**3GPP TSG-RAN WG4 Meeting # 109 R4-** **2319932**

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

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | **1936** | **rev** | **-** | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *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:*** | Big CR for NR SL evoluation | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | OPPO | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_enh2-Core | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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:*** | | This big CR is to capture the endorsed draftCR for SL-U feature on RAN4#108, RAN4#108-bis and RAN4#109 meeting. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Belwo endorsed draftCRs are captured:  RAN4#108:  R4-2312989 draft CR 38.101-1 SL-U TX requirement OPPO  R4-2314735 draft CR 38.101-1 SL-U RX requirement OPPO  RAN4#108-bis:  R4-2317721 Draft CR on system parameters for SL unlicensed operation for single CC Vivo  R4-2315525 draft CR on SL-U NR\_values LG Electronics  R4-2317724 Draft CR on Rx requirements for inter-band con-current operation vivo, Meta  R4-2317725 draft CR 38.101-1 SL-U inter-band concurrent operation OPPO, Meta Ireland  R4-2315155 Draft CR TS38.101-1 on NR SL CA RX requirements Meta Ireland  R4-2317730 draftCR to 38.101-1 Tx requirements for SL CA Huawei, HiSilicon  RAN4#109:  R4-2318996 Draft CR on introduction of definitions, symbols and abbreviations for SL evolution Vivo  R4-2318445 Draft CR to TS38.101-1 on UE RF requirements for SL-U features Meta Ireland, OPPO  R4-2321770 Draft CR to TS38.101-1 on operating band and system parameters for SL-U features Meta Ireland, OPPO, LG Electronics, vivo  R4-2321773 draft CR on SL-U MPR and A-MPR (alt2) LGE  R4-2321774 DraftCR for SL-U OPPO  R4-2321776 draft CR on UE RF requirements of con-current operation on Uu and sidelink LG Electronics  R4-2321777 Draft CR on RF requirements for SL-U con-current operation vivo  R4-2321775 Draft CR on NR SL co-channel coexistence with LTE SL LG Electronics, Qualcomm  R4-2318447 Draft CR on TS38.101-1 to update configured Tx power for SL-CA operation Meta Ireland, Huawei, OPPO, LG Electronics, Xiaomi, vivo  R4-2321783 draft CR on SL CA UE RF requirements LG Electronics  R4-2321781 draftCR to 38.101-1 Tx requirements for SL CA Huawei, HiSilicon | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The requirements for SL-U is missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3,4.2,5,6,7 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS38.521-1 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<<start of change>>

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

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

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

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

**Con-current operation**: The simultaneous transmission and reception of sidelink and Uu interfaces while operation is agnostic of the service used on each interface.

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

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

**Contiguous spectrum**: Spectrum consisting of a contiguous block of spectrum with no sub-block gaps.

**Inter-band carrier aggregation:** Carrier aggregation of component carriers in different operating bands.

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

**Inter-band con-current operation:** Operation of NR Uu carrier and NR Sidelink carrier in different operating bands**.**

**Intra-band contiguous carrier aggregation**: Contiguous carriers aggregated in the same operating band.

**Intra-band non-contiguous carrier aggregation**: Non-contiguous carriers aggregated in the same operating band.

**Intra-band SL CA UE:** UE that supports NR SL CA operation in a single band

**NR SL CA:** Aggregation of two or more NR Sidelink component carriers in order to support wider transmission bandwidths

**NR SL inter-band con-current operating Band**：Band combinations of NR Uu carrier and NR Sidelink carrier in different operating bands**.**

**NR SL-U UE:** UE that supports NR Sidelink operation in unlicensed bands (e.g. n46, n96, n102).

**RedCap UE**: The UE with reduced capabilities as defined in clause 4.2.21.1 from TS38.306 [15].

**Sub-band**: For a UE that supports shared spectrum channel access in wideband operation, a sub-band is the set of RBs within an approximately 20 MHz segment of the channel where the wideband channel is uniformly divided into an integer number of 20 MHz sub-bands. Sub-bands may be separately allocated in uplink and downlink.

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

**Sub-block bandwidth**: The bandwidth of one sub-block.

**Sub-block gap**: A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

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

**Vehicular UE:** A UE embedded in a vehicle, permanently connected to an embedded antenna system that radiates externally for NR operating bands.

NOTE: Vehicular UE does not refer to other UE form factors placed inside the vehicle.

**Wideband operation:** For a UE that supports shared spectrum channel access, wideband operation refers to operation within a channel larger than 20 MHz in which intra-cell guard bands may be configured to distinguish individual RB-sets

3.2 Symbols

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

ΔFGlobal Granularity of the global frequency raster

ΔFRaster Band dependent channel raster granularity

ΔfOOB Δ Frequency of Out Of Band emission

ΔFTX-RX Maximum deviation to the Tx-Rx carrier center frequency separation for asymmetric uplink/downlink channel bandwidth operation

∆MPRc Allowed Maximum Power Reduction relaxation for serving cell *c*

ΔPPowerClass Adjustment to maximum output power for a given power class

RB The starting frequency offset between the allocated RB and the measured non-allocated RB

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

ΔRIBC Allowed reference sensitivity relaxation due to support for intra-band contiguous CA operation

ΔRIBNC Allowed reference sensitivity relaxation due to support for intra-band non-contiguous CA operation

