**3GPP TSG- Meeting #109 *Rev of R4-2320032***

**Chicago, US, November 13 – 17, 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  |  | **CR** |  | **rev** | **1** | **Current version:** |  |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | CR to 38.101 for introduction of MPR reduction | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_cov\_enh2 | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | |  |
|  | *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:*** | | MPR reduction is to be introduced to the specification according to RAN4 agreement. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This CR follow agreed approach for the introduction of a reduction of MPR and enabeling power boosting for QPSK. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | There are no MPR reduction and/or power boosting for QPSK. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.2.2, 6.2.3, 6.2.4, 6.4.2.4.1, 6.5.2.4.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | This revision incorporates changes agreed during RAN4#109 | | | | | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* START OF CHANGES \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 6.2.2 UE maximum output power reduction

UE is allowed to reduce the maximum output power due to higher order modulations and transmit bandwidth configurations. For UE power class 2 and 3 and UE power class 1, the allowed maximum power reduction (MPR) is defined in Table 6.2.2-2, Table 6.2.2-1, Table 6.2.2-4b and Table 6.2.2-5, respectively for channel bandwidths ≤ 100 MHz. For UE power class 1.5, the allowed maximum power reduction (MPR) is defined in Table 6.2D.2-2 and Table 6.2D.2-3 in accordance with the indicated *modifiedMPR-Behavior* specified in Table L.1-1 for channel bandwidths ≤ 100 MHz. . When A UE that indicates PC1.5 for a given band is limited to PC2 by the rules in clause 6.2.1, the MPR requirements in Table 6.2.2-2 apply.

If the relative channel bandwidth ≤ 4% for TDD bands or ≤ 3% for FDD band, the ∆MPR is set to zero.

If the relative channel bandwidth > 4% for TDD bands or > 3% for FDD bands, the ∆MPR is defined in Table 6.2.2-3.

Where relative channel bandwidth = 2\*BWChannel / (FUL\_low + FUL\_high)

The allowed MPR for SRS, PUCCH formats 0, 1, 3 and 4, and PRACH shall be as specified for QPSK modulated DFT-s-OFDM of equivalent RB allocation. The allowed MPR for PUCCH format 2 shall be as specified for QPSK modulated CP-OFDM of equivalent RB allocation.

Table 6.2.2-1 Maximum power reduction (MPR) for power class 3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.51 | ≤ 1.21 | ≤ 0.21 |
|  |  | ≤ 0.52,3 | ≤ 0.52 | 02,4 |
|  | Pi/2 BPSK w Pi/2 BPSK DMRS | ≤ 0.52,3 | 02 | 02,4 |
|  | QPSK | ≤ 1 | | 05 |
|  | 16 QAM | ≤ 2 | | ≤ 1 |
|  | 64 QAM | ≤ 2.5 | | |
|  | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3 | | ≤ 1.5 |
|  | 16 QAM | ≤ 3 | | ≤ 2 |
|  | 64 QAM | ≤ 3.5 | | |
|  | 256 QAM | ≤ 6.5 | | |
| NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0 dB MPR is 26 dBm.  NOTE 2: Applicable for conditions where note 1 does not apply.  NOTE 3: For 3 MHz channel bandwidth the Pi/2 BPSK edge allocation MPR is 1 dB  NOTE 4: For a UE indicating support for UE capability [*powerBoostRel18*] and if the IE [*powerBoostPi2BPSKRel18*] is set to 1, the reference power is increased equivalent to ΔPPowerBoost - ΔPPowerClass  NOTE 5: For a UE indicating support for UE capability [*powerBoostRel18*] and if the IE [*powerBoostQPSKRel18*] is set to 1, the reference power is increased equivalent to to ΔPPowerBoost - ΔPPowerClass | | | | |

Mediatek: the power boosting will be independent capability from transparent waveform.

Moderator: power boosting will be a capability. There will be two capabilities.

Mediatek: we cannot accept the power boosting for outer region for PC2

Huawei: we cannot accept the power boosting for PC2. We had analysis.

Smarter: we agree with Huawei.

Qualcomm: about PC2, in last meeting, there are wide range of companies supporting PC2. We do agree that there is implementation challenges. It is optional feature. As far as the technique concern, PC1.5 won’t exist. We do not think the argument is justified.

Apple: We are not quite happy to include PC2. We propose to keep PC3 only.

Vivo: Our first preference is not to include PC2. PC3 has full analysis.

Ericsson: we also provided PC2 analysis. This is optional feature. PC2 has only 0.5dB improvement. There is really constraint for power boosting for PC2.

