power shall be measured over all component carriers from different bands. If each band has separate antenna connectors, maximum output power is defined as the sum of maximum output power from each UE antenna connector. The period of measurement shall be at least one sub frame (1 ms). The maximum output power is specified in Table 6.2A.1.3-1.

Table 6.2A.1.3-1 UE Power Class for uplink inter-band CA (two bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Uplink CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance  (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| CA\_n1A-n3A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n7A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n8A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n18A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n28A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n1A-n40A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n1A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n74A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n1A-n77A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n1A-n78A |  |  | 266 | +2/-3 | 23 | +2/-3 |  |  |
| CA\_n1A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n2A-n5A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n7A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n12A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n14A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n30A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n48A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n2A-n77A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n2A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n7A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n8A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n18A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n28A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n34A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3-n38A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n40A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n41A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n3A-n74A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n3A-n79A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n5A-n12A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n5A-n14A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n5A-n25A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n5A-n30A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n5A-n48A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n5A-n66A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n5A-n77A |  |  | 266 | +2/-32 | 23 | +2/-3 |  |  |
| CA\_n5A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n5A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n7A-n25A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n7A-n28A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n7A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n7A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n7A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n34A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n39A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n40A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n8A-n79A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n12A-n30A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n12A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n12A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n13A-n25A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n13A-n66A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n13A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n14A-n30A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n14A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n14A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n18A-n28A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n18A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n18A-n74A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n18A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n18A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n20A-n28A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n20A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n24A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n24A-n48A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n24A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n25A-n38A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n25A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_25A-n48A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n25A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n25A-n77A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n25A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n28A-n40A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n28A-n41A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n28A-n50A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n28A-n74A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n28A-n77A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n28A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n28A-n79A |  |  | 266 | +2/-32 | 23 | +2/-3 |  |  |
| CA\_n34A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n30A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n30A-n77A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n34A-n40A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n38A-n66A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n38A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n39A-n40A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n39A-n41A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n39A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n40A-n41A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n40A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n40A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n41A-n66A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n41A-n71A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n41A-n74A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n41A-n77A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n41A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n41A-n79A |  |  | 266 | +2/-32 | 23 | +2/-32 |  |  |
| CA\_n41A-n50A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n46A-n48A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n46A-n48B |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n48A-n66A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n50A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n66A-n71A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n66A-n77A |  |  | 266 | +2/-32 | 23 | +2/-3 |  |  |
| CA\_n66A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n70A-n71A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n71A-n77A |  |  | 266 | +2/-32 | 23 | +2/-3 |  |  |
| CA\_n71A-n78A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n74A-n77A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n74A-n78A |  |  |  |  | 23 | +2/-32 |  |  |
| CA\_n77A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n78A-n79A |  |  |  |  | 23 | +2/-3 |  |  |
| CA\_n78A-n92A |  |  |  |  | 23 | +2/-32 |  |  |
| NOTE 1: Void  NOTE 2: 2 refers to the transmission bandwidths 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: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE).  NOTE 5: Power class 3 is the default power class unless otherwise stated.  NOTE 6: The UE supports PC3 within NR FDD band, and supports either PC3 or PC2 within NR TDD band. | | | | | | | | |

If a UE supports a different power class than the default UE power class for the band combination listed in Table 6.2A.1.3-1 and the supported power class enables the higher maximum output power than that of the default power class:

- if the field of UE capability *maxUplinkDutyCycle-interBandCA-PC2* is absent and the average percentage of uplink symbols transmitted in a certain evaluation period is larger than 50% (The exact evaluation period is no less than one radio frame); or

- if the field of UE capability *maxUplinkDutyCycle-interBandCA-PC2* is not absent and the average percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-interBandCA-PC2* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); or

- if the IE P-Max as defined in TS 38.331 [7] is provided and set to the maximum output power of the default power class or lower;

- shall apply all requirements for the default power class to the supported power class and set the configured transmitted power as specified in clause 6.2A.4;

- else if the IE *P-Max* as defined in TS 38.331 [7] is not provided or set to the higher value than the maximum output power of the default power class and the average percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to *maxUplinkDutyCycle-interBandCA-PC2* as defined in TS 38.331; or

- if the IE *P-Max* as defined in TS 38.331 [7] is not provided or set to the higher value than the maximum output power of the default power class and the average percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to 50% when *maxUplinkDutyCycle-interBandCA-PC2* is absent. (The exact evaluation period is no less than one radio frame):

- shall apply all requirements for the supported power class and set the configured transmitted power as specified in clause 6.2A.4.