ΔRIB,4R Reference sensitivity adjustment due to support for 4 antenna ports

ΔR1RReference sensitivity adjustment due to support for 1 antenna ports

ΔShift Channel raster offset

TC Allowed operating band edge transmission power relaxation

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

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, inter-band NR-DC operation and due to support for SUL operations, for serving cell *c*

BWChannel Channel bandwidth

BWChannel,block Sub-block bandwidth, expressed in MHz. BWChannel,block= Fedge,block,high- Fedge,block,low

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz

BWChannel,max Maximum channel bandwidth supported among all bands in a release

BWGB max( BWGB,Channel(*k*) )

BWGB,Channel(k) Minimum guard band defined in clause 5.3A.1 of carrier *k*

BWDL Channel bandwidth for DL

BWUL Channel bandwidth for UL

BWinterferer Bandwidth of the interferer

Ceil(x) Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x

Floor(x) Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x

FC *RF reference frequency* on the channel raster, given in table 5.4.2.2-1

FC,block, high Fc of the highest transmitted/received carrier in a *sub-block*

FC,block, low Fc of the lowest transmitted/received carrier in a *sub-block*

FC,low The Fc of the lowest carrier, expressed in MHz

FC,high The Fc of the highest carrier, expressed in MHz

FDL\_low The lowest frequency of the downlink *operating band*

FDL\_high The highest frequency of the downlink *operating band*

FUL\_low The lowest frequency of the uplink *operating band*

FUL\_high The highest frequency of the uplink *operating band*

Fedge,block,low The lower *sub-block* edge, where Fedge,block,low = FC,block,low - Foffset, low.

Fedge,block,high The upper *sub-block* edge, where Fedge,block,high = FC,block,high + Foffset, high.

Fedge , low The *lower edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,low = FC,low - Foffset,low.

Fedge, high The *higher edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,high = FC,high + Foffset,high.

FInterferer (offset) Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)

FInterferer Frequency of the interferer

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

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

Foffset,high Frequency offset from FC,high to the upper *UE RF Bandwidth edge*, or from FC,block, high to the upper sub-block edge

Foffset,low Frequency offset from FC,low to the lower *UE RF Bandwidth edge*, or from FC,block, low to the lower sub-block edge

FOOB The boundary between the NR out of band emission and spurious emission domains

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

FREF, shift RF reference frequency for Supplementary Uplink (SUL) bands, the uplink of all FDD bands, and TDD bands

Fuw (offset) The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

GBChannel Minimum guard band defined in clause 5.3.3, expressed in kHz

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

Max() The largest of given numbers

Min() The smallest of given numbers

 Physical resource block number

NRACLR NR ACLR

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NRB\_agg The number of the aggregated RBs within the fully allocated aggregated channel bandwidth

for carrier 1 to j, where *μ* is defined in TS 38.211 [6]

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

for carrier j, where *μ* is defined in TS 38.211 [6]

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

NRB,low The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in clause 5.3A.1

NRB,high The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in clause 5.3A.1

NREF NR Absolute Radio Frequency Channel Number (NR-ARFCN)

NREF-Offs Offset used for calculating NREF

PCMAX The configured maximum UE output power

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

PCMAX, *f*, *c* The configured maximum UE output power for carrier *f* of serving cell *c* in each slot

PEMAX Maximum allowed UE output power signalled by higher layers

PEMAX, *c* Maximum allowed UE output power signalled by higher layers for serving cell *c*

PInterferer Modulated mean power of the interferer

Plargest BW Power of the largest transmission bandwidth configuration of the component carriers in the bandwidth combination

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

P-MPR*c* Power Management Maximum Power Reduction for serving cell *c*

PRB The transmitted power per allocated RB, measured in dBm

PREFSENS\_SL The REFSENS power for Sidelink

PUMAX The measured configured maximum UE output power

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart The lowest RB index of transmitted resource blocks

RBstart\_CA The lowest RB index of transmitted resource blocks for intra-band contiguous CA

SCSc SCS for the component carrier c, expressed in kHz

SCSlargest BW SCS for the largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in kHz

SCSlow SCS for the lowest assigned component carrier in clause 5.3A.1, expressed in kHz

SCShigh SCS for the highest assigned component carrier in clause 5.3A.1, expressed in kHz

*tp* Transient Period value signalled by the UE

*tpstart* Start position of transient period relative to the symbol boundary

T(PCMAX, *f*, *c*) Tolerance for applicable values of PCMAX, *f*, *c* for configured maximum UE output power for carrier *f* of serving cell *c*

TL,c Absolute value of the lower tolerance for the applicable *operating band* as specified in clause 6.2.1

SSREF SS block reference frequency position

UTRAACLR UTRA ACLR

3.3 Abbreviations

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

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CA Carrier Aggregation

CA\_nX-nY Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating bands*

CC Component Carriers

CG Carrier Group

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

DC Dual Connectivity

DFT-s-OFDM Discrete Fourier Transform-spread-OFDM

DM-RS Demodulation Reference Signal

DTX Discontinuous Transmission

E-UTRA Evolved UTRA

EIRP Equivalent Isotropically Radiated Power

EVM Error Vector Magnitude

FR Frequency Range

FRC Fixed Reference Channel

FWA Fixed Wireless Access

GSCN Global Synchronization Channel Number

HD Half Duplex

IBB In-band Blocking

IDFT Inverse Discrete Fourier Transformation

ITS Intelligent Transportation System

ITU‑R Radiocommunication Sector of the International Telecommunication Union

MBW Measurement bandwidth defined for the protected band

MCG Master Cell Group

MOP Maximum Output Power

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NS Network Signalling

OCNG OFDMA Channel Noise Generator

OOB Out-of-band

P-MPR Power Management Maximum Power Reduction

PRB Physical Resource Block

PS Public Safety

PSBCH Physical Sidelink Broadcast CHannel

PSCCH Physical Sidelink Control Channel

PSFCH Physical Sidelink Feedback CHannel

PSSCH Physical Sidelink Shared CHannel

QAM Quadrature Amplitude Modulation

RE Resource Element

REFSENS Reference Sensitivity

RedCap Reduced Capability

RF Radio Frequency

RMS Root Mean Square (value)