Huawei: Our analysis is based on measurement. There is difficulty. We need consider filter design and other aspects rather than only from PA perspective.

Qualcomm: PC1.5 won’t happen if following Huawei comment. This is the optional feature. Moreover the network control is agreed. It is safe for both network and UE perspective.

Huawei: At least we have the same situation for other feature.

Spreadtrum: According to our measurement data, PC2 is challenging for us. We prefer PC3.

Verizon: We do not want to remove PC2. We have market waiting for this.

Mediatek: the compromise would be PC2 within the inner region.Verizon: This morning we had discussions. We made some progress. The issue can be addressed.

Intel: Support to define PC2 as optional feature. Support Qualcomm. We need find some compromise.

T-Mobile USA: we support PC2 as optional feature.

Moderator: we make the progress on the framework how to do. It seems diversing now for which power class we should do the power boosting. We can continue work on the CR and split them into two streams: PC3 and PC2.

Table 6.2.2-2 Maximum power reduction (MPR) for power class 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.5 | ≤ 0.5 | 0 |
|  |  |  |  | 0.51 |
|  | QPSK | ≤ 3.5 | ≤ 1 | 0 |
|  |  |  |  | 0.52 |
|  | 16 QAM | ≤ 3.5 | ≤ 2 | ≤ 1 |
|  | 64 QAM | ≤ 3.5 | ≤ 2.5 | |
|  | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3.5 | ≤ 3 | ≤ 1.5 |
|  | 16 QAM | ≤ 3.5 | ≤ 3 | ≤ 2 |
|  | 64 QAM | ≤ 3.5 | | |
|  | 256 QAM | ≤ 6.5 | | |
| NOTE 1: Applicable for a UE indicating support for UE capability [powerBoostRel18] and if the IE [powerBoostPi2BPSKRel18] is set to 1. The reference power is increased equivalent to ΔPPowerBoost.  NOTE 2: Applicable for a UE indicating support for UE capability [powerBoostRel18] and if the IE [powerBoostQPSKRel18] is set to 1. The reference power is increased equivalent to ΔPPowerBoost. | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* UNCHANGED CLAUSES OMITTED \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 6.2.3 UE additional maximum output power reduction

#### 6.2.3.1 General

Additional emission requirements can be signalled by the network. Each additional emission requirement is associated with a unique network signalling (NS) value indicated in RRC signalling by an NR frequency band number of the applicable operating band and an associated value in the field *additionalSpectrumEmission.* Throughout this specification, the notion of indication or signalling of an NS value refers to the corresponding indication of an NR frequency band number of the applicable operating band, the IE field *freqBandIndicatorNR* and an associated value of *additionalSpectrumEmission* in the relevant RRC information elements [7]*.*

To meet the additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in Table 6.2.1-1. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPR is defined in clause 6.2.2. Outer and inner allocation notation used in clause 6.2.3 is defined in clause 6.2.2. Unless stated otherwise, Edge RB allocations get the same AMPR as Outer RB allocations. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

Table 6.2.3.1-1 specifies the additional requirements with their associated network signalling values and the allowed A-MPR and applicable operating band(s) for each NS value. In case of a power class 3 UE, when IE *powerBoostPi2BPSK* is set to 1, power class 2 A-MPR values apply. In case of a UE, when IE [*powerBoostPi2BPSKRel18*] or [*powerBoostQPSKRel18*] is set to 1 the A-MPR is increased equivalent ΔPPowerBoost. The mapping of NR frequency band numbers and values of the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2.3.1-1A.

For almost contiguous allocations in CP-OFDM waveforms in power class 3, the allowed A-MPR defined in clause 6.2.3 is increased by CEIL{ 10 log10(1 + NRB\_gap / NRB\_alloc), 0.5 } dB, where CEIL{x, 0.5} means x rounding upwards to closest 0.5dB, NRB\_gap is the total number of unallocated RBs between allocated RBs and NRB\_alloc is the total number of allocated RBs, and the parameter LCRB is replaced by NRB\_alloc + NRB\_gap in specifying the RB allocation regions.