While, the average percentage of uplink symbols is defined as 50% × ( DutyNR, x /maxDutyNR,x + DutyNR, y /maxDutyNR,y, )

DutyNR, x, DutyNR, y represent the actual percentage of uplink symbols transmitted in the same ~~certain~~ evaluation period (The exact evaluation period is no less than one radio frame) for NR Band x, NR Band y respectively; maxDutyNR,x,maxDutyNR,y represent the field of UE capability *maxUplinkDutyCycle-PC2-FR1* per band as defined in TS 38.331. For NR Band x or NR Band y,

* if the band is configured with power class 2 and the corresponding UE capability *maxUplinkDutyCycle-PC2-FR1* is absent;
* the corresponding maxDutyNR,x or maxDutyNR,y is equal to 50%;
* else if the band is configured with power class 3;
* the corresponding maxDutyNR,x or maxDutyNR,y is equal to 100%.

Table 6.2A.1.3-2 UE Power Class except class 3 for downlink inter-band CA (two bands DL/ 1 band UL)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Downlink CA Configuration | Band | Class 1.5 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance  (dB) |
| CA\_n1A-n78A | n78 |  |  | 264 | +2/-31 |
| CA\_n2A-n77A, CA\_n2A-n77(2A) | n77 |  |  | 264 | +2/-31 |
| CA\_n3A-n41A | n41 |  |  | 264 | +2/-31 |
| CA\_n5A-n77A, CA\_n5A-n77(2A) | n77 |  |  | 264 | +2/-31 |
| CA\_n25A-n77A | n77 |  |  | 264 | +2/-31 |
| CA\_n28A-n41A | n41 |  |  | 264 | +2/-31 |
| CA\_n28A-n79A | n79 |  |  | 264 | +2/-31 |
| CA\_n40A-n41A | n41 |  |  | 264 | +2/-31 |
| CA\_n41A-n77A | n41, n77 |  |  | 264 | +2/-31 |
| CA\_n41A-n79A | n41, n79 |  |  | 264 | +2/-31 |
| CA\_n66A\_n77A, CA\_n66A-n77(2A) | n77 |  |  | 264 | +2/-31 |
| CA\_n71A-n77A | n77 |  |  | 264 | +2/-31 |
| NOTE 1: 2 refers to the transmission bandwidths 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 2: PPowerClass is the maximum UE power specified without taking into account the tolerance.  NOTE 3: Power class 3 is the default power class unless otherwise stated.  NOTE 4: The power class is supported by UE within NR TDD band. | | | | | |

If a UE supports a different power class than the default UE power class for the band combination listed in Table 6.2A.1.3-2 and the supported power class enables the higher maximum output power than that of the default power class, the UE shall apply procedures as specified in 6.2.1.

## <Next Changes>

##### 6.2A.4.1.3 Configured transmitted power for Inter-band 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 clause 6.2.4.

For uplink inter-band carrier aggregation, MPR*c* and A-MPR*c* apply per serving cell *c* and are specified in clause 6.2.2 and clause 6.2.3, respectively. P-MPR*c* accounts for power management for serving cell *c*. PCMAX,*c* is calculated under the assumption that the transmit power is increased independently 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 inter-band carrier aggregation with one serving cell c per operating band when same slot symbol pattern is used in all aggregated serving cells,

PCMAX\_L = MIN {10log10∑ MIN [ pEMAX,c/(tC,c), pPowerClass.c/(MAX(mprc·∆mprc, a-mprc)·tC,c ·tIB,c·tRxSRS,c), pPowerClass,c/pmprc], PEMAX,CA, PPowerClass,CA-ΔPPowerClass, CA}