RSRP Reference Signal Receiving PowerRx Receiver

Rx Receiver

SC Single Carrier

SCG Secondary Cell Group

SCS Subcarrier spacing

SDL Supplementary Downlink

SEM Spectrum Emission Mask

SL Sidelink

SL-MIMO Sidelink-Multiple Antenna transmission

SNR Signal-to-Noise Ratio

SRS Sounding Reference Symbol

SS Synchronization Symbol

S-SSB Sidelink Synchronization Signal Block

SUL Supplementary uplink

TAE Time Alignment Error

TAG Timing Advance Group

Tx Transmitter

TxD Tx Diversity

UL MIMO Uplink Multiple Antenna transmission

ULFPTx Uplink Full Power Transmission

V2X Vehicle to Everything

## 4.2 Applicability of minimum requirements

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

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

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

d) All the requirements for intra-band contiguous and non-contiguous CA apply under the assumption of the same slot format indicated by UL-DL-configuration-common in the PCell and SCells for NR SA.

e) The requirements for Tx diversity in this release are applied for UE which indicates IE [*txDiversity-r16*].

f) All the requirements for intra-band contiguous SL CA apply under the assumption of the same subcarrier spacing for SL CA.

5.2E Operating band for V2X

5.2E.1 V2X operating bands

NR V2X is designed to operate in the operating bands in FR1 defined in Table 5.2E.1-1.

**Table 5.2E.1-1 V2X operating bands in FR1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **V2X Operating Band** | **Sidelink (SL) Transmission operating band** | | | **Sidelink (SL) Reception operating band** | | | **Duplex Mode** | **Interface** |
|  | **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |  |  |
| n142 | 788 MHz | - | 798 MHz | 788 MHz | - | 798 MHz | HD | PC5 |
| n381 | 2570 MHz | - | 2620 MHz | 2570 MHz | - | 2620 MHz | HD | PC5 |
| n47 | 5855 MHz | - | 5925 MHz | 5855 MHz | - | 5925 MHz | HD | PC5 |
| n79 | 4400 MHz | - | 5000 MHz | 4400 MHz | - | 5000 MHz | HD | PC5 |
| Note 1: When this band is used for V2X SL service, the band is exclusively used for NR V2X in particular regions.  Note 2: When this band is used for public safety service, the NR band is operated with both in-coverage scenarios and out-of-coverage scenarios. | | | | | | | | |

5.2E.1A Sidelink CA operating bands

For NR sidelink intra-band CA operation is designed to operate in the operating bands in FR1 defined in Table 5.2E.1A-1.

**Table 5.2E.1A-1 Intra-band contiguous SL CA operating bands in FR1**

|  |  |  |
| --- | --- | --- |
| NR SL CA Band | NR Band | Interface |
| SL\_n47 | n47 | PC5 |

5.2E.1F Operating bands for Sidelink Unlicensed

NR Sidelink is designed to operate in the unlicensed operating bands in FR1 defined in Table 5.2E.1F-1.

Table 5.2E.1F-1. NR SL-U operating bands in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR SL-U operating band** | **Sidelink (SL) Transmission operating band** | **Sidelink (SL) Reception operating band** | **Duplex Mode** | **Interface** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |  |
| n461 | 5150 MHz – 5925 MHz | 5150 MHz – 5925 MHz | HD | PC5 |
| n961 | 5925 MHz – 7125 MHz | 5925 MHz – 7125 MHz | HD | PC5 |
| n1021 | 5925 MHz – 6425 MHz | 5925 MHz – 6425 MHz | HD | PC5 |
| NOTE 1: Direct connection between client devices and between vehicular devices in the shared spectrum bands or portions of the shared spectrum bands is subject to country-specific conditions and can be prohibited per region-specific regulatory rules, e.g., in USA and Canada. | | | | |

5.2E.2 V2X operating bands for con-current operation

NR V2X operation is designed to operate concurrent with NR uplink/downlink on the operating bands combinations listed in Table 5.2E.2-1 and Table 5.2E.2-2.

**Table 5.2E.2-1 Inter-band con-current V2X operating bands**

|  |  |  |
| --- | --- | --- |
| **V2X con-current operating Band** | **NR or V2X Operating Band** | **Interface** |
| V2X\_n1-n47 | n1 | Uu |
|  | n47 | PC5 |
| V2X\_n3-n47 | n3 | Uu |
|  | n47 | PC5 |
| V2X\_n5-n47 | n5 | Uu |
|  | n47 | PC5 |
| V2X\_n8-n47 | n8 | Uu |
|  | n47 | PC5 |
| V2X\_n34-n47 | n34 | Uu |
| n47 | PC5 |
| V2X\_n39-n47 | n39 | Uu |
|  | n47 | PC5 |
| V2X\_n40-n47 | n40 | Uu |
|  | n47 | PC5 |
| V2X\_n41-n47 | n41 | Uu |
|  | n47 | PC5 |
| V2X\_n71-n47 | n71 | Uu |
|  | n47 | PC5 |
| V2X\_n78-n47 | n78 | Uu |
|  | n47 | PC5 |
| V2X\_n79-n47 | n79 | Uu |
|  | n47 | PC5 |

**Table 5.2E.2-2 Intra-band con-current V2X operating bands**

|  |  |  |
| --- | --- | --- |
| **V2X con-current operating Band** | **NR or V2X Operating Band** | **Interface** |
| V2X\_n79-n79 | n79 | Uu |
|  | n79 | PC5 |

5.2E.2F Operating bands for SL-U con-current operation

For NR SL-U inter-band con-current operation, NR sidelink in the unlicensed operating band is designed to operate concurrently with NR uplink/downlink on the operating band combinations are listed in Table 5.2E.2F-1.

**Table 5.2E.2F-1 SL-U Inter-band con-current operating bands**

|  |  |  |
| --- | --- | --- |
| **NR SL inter-band con-current operating Band** | **NR Operating Band** | **Interface** |
| SL\_n78-n46 | n78 | Uu |
|  | n46 | PC5 |

## 5.3E Channel bandwidth for V2X

### 5.3E.1 General

NR V2X operation channel bandwidths for each operating band are specified in Table 5.3E.1-1. The same (symmetrical) channel bandwidth is specified for both the transmission and reception path. The maximum channel bandwidth for SL operation in licensed band is 40MHz.

Table 5.3E.1-1 NR V2X operation channel bandwidths for each operating band

| NR band / SCS / UE Channel bandwidth (MHz) | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| NR Band | SCS  (kHz) | 5 | 10 | 20 | 30 | 40 |
| n14 | 15 | 5 | 10 |  |  |  |
|  | 30 |  | 10 |  |  |  |
|  | 60 |  |  |  |  |  |
| n38 | 15 |  | 10 | 20 | 30 | 40 |
|  | 30 |  | 10 | 20 | 30 | 40 |
|  | 60 |  | 10 | 20 | 30 | 40 |
| n47 | 15 |  | 10 | 20 | 30 | 40 |
|  | 30 |  | 10 | 20 | 30 | 40 |
|  | 60 |  | 10 | 20 | 30 | 40 |
| n79 | 15 |  | 10 | 20 | 30 | 40 |
|  | 30 |  | 10 | 20 | 30 | 40 |
|  | 60 |  | 10 | 20 | 30 | 40 |

### 5.3E.1A Channel bandwidth for Sidelink CA

For NR SL CA operation, the SL CA channel bandwidths for each band are specified in Table 5.3E.1A-1. The same (symmetrical) channel bandwidth is specified for both the transmission and reception path.

**Table 5.3E.1A-1 NR SL intra-band contiguous CA operating bands for SL CA in FR1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sidelink CA configuration / Bandwidth combination set | | | | | | | |
| Sidelink CA configuration | Sidelink CA configuration for TX | Component carriers in order of increasing carrier frequency | | | | Maximum aggregated  bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | **Channel bandwidths for carrier [MHz]** |
| SL\_n47B | SL\_n47B | 10 | 10, 20,30 |  |  | 70 | 0 |
| [20] | 20,30 |  |  |
| 30 | 30,40 |  |  |

### 5.3E.1F Channel bandwidth for Sidelink Unlicensed

NR SL-U Channel bandwidths for each band are specified in Table 5.3E.1F-1. The same (symmetrical) channel bandwidth is specified for both the transmission and reception path.

**Table 5.3E.1F-1 NR SL-U channel bandwidth**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **SL-U band /channel bandwidth** | | | | | | | | |
| **NR SL-U Operating Band** | **SCS kHz** | **10MHz** | **20 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| n46 | 15 |  | 20 |  | 40 |  |  |  |  |  |
| 30 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| 60 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| n96 | 15 |  | 20 |  | 40 |  |  |  |  |  |
| 30 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| 60 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| n102 | 15 |  | 20 |  | 40 |  |  |  |  |  |
| 30 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| 60 |  | 20 |  | 40 |  | 60 | 80 |  | 1001 |
| NOTE 1: This UE channel bandwidth is optional in this release of the specification. | | | | | | | | | | |

### 5.3E.2 Channel bandwidth for V2X concurrent operation

For NR V2X inter-band con-current operation in FR1, the NR V2X channel bandwidths for each operating band are specified in Table 5.3E.2-1.

Table 5.3E.2-1: Inter-band con-current operation configurations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR V2X inter-band con-current operating configuration | NR Band | Interface | Channel bandwidth (MHz) (NOTE 1) | Bandwidth combination set |
| V2X\_n1A-n47A | n1 | Uu | 5, 10, 15, 20, 25, 30, 40, 45, 50 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n3A-n47A | n3 | Uu | 5, 10, 15, 20, 25, 30, 35, 40, 45, 50 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n5A-n47A | n5 | Uu | 5, 10, 15, 20, 25 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n8A-n47A | n8 | Uu | 5, 10, 15, 20, 35 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n34A-n47A | n34 | Uu | 5, 10, 15 | 0 |
| n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n39A-n47A | n39 | Uu | 5, 10, 15, 20, 25, 30, 40 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n40A-n47A | n40 | Uu | 5, 10, 15, 20, 25, 30, 40, 50, 60, 80 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n41A-n47A | n41 | Uu | 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n71A-n47A | n71 | Uu | 5, 10, 15, 20 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |
| V2X\_n78A-n47A | n78 | Uu | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 | 0 |
|  | n47 | PC5 | 10, 20, 30, 40 |  |

For NR V2X intra-band con-current operation in FR1, the NR V2X channel bandwidths for each operating band are specified in Table 5.3E.2-2.

Table 5.3E.2-2: Intra-band con-current operation configurations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR V2X intra-band con-current operating configuration | NR Band | Interface | Channel bandwidth (MHz) (NOTE 1) | Bandwidth combination set |
| V2X\_n79B | n79 | Uu | 40, 50, 60, 80, 100 | 0 |
|  | n79 | PC5 | 10, 20, 30, 40 |  |
| NOTE 1: The SCS of each channel bandwidth for NR band refers to Table 5.3.5-1. | | | | |

### 5.3E.2F Channel bandwidth for SL-U con-current operation

For NR SL-U inter-band con-current operation, the SL-U Channel bandwidths for each operating band are specified in Table 5.3E.2F-1.

**Table 5.3E.2F-1 NR SL-U inter-band con-current operating configurations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR SL inter-band con-current operating configuration | NR Band | Interface | Channel bandwidth (MHz) (NOTE 1) | Bandwidth combination set |
| SL\_n78A-n46A | n78 | Uu | 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 | 0 |
|  | n46 | PC5 | 20, 40, 60, 80, 100 |  |
| NOTE 1: The SCS of each channel bandwidth for NR band refers to Table 5.3.5-1. | | | | |

## 5.4E Channel arrangement for V2X

### 5.4E.1 Channel spacing

For NR V2X, the channel spacing requirements in clause 5.4.1 apply for each operating band.

### 5.4E.1A Channel spacing for Sidelink CA

For NR sidelink CA operation, the channel spacing requirements in clause 5.4A.1 apply.

### 5.4E.1F Channel spacing for Sidelink Unlicensed

For NR SL-U operation, the channel spacing requirements in clause 5.4.1 apply for each operating band.

### 5.4E.2 Channel raster

#### 5.4E.2.1 NR-ARFCN and channel raster

For NR V2X, the NR-ARFCN and channel raster requirements in clause 5.4.2.1 apply for each operating band.

For NR V2X UE, the reference frequency can be shifted by configuration.

FREF\_V2X = FREF + Δshift + N \* 5 kHz

where

Δshift = 0 kHz or 7.5 kHz indicated in IE (*frequencyShift7p5khz*), and

N can be set as one of following values {-1, 0, 1}, which are signalled by the network in higher layer parameters or configured by pre-configuration parameters.

#### 5.4E.2.1A NR-ARFCN and channel raster for Sidelink CA

For NR SL intra-band contiguous CA operation, the NR-ARFCN and channel raster requirements in clause 5.4E.2.1 apply for each component carrier.

#### 5.4E.2.1F NR-ARFCN and channel raster for Sidelink Unlicensed

For NR SL-U operation, the general requirements in clause 5.4.2 are applied.

NR-ARFCN and channel raster requirements in clause 5.4.2.1 are applied for NR SL-U with following exception:

* N\*5kHz/7.5kHz frequency raster shift, which can be used in NR V2X in band n47 is not defined for NR SL-U operation in bands n46, n96, n102.
* Channel raster entries for each operating band requirements in clause 5.4.2.3 are applied for NR SL-U with following exception: Channel raster points for 10MHz CBW in band n46 as defined in Table 5.4.2.3-2 are not applicable for NR SL-U.

#### 5.4E.2.2 Channel raster to resource element mapping

For NR V2X, the channel raster to resource element mapping requirements in clause 5.4.2.2 apply for each operating band.

#### 5.4E.2.2A Channel raster to resource element mapping for Sidelink CA

For NR SL intra-band contiguous CA operation, the channel raster to resource element mapping requirements in clause 5.4.2.2 apply for each component carrier.

#### 5.4E.2.2F Channel raster to resource element mapping for Sidelink Unlicensed

The mapping between the RF reference frequency on the channel raster and the corresponding resource element is given in Table 5.4.2.2-1 and can be used to identify the RF channel position. The mapping depends on the total number of RBs that are allocated in the channel and applies to both Tx and Rx for SL. The mapping must apply to at least one numerology supported by the UE.

#### 5.4E.2.3 Channel raster entries for each operating band

For NR V2X, the channel raster entries requirements in clause 5.4.2.3 apply for each operating band.

The RF channel positions on the channel raster in each NR V2X operating band are given through the applicable NR-ARFCN in Table 5.4.2.3-1, using the channel raster to resource element mapping in clause 5.4.2.2.

For NR V2X operating band n47, ΔFRaster = *I* × ΔFGlobal, where *I ϵ {1}.* Every *Ith* NR‑ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3-1 is given as <*I*>.

#### 5.4E.2.3A Channel raster entries for each operating band for Sidelink CA

For NR SL intra-band contiguous CA operation, the channel raster entries requirements in clause 5.4E.2.3 apply for each component carrier.

#### 5.4E.2.3F Channel raster entries for Sidelink Unlicensed

For NR SL-U operation, the channel raster entries requirements in clause 5.4.2.3 apply for each operating band.

### 5.4E.3 Synchronization raster for V2X

There is no synchronization raster definition for NR V2X for both licensed bands and unlicensed bands.

### 5.4E.3A Synchronization raster for Sidelink CA

There is no synchronization raster definition for NR SL CA operating bands.

### 5.4E.3F Synchronization raster for Sidelink Unlicensed

There is no synchronization raster definition for NR SL-U operating bands n46, n96, n102.

## 6.2E Transmitter power for V2X

### 6.2E.1 UE maximum output power for V2X

#### 6.2E.1.1 General

When NR V2X UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the allowed NR V2X UE maximum output power is specified in Table 6.2E.1.1-0.

Table 6.2E.1.1-0: NR V2X UE Power Class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) |
| n14 | 31 | +2/-3 |  |  | 23 | ±2 |
| n38 |  |  |  |  | 23 | ±2 |
| n47 |  |  | 26 | +2/-3 | 23 | ±2 |
| n79 |  |  |  |  | 23 | +2/-3 |

When a UE is configured for NR V2X sidelink transmissions in NR Band n47, the V2X UE shall meet the following additional requirements for transmission within the frequency ranges 5855-5925 MHz:

- The maximum mean power spectral density shall be restricted to 23 dBm/MHz EIRP when the network signaling value NS\_33 is indicated.

where the network signaling values are specified in clause 6.2E.3.

NOTE: The PSD limit in EIRP shall be converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I in [11].

For NR V2X UE supporting SL MIMO or Tx diversity, the maximum output power requirements in Table 6.2E.1.1-1 is defined as the sum of the maximum output power from each UE antenna connector. The period of measurement shall be at least one sub frame (1 ms). For UE supporting SL MIMO, the requirements shall be met with the SL MIMO configurations specified in Table 6.2D.1-2.

Table 6.2E.1.1-1: NR V2X UE Power Class for SL-MIMO

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
|  |  |  |  |  |  |  |  |  |
| n38 |  |  |  |  | 23 | +2/-3 |  |  |
| n47 |  |  | 26 | +2/-3 | 23 | +2/-3 |  |  |
| n79 |  |  |  |  | 23 | +2/-3 |  |  |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2E.1.1-0 shall apply to the active antenna connector.

#### 6.2E.1.1A UE maximum output power for sidelink CA

For the intra-band SL CA operation, the following NR SL CA UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1.1A-1: NR SL CA UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR SL CA band Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| SL \_n47B |  |  |  |  | 23 | +2/-3 |  |  |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 2: For intra-band SL CA UE, the maximum power requirement apply to the total transmitted power over all component carriers (per UE). | | | | | | | | |

### 6.2E.1F UE maximum output power for Sidelink Unlicensed

#### 6.2E.1F.1 General

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth of shared spectrum channel access carrier unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1F-1: UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR  band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) |
| n46 |  |  |  |  |  |  | 20 | +2/-3 |
| n96 |  |  |  |  |  |  | 20 | +2/-3 |
| n102 |  |  |  |  |  |  | 20 | +2/-3 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance | | | | | | | | |

The UE operating shall meet the following additional requirements for maximum mean transmission power density specified in Table 6.2E.1F-2 when NS is signaled and when transmission overlaps with any portion of the specified frequency range. In case transmission overlaps multiple frequency ranges, the lowest power density requirement applies.

Table 6.2E.1F-2: Additional requirements for transmit power density

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR Band | NS value | Channel bandwidth (MHz) | Frequency range (MHz) | Maximum mean power density (dBm/MHz) |
| n46 | NS\_31 | 20 | 5150 - 5230 | 10 |
|  |  |  | 5250 – 5350 |  |
|  |  |  | 5470 – 5725 |  |
|  |  |  | 5725 - 5850 |  |
|  |  |  | 5230 – 5250 | 4 |
|  |  | 40 | 5150 - 5230 | 7 |
|  |  |  | 5250 – 5350 |  |
|  |  |  | 5470 – 5725 |  |
|  |  |  | 5725 - 5850 |  |
|  |  |  | 5230 – 5250 | 4 |
|  |  | 60, 80 | 5150 - 5230 | 4 |
|  |  |  | 5250 – 5350 |  |
|  |  |  | 5470 – 5725 |  |
|  |  |  | 5725 - 5850 |  |
|  |  |  | 5230 – 5250 |  |
| n96 | NS\_53 | 20, 40, 60, 80, 100 | 5925 – 7125 | -1 |
|  | NS\_60 | 20, 40, 60, 80, 100 | 5925 – 7125 | 2 |
|  | NS\_61 | 20, 40, 60, 80 | 5925 - 6425 | 1 |
| n102 | NS\_58 | 20, 40, 60, 80, 100 | 5945 – 6425 | 10 |

#### 6.2E.1.2 UE maximum output power for V2X con-current operation

For the inter-band NR V2X con-current operation, the maximum output power is specified in Table 6.2E.1.2-1 for each operating band. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1.2-1: Power Class for NR V2X inter-band con-current combination (two bands)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X con-current operating band Configuration | NR band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance  (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| V2X\_n1A-n47A | n1 |  |  |  |  | 23 | ±2 |  |  |
| n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n5A-n47A | n5 |  |  |  |  | 23 | ±2 |  |  |
| n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n8A-n47A | n8 |  |  |  |  | 23 | ±2 |  |  |
| n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n39A-n47A | n39 |  |  |  |  | 23 | +2/-3 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n40A-n47A | n40 |  |  |  |  | 23 | +2/-3 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n41A-n47A | n41 |  |  |  |  | 23 | +2/-3 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n71A-n47A | n71 |  |  |  |  | 23 | +2/-34 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n78A-n47A | n78 |  |  |  |  | 23 | +2/-3 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| V2X\_n79A-n47A | n79 |  |  |  |  | 23 | +2/-3 |  |  |
|  | n47 |  |  |  |  | 23 | +2/-3 |  |  |
| NOTE 1: For the con-current band combinations, the simultaneous transmission and reception of sidelink and Uu interfaces can be supported while operation is agnostic of the service used on each interface.  NOTE 2: PPowerClass is the maximum output power specified without taking into account the tolerance for each operating band.  NOTE 3: For inter-band con-current operation, the aggregation power apply to the total transmitted power over all component carriers (per UE).  NOTE 4: 4 refers to the transmission bandwidths (Figure 5.6-1) confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB | | | | | | | | | |

For the intra-band con-current NR V2X operation, the maximum output power is specified in Table 6.2E.1.2-2. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1.2-2: NR V2X UE Power Class for intra-band con-current combination

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X con-current operating band Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance  (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| V2X\_n79B |  |  | 26 | +2/-32 | 23 | +2/-32 |  |  |
| NOTE 1: Void.  NOTE 2: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 3: For intra-band con-current aggregation the maximum power requirement apply to the total transmitted power over all component carriers (per UE).  NOTE 4: Power Class 3 is the default power class unless otherwise stated. | | | | | | | | |

#### 6.2E.1.2F UE Maximum output power for SL-U con-current operation

For the inter-band NR SL con-current operation, the maximum output power is specified in Table 6.2E.1F.2-1 for each operating band. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1.2F-1:NR UE Power Class for inter band SL-U con-current combination

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR SL con-current operating band Configuration | NR band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance  (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) | Class 5(dBm) | Tolerance (dB) |
| SL\_n78-n46 | n78 |  |  |  |  | 23 | +2/-3 |  |  |  |  |
| n46 |  |  |  |  |  |  |  |  | 20 | +2/-3 |
| NOTE 1: For the con-current band combinations, the simultaneous transmission and reception of sidelink and Uu interfaces can be supported while operation is agnostic of the service used on each interface.  NOTE 2: PPowerClass is the maximum output power specified without taking into account the tolerance for each operating band.  NOTE 3: For inter-band con-current operation, the aggregation power apply to the total transmitted power over all component carriers (per UE).s | | | | | | | | | | | |

### 6.2E.2 UE maximum output power reduction for V2X

#### 6.2E.2.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, this clause specifies the allowed Maximum Power Reduction (MPR) power for V2X physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

#### 6.2E.2.1A MPR for sidelink CA

For SL intra-band contiguous CA of PSCCH and PSSCH simultaneous transmission with contiguous RB allocation, the allowed MPR for the maximum output power are specified in Table 6.2E.2.1A-1.

**Table 6.2E.2.1A-1: MPR for power class 3 SL CA [with contiguous RB allocation]**

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation** | | **MPR for bandwidth class B(dB)** | |
|  | | **inner** | **outer** |
| CP-OFDM | QPSK | ≤ 3.0 | ≤ 5.0 |
|  | 16QAM | ≤ 3.0 | ≤ 5.0 |
|  | 64QAM | ≤ 4.5 | ≤ 5.0 |
|  | 256QAM | ≤ 6.5 | ≤ 7.0 |

The contiguous allocation rule of inner and outer for SL intra-band contiguous CA refers to that for NR intra-band contiguous CA in 6.2A.2.1 in TS38.101-1.

For SL intra-band CA of PSFCH with single RB transmission on each carrier, the required MPR are specified as follow.

|  |  |
| --- | --- |
| MPR\_PSFCH\_SLCA = 2.5; | 0< R ≤ 0.3 |
| =7.5; | 0.3< R ≤ 0.5 |
| =12; | 0.5< R ≤ 1 |

Where,

R is the ratio of the gap bandwidth between the two PSFCH transmitted on the two intra-band carrier by the total bandwidth of the two carrier.

When single S-SSB is transmitted on intra-band contiguous carriers, required MPR for single cell V2X in Table 6.2E.2.2-2 is reused. For two S-SSB transmissions on intra-band contiguous carriers, the required MPR are specified as follow.

**Table 6.2E.2.1A-2: MPR for two S-SSB transmissions on intra-band contiguous carriers for power class 3**

|  |  |  |
| --- | --- | --- |
| MPR for bandwidth class B(dB) | | |
| Inner | Outer1 | Outer2 |
| 3.5 | 9.0 | 13.0 |

#### 6.2E.2.2 MPR for Power class 2 and Power class 3 V2X UE

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for NR V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2E.2.2-1 for Power class 3 NR V2X UE and Table 6.2E.2.2-2 for power class 2 NR V2X UE.

Table 6.2E.2.2-1: Maximum Power Reduction (MPR) for power class 3 NR V2X

|  |  |  |  |
| --- | --- | --- | --- |
| Modulation | | Channel bandwidth/MPR (dB) | |
|  | | Outer RB allocations | Inner RB allocations |
| CP-OFDM | QPSK | ≤ 4.5 | ≤ 2.5 |
|  | 16QAM | ≤ 4.5 | ≤ 2.5 |
|  | 64 QAM | ≤ 4.5 | |
|  | 256 QAM | ≤ 7.0 | |

Table 6.2E.2.2-2: Maximum Power Reduction (MPR) for power class 2 NR V2X

|  |  |  |  |
| --- | --- | --- | --- |
| Modulation | | Channel bandwidth/MPR (dB) | |
|  | | Outer RB allocations | Inner RB allocations |
|  | QPSK | ≤ 5.5 | ≤ 2.5 |
| CP-OFDM | 16QAM |
|  | 64 QAM | ≤ 6 | ≤ 4.5 |
|  | 256 QAM | ≤ 7.0 | |

For NR V2X UE supporting SL MIMO or Tx diversity, the allowed MPR for the maximum output power for NR V2X physical channels PSCCH and PSSCH are specified in Table 6.2E.2.2-3 for power class 2 UE.

Table 6.2E.2.2-3: Maximum Power Reduction (MPR) for power class 2 NR V2X with dual Tx

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation** | | **Channel bandwidth/MPR (dB)** | |
| **Outer RB allocations** | **Inner RB allocations** |
| CP-OFDM | QPSK | ≤ 6.0 | ≤ 3.0 |
| 16QAM |
| 64 QAM | ≤ 7.0 | ≤ 5.5 |
| 256 QAM | ≤ 9.0 | |

Where the following parameters are defined to specify valid RB allocation ranges for Outer and Inner RB allocations:

NRB is the maximum number of RBs for a given Channel bandwidth and sub-carrier spacing defined in Table 5.3.2-1.

RBStart,Low = max(1, floor(LCRB/2))

where max() indicates the largest value of all arguments and floor(x) is the greatest integer less than or equal to x.

RBStart,High = NRB – RBStart,Low – LCRB

The RB allocation is an Inner RB allocation if the following conditions are met

RBStart,Low ≤ RBStart ≤ RBStart,High,and

LCRB ≤ ceil(NRB/2)

where ceil(x) is the smallest integer greater than or equal to x.

The RB allocation is an Outer RB allocation for all other allocations which are not an Inner RB allocation.

For PSFCH with single RB transmission for PC3 NR V2X UE, the required MPR is defined as follow

MPR\_PSFCH = 3.5 dB

For contiguous and non-contiguous allocation for simultaneous PSFCH transmission for PC3 NR V2X UE, the required MPR are specified as follow

MPR\_PSFCH = CEIL {MA\_PSFCH, 0.5}

Where MA\_PSFCH for power class 3 is defined as follows

MA\_PSFCH = 7.5 ; 0.00< NGap/NRB ≤ 0.55

= 12.0 ; 0.55< NGap/NRB ≤1.0

For PSFCH with single RB transmission for PC2 NR V2X UE, the required MPR is defined as follow

MPR\_PSFCH = 4.5 dB

For contiguous and non-contiguous allocation for simultaneous PSFCH transmission for PC2 NR V2X UE, the required MPR are specified as follow

MPR\_PSFCH = CEIL {MA\_PSFCH, 0.5}

Where MA is defined as follows

Where MA\_PSFCH for power class 2 is defined as follows

MA\_PSFCH = 8.5 ; 0.00 ≤ NGap/NRB < 0.4

= 10.0 ; 0.4 ≤ NGap/NRB < 0.55

= 14.0 ; 0.55 ≤ NGap/NRB ≤ 1.0

Where,

NGap is the gap RB amount between RBstart and RBend for contiguous and non-contiguous allocation simultaneous PSFCH transmission. (NGap = RBend - RBstart)

CEIL{MA, 0.5} means rounding upwards to closest 0.5dB.

The allowed MPR for the maximum output power for NR V2X physical channels on S-SSB transmission shall be specified in Table 6.2E.2.2-2 for power class 3 and power class 2.

Table 6.2E.2.2-2: Maximum Power Reduction (MPR) for S-SSB transmission for power class 3 and power class 2 NR V2X

|  |  |  |
| --- | --- | --- |
| Channel | MPRS-SSB (dB) | |
|  | Outer RB allocations | Inner RB allocations |
| S-SSB | ≤ 6.0 | ≤ 2.5 |

For NR V2X UE with two transmit antenna connectors, the allowed Maximum Power Reduction (MPR) values specified in clause 6.2E.2 for PC3 and PC2 shall apply to the maximum output power specified in Table 6.2E.1.1-1. For UE supporting SL MIMO, the requirements shall be met with SL MIMO configurations defined in Table 6.2D.1-2. For UE supporting SL MIMO or Tx diversity, the maximum output power is defined as the sum of the maximum output power from each UE antenna connector.

For the UE maximum output power modified by MPR, the power limits specified in clause 6.2E.4 apply.

#### 6.2E.2.3 MPR for Power class 2 and Power class 3 V2X con-current operation

For the inter-band con-current NR V2X operation, the allowed maximum power reduction (MPR) for the maximum output power shall be applied per each component carrier. The MPR requirements in clause 6.2.2 apply for NR Uu operation in licensed band, and the MPR requirements in clause 6.2E.2 apply for NR sidelink operation in licensed band or Band n47.

For the intra-band con-current NR V2X operation with contiguous RB allocation, the allowed maximum power reduction (MPR) for NR V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2E.2.3-1 for Power class 3 V2X con-current UE.

Table 6.2E.2.3-1: MPR for contiguous RB allocation for power class 3 NR V2X con-current UE

|  |  |  |  |
| --- | --- | --- | --- |
| Higher Modulation order between Sidelink and Uplink | | MPR for bandwidth class B(dB) | |
| Inner RB allocation | Outer RB allocation |
| CP-OFDM | QPSK | ≤ 2.5 | ≤ 4.5 |
| 16QAM | ≤ 2.5 | ≤ 4.5 |
| 64QAM | ≤ 4.5 | ≤