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.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* UNCHANGED CLAUSES OMITTED \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 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 + ΔPPowerBoost) – MAX(MAX(MPRc+∆MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c +∆TRxSRS, P-MPRc) }

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

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 and in Table 6.2F.1-1 for shared spectrum access operation, without taking into account the tolerance specified in the Table 6.2.1-1 and in Table 6.2F.1-1 for shared spectrum access operation;

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 field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-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 38.306 (The exact evaluation period is no less than one radio frame); or when the field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-FR1* is not absent and half the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-PC1dot5-MPE-FR1* as defined in TS 38.306 (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 field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-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 38.306 (The exact evaluation period is no less than one radio frame); or when the field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-FR1* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-PC1dot5-MPE-FR1* as defined in TS 38.306 (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;

- 3dB is applied during SRS transmission occasions with usage in SRS-ResourceSet set as ‘antennaSwitching’ with configured SRS resources in each SRS resource set(s) consisting of one SRS port when PC2 capable UE with txDiversity-r16 capability or PC1.5 capable UE further indicates SRS-TxSwitch capability ‘t1r2’ or ‘t1r4’ or ‘t1r1-t1r2’ or ‘t1r1-t1r2-t1r4’;

- 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 V2X operating bands for concurrent operation, 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.

ΔPPowerBoost = 1dB and PEMAX,c is increased by +1 dB when all of the following conditions are met

* If the IE [*powerBoostPi2BPSKRel18*] or [*powerBoostQPSKRel18*] is set to 1
* If UE indicates power class 2 or power class 3
* ΔPPowerClass is set to 0dB with UE indicating support for UE capability [*powerBoostRel18*], or ΔPPowerClass is set to +3 dB with UE indicating support for UE capability [*powerBoostRel18*\_**Reduced**]
* If scheduled UL transmission is DFT-s-OFDM with either PI/2 BPSK modulation or QPSK modulation and the RB allocation [belongs to the inner region]
* If the RB allocation is at least [5 MHz] from the band edges as defined in table 5.2.1.
* If UE indicates power class 3 or ΔPPowerClass is set to 3dB, the percentage of uplink symbols transmitted in a certain evaluation period is less than 80%
* If UE indicates power class 2 and ΔPPowerClass is set to 0dB, when the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is absent and the field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-FR1* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is less than 0.8\*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 less than 0.8\**maxUplinkDutyCycle-PC2-FR1* as defined in TS 38.306 (The exact evaluation period is no less than one radio frame); or when the field of UE capability *maxUplinkDutyCycle-PC1dot5-MPE-FR1* is not absent and half the percentage of uplink symbols transmitted in a certain evaluation period is less than 0.8\**maxUplinkDutyCycle-PC1dot5-MPE-FR1* as defined in TS 38.306 (The exact evaluation period is no less than one radio frame)

- 0 dB otherwise;

∆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 and in clause 6.2F.2 and clause 6.2F.3 respectively for shared spectrum access operation;

∆MPRc for serving cell c is specified in clause 6.2.2 and in clause 6.2F.2 for shared spectrum access operation.

∆TRxSRS is applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ when

a) UE transmits SRS on the second SRS resource in every configured SRS resource set when the *SRS-TxSwitch* capability is indicated as 't1r2' or 't1r1-t1r2'

b) UE transmits SRS on the second, third and fourth SRS resources of the total 4 SRS resources from all configured SRS resource set(s) consisting of one SRS port when the *SRS-TxSwitch* capability is indicated as 't1r4' or, 't1r4-t2r4' or 't1r1-t1r2-t1r4' or, 't1r1-t1r2-t2r2-t1r4-t2r4'

c) UE transmits SRS from the second SRS port pair on the second SRS resource in every configured SRS resource set consisting of two SRS ports when the *SRS-TxSwitch* capabilityis indicated as' t2r4' or ' t1r4-t2r4', or 't1r1-t1r2-t2r2-t2r4' or 't1r1-t1r2-t2r2-t1r4-t2r4', or

d) UE transmits SRS to a DL-only carrier

The value of ∆TRxSRS is 4.5dB for bands whose FUL\_high is higher than the FUL\_low of 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 or power class 5 or power class 1.5 in the band, or when the device is capable of power class 2 in the band and ΔPPowerClass = 3 dB, or when UE indicating *txDiversity-r16*~~.~~.

The value of ∆TRxSRS is 7.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 during SRS transmission occasions with configured SRS resources consisting of one SRS port when the device is capable of power class 2 in the band and ΔPPowerClass = 0 dB and not indicating *txDiversity-r16*.

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 and in Table 6.2F.1-1 for shared spectrum access operation.