PCMAX\_H = MIN{10 log10 ∑ pEMAX,c , PEMAX,CA, PPowerClass,CA-ΔPPowerClass, CA}

where

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

- PPowerClass,CA is the maximum UE power specified in Table 6.2A.1.3-1 without taking into account the tolerance specified in the Table 6.2A.1.3-1;

- pPowerClass,c is the linear value of the maximum UE power for serving cell *c* specified in Table 6.2.1-1 without taking into account the tolerance;

- ΔPPowerClass, CA = 3 dB for a power class 2 capable UE when P-max of 23 dBm or lower is indicated; or when the field of UE capability *maxUplinkDutyCycle-interBandCA-PC2* is absent and the average percentage of uplink symbols transmitted in a certain evalutation period is larger than 50% (The average percentage of uplink symbols is specified in 6.2A.1.3); or when the field of UE capability *maxUplinkDutyCycle-interBandCA-PC2* is not absent and the average percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-interBandCA-PC2* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); otherwise ΔPPowerClass, CA = 0 dB;- mpr *c* and a-mpr *c* are the linear values of MPR *c* and A-MPR *c* as specified in clause 6.2.2 and clause 6.2.3, respectively;

- ∆mpr *c* is the linear value of ∆MPR *c* as specified in clause 6.2.2;

- pmprc is the linear value of P-MPR*c*;

- ∆tRxSRS,c is the linear value of ∆TRxSRS,c;

- tC,c is the linear value of TC,ctC,c = 1.41 when NOTE 2 in Table 6.2A.1.3-1 applies for a serving cell *c*, otherwise tC,c = 1;

- tIB,c is the linear value of the inter-band relaxation term TIB,c of the serving cell *c* as specified in clause 6.2A.4.2 for NR CA, clause 6.2C.2 for SUL, or TS 38.101-3 clause 6.2B.4.2 for EN-DC; otherwise tIB,c In case the UE supports more than one of band combinations for CA, SUL or DC, and an operating band belongs to more than one band combinations then

a) When the operating band frequency range is ≤ 1 GHz, the applicable additional TIB,c shall be the average value for all band combinations defined in clause 6.2A.4.2, 6.2C.2 in this specification and 6.2B.4.2 in TS 38.101-3 [3], truncated to one decimal place that apply for that operating band among the supported band combinations. In case there is a harmonic relation between low band UL and high band DL, then the maximum ∆TIB,c among the different supported band combinations involving such band shall be applied

b) When the operating band frequency range is > 1 GHz, the applicable additional ∆TIB,c shall be the maximum value for all band combinations defined in clause 6.2A.4.2, 6.2C.2 in this specification and 6.2B.4.2 in TS 38.101-3 [3] for the applicable operating bands.

- PEMAX,CA is the value indicated by *p-NR-FR1* or by *p-UE-FR1* whichever is the smallest if both are present.For uplink inter-band carrier aggregation with one serving cell *c* per operating band when at least one different numerology/slot pattern is used in aggregated cells, the UE is allowed to set its configured maximum output power PCMAX,c(i),i for serving cell c(i) of slot numerology type *i*, and its total configured maximum output power PCMAX.

The configured maximum output power PCMAX,c(i),i (p) in slot p of serving cell c(i) on slot numerology type *i* shall be set within the following bounds:

PCMAX\_L,f,c(i),i (p) ≤ PCMAX,f,c(i), i (p) ≤ PCMAX\_H,f,c(i),i (p)

where PCMAX\_L,f,c (i),i (p) and PCMAX\_H,f,c(i),i (p) are the limits for a serving cell c(i) of slot numerology type i as specified in clause 6.2.4.

The total UE configured maximum output power PCMAX (p,q) in a slot p of slot numerology or symbol pattern *i*, and a slot q of slot numerology or symbol pattern *j* that overlap in time shall be set within the following bounds unless stated otherwise:

PCMAX\_L(p,q) ≤ PCMAX (p,q) ≤ PCMAX\_H (p,q)

When slots p and q have different transmissions lengths and belong to different cells on different bands:

PCMAX\_L (p,q) = MIN {10 log10 [pCMAX\_L,f,c(i),i (p) + pCMAX\_L,f,c(i),j (q)], PPowerClass,CA, PEMAX,CA}

PCMAX\_H (p,q) = MIN {10 log10 [pCMAX\_ H,f,c(i),i (p) + pCMAX\_ H,f,c(i),j (q)], PPowerClass,CA, PEMAX,CA}

where pCMAX\_L,f,c (i),i and pCMAX\_ H,f,c(i),i are the respective limits PCMAX\_L,f,c (i),i and PCMAX\_H,f,c(i),i expressed in linear scale.

For combinations of intra-band and inter-band carrier aggregation with UE configured for transmission on three serving cells (up to two contiguously aggregated carriers per operating band), the following apply:

For the case when p and q belong to the same band and k belongs to a different band, but p, q and k are of the same numerology and slot patterns.

PCMAX\_L = MIN {10log10∑( pCMAX\_L, Bi), PEMAX,CA, PPowerClass}

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

Where

- pCMAX\_L, Bi is the linear values of PCMAX\_L specified for the specific operating band *Bi*.

- The linear value of PCMAX\_L specified for uplink intra-band contiguous carrier aggregation in subclause 6.2A.4.1.1 applies for operating band supporting two contiguous serving cells, designated by its band index *Bi*. The linear value of PCMAX\_L specified for single carrier in subclause 6.2.4 applies for operating band *Bj* supporting one serving cell.

For the case when p and q belong to the same band and are of the same numerology *i* and slot patterns (p,q),while k belong to a different band and is of different numerology *j* and/or slot pattern on the 3rd cell then:

PCMAX\_L (p,q,k) = MIN {10 log10 [pCMAX\_L,Bi,i(p,q) + pCMAX\_L,c(3),Bj,j(k)], PEMAX,CA, PPowerClass}

PCMAX\_H (p,q,k) = MIN {10 log10 [pCMAX\_ H,Bi,i (p,q) + pCMAX\_ H,c(3), Bj,j(k)], PEMAX,CA, PPowerClass}

Where

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

- PEMAX,CA is p-UE-FR1 value signalled by RRC and defined in [38.331];

- PPowerClass is the maximum UE power specified in Table 6.2A.1.3-1 without taking into account the tolerance specified in the Table 6.2A.1.3-1 or Table 6.2F.1A.1-1 for shared spectrum bands;

- pCMAX\_L,c(3),Bj,j(k) and pCMAX\_ H,c(3), Bj,j(k)are the linear values of PCMAX\_L and PCMAX\_H respectively, specified for single carrier in subclause 6.2.4 and applies for operating band supporting one serving cell in the *Bj* band on numerology *j*, using slot pattern k;

- pCMAX\_L,Bi,i(p,q) and pCMAX\_ H,Bi,i (p,q) are the linear values of PCMAX\_L respectively PCMAX\_H for uplink intra-band contiguous carrier aggregation specified in subclause 6.2A.4.1.1 which applies for operating band *Bi* on numerology *i*, supporting two contiguous serving cells, using the same slot pattern (p,q).

TREF and Teval are specified in Table 6.2A.4.1.3-0 when same and different slot patterns are used in aggregated carriers. For each TREF, the PCMAX\_L is evaluated per Teval and given by the minimum value taken over the transmission(s) within the Teval; the minimum PCMAX\_L over the one or more Teval is then applied for the entire TREF. The lesser of PPowerClass,CA and PEMAX,CA shall not be exceeded by the UE during any period of time.

Table 6.2A.4.1.3-0: PCMAX evaluation window for different slot and channel durations

|  |  |  |
| --- | --- | --- |
| TREF | Teval | Teval with frequency hopping |
| TREF of largest slot duration over both UL CCs | Physical channel length | Min(Tno\_hopping, Physical Channel Length) |

If the UE is configured with multiple TAGs and transmissions of the UE on slot *i* for any serving cell in one TAG overlap some portion of the first symbol of the transmission on slot *i* +1 for a different serving cell in another TAG, the UE minimum of PCMAX\_L for slots *i* and *i* + 1 applies for any overlapping portion of slots *i* and *i* + 1. The lesser of PPowerClass,CA and PEMAX,CA shall not be exceeded by the UE during any period of time.

The measured maximum output power PUMAX over all serving cells with same slot pattern 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 6.2A.4.1.3-1. The tolerance TL is the absolute value of the lower tolerance for applicable NR CA configuration as specified in Table 6.2A.1.3-1-2 for inter-band carrier aggregation.

The measured maximum output power PUMAX over all serving cells, when at least one slot has a different transmission numerology or symbol pattern, shall be within the following range:

P'CMAX\_L– MAX{TL, TLOW (P'CMAX\_L)} ≤ P'UMAX  ≤ P'CMAX\_H + THIGH (P'CMAX\_H)

P'UMAX = 10 log10 ∑ p'UMAX,c

where p'UMAX,c denotes the average measured maximum output power for serving cell *c* expressed in linear scale over TREF. The tolerances TLOW(P'CMAX) and THIGH(P'CMAX) for applicable values of P'CMAX are specified in Table 6.2A.4.1.3-1 for inter-band carrier aggregation. The tolerance TL is the absolute value of the lower tolerance for applicable NR CA configuration as specified in Table 6.2A.1.3-1 for inter-band carrier aggregation.

where:

P'CMAX\_L  = MIN{ MIN {10log10∑( pCMAX\_L,f,c(i),i), PPowerClass,CA} over all overlapping slots in TREF}

P'CMAX\_H = MAX{ MIN{10 log10 ∑ pEMAX,c , PPowerClass,CA} over all overlapping slots in TREF}

Table 6.2A.4.1.3-1: PCMAX tolerance for uplink inter-band CA (two bands)

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

## <Next Changes>

### 6.2C.1 Configured transmitted power for SUL

When a UE is configured with both NR UL and NR SUL carriers in a serving cell with active transmission either on the UL carrier(s) or SUL carrier, the configured transmit power requirements specified in clause 6.2.4 and 6.2A.4 are applicable for the UL carrier(s) and the SUL carrier, respectively.

If a UE supports a different power class than the default UE power class for NR UL band of SUL combination and the supported power class enables the higher maximum output power for SUL combination than that of the default power class:

- if the field of UE capability *maxUplinkDutyCycle- SULcombination-PC2* is absent and the average percentage of uplink symbols transmitted in a certain evaluation period is larger than 50% (The exact evaluation period is no less than one radio frame); or

- if the field of UE capability *maxUplinkDutyCycle- SULcombination-PC2* is not absent and the average percentage of uplink symbols transmitted in a certain evaluation period is larger than the maximum percentage of uplink symbols that the UE indicates by *maxUplinkDutyCycle- SULcombination-PC2* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); or

- if the IE P-Max as defined in TS 38.331 [7] is provided and set to the maximum output power of the default power class or lower;

- shall apply all requirements for the default power class to the supported power class and set the configured transmitted power as specified in clause 6.2.4;

- else if the IE *P-Max* as defined in TS 38.331 [7] is not provided or set to the higher value than the maximum output power of the default power class and the average percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to *maxUplinkDutyCycle- SULcombination-PC2* as defined in TS 38.331; or

- if the IE *P-Max* as defined in TS 38.331 [7] is not provided or set to the higher value than the maximum output power of the default power class and the average percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to 50% when *maxUplinkDutyCycle- SULcombination-PC2* is absent. (The exact evaluation period is no less than one radio frame):

- shall apply all requirements for the supported power class and set the configured transmitted power as specified in clause 6.2.4.

While, the average percentage of uplink symbols is defined as 50% × ( DutyNR, x /maxDutyNR,x + DutyNR, y /maxDutyNR,y, )

DutyNR, x, DutyNR, y represent the actual percentage of uplink symbols transmitted in a same certain evaluation period (The exact evaluation period is no less than one radio frame) for NR Band x, NR Band y respectively maxDutyNR,x,maxDutyNR,y represent the field of UE capability *maxUplinkDutyCycle-PC2-FR1* per band as defined in TS 38.331. For NR Band x or NR Band y,

* if the band is configured with power class 2 and the corresponding UE capability *maxUplinkDutyCycle-PC2-FR1* is absent;
* the corresponding maxDutyNR,x or maxDutyNR,y is equal to 50%;
* else if the band is configured with power class 3;
* the corresponding maxDutyNR,x or maxDutyNR,y is equal to 100%.

## <End of Changes>