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 |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* UNCHANGED CLAUSES OMITTED \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

6.4.2.4.1 Requirements for Pi/2 BPSK modulation with *powerBoosting-pi2BPSK* capabilty

These requirements apply if the IE *powerBoostPi2BPSK* is set to 1 for 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. These requirements also apply if the IE *dmrs-UplinkTransformPrecoding-r16* is configured and UE indicates support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*. Otherwise the requirements for EVM equalizer spectrum flatness defined in clause 6.4.2.4 apply

The EVM equalizer coefficients across the allocated uplink block shall be modified to fit inside the mask specified in Table 6.4.2.4.1-1 for normal conditions, prior to the calculation of EVM. The limiting mask shall be placed to minimize the change in equalizer coefficients in a sum of squares sense.

**Table 6.4.2.4.1-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions**

|  |  |  |
| --- | --- | --- |
| **Frequency range** | **Parameter** | **Maximum ripple (dB)** |
| |FUL\_Meas – Fcenter| ≤ X MHz  (Range 1) | X1 | 6 (p-p) |
| |FUL\_Meas – Fcenter| > X MHz  (Range 2) | X2 | 14 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: Fcenter refers to the center frequency of an allocated block of PRBs  NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation  NOTE 4: See Figure 6.4.2.4.1-1 for description of X1, X2 | | |



**Figure 6.4.2.4.1-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. .**

For Pi/2 BPSK modulation the UE shall be allowed to employ spectral shaping and the shaping filter shall be restricted so that the impulse response of the shaping filter itself shall meet

│*ãt*(*t*,0)│ ≥ │*ãt*(*t*, *τ*)│ ∀*τ* ≠ 0

20*log*10│*ãt*(*t*,*τ*)│< -15 dB 1< *τ* < M – 1,

where│*ãt*(*t*, *τ*)│=*IDFT*{│*ãt*(*t*,*f*)│*ejφ (t*,*f)*}, *f* is the frequency of the *M* allocated subcarriers , *ã*(*t*,*f*) and *φ*(*t*,*f*) are the amplitude and phase response.

0 dB reference is defined as20*log*10│*ãt*(*t*,0)│.

6.4.2.4.2 Requirements for Pi/2 BPSK and QPSK modulation with [*powerBoostRel18*] capability

These requirements apply when ΔPPowerBoost = 1 dB applies (as defined in section 6.2.4), otherwise the requirements for EVM equalizer spectrum flatness defined in clause 6.4.2.4 apply. [TBD on the power boosting without FDSS]

The EVM equalizer coefficients across the allocated uplink block shall be modified to fit inside the mask specified in Table 6.4.2.4.2-1 for normal conditions, prior to the calculation of EVM. The limiting mask shall be placed to minimize the change in equalizer coefficients in a sum of squares sense.

**Table 6.4.2.4.1-1: Mask for EVM equalizer coefficients for [*powerBoostRel18*] normal conditions**

|  |  |  |
| --- | --- | --- |
| **Frequency range** | **Parameter** | **Maximum ripple (dB)** |
| |FUL\_Meas – Fcenter| ≤ X MHz  (Range 1) | X1 | [6] (p-p) |
| |FUL\_Meas – Fcenter| > X MHz  (Range 2) | X2 | [10] (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: Fcenter refers to the center frequency of an allocated block of PRBs  [NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation]  NOTE 4: See Figure 6.4.2.4.2-1 for description of X1, X2 | | |



**Figure 6.4.2.4.2-1: The limits for EVM equalizer spectral flatness referenced in table 6.4.2.4.2-1.**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* UNCHANGED CLAUSES OMITTED \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

##### 6.5.2.4.1 NR ACLR

NR Adjacent Channel Leakage power Ratio (NRACLR) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.5.2.4.1-1.

If the measured adjacent channel power is greater than –50 dBm then the NRACLR shall be higher than the value specified in Table 6.5.2.4.1-2.[NR ACLR requirement for power class 2 and 3 are applicable for a UE when the IE [*powerBoostPi2BPSKRel18*] or [*powerBoostQPSKRel18*] is set to 1 and ΔPPowerBoost ≤ 1dB.]

Table 6.5.2.4.1-1: NR ACLR measurement bandwidth

|  |  |  |  |
| --- | --- | --- | --- |
| Channel bandwidth | (MHz) | 3,5,10,15,20,25,30,35,40,45,50 | 60,70,80,90,100 |
| REF\_SCS | (kHz) | 15 | 30 |
| NR ACLR measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 | |
| NOTE : “NRB” in the formula is the maximum transmission bandwidth configuration as defined in Table 5.3.2-1. | | | |

Table 6.5.2.4.1-2: NR ACLR requirement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Power class 1 | Power class 1.5 | Power class 2 | Power class 3 |
| NR ACLR | 37 dB | 31 dB | 31 dB | 30 dB |
| NOTE 1: Void | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* END OF CHANGES \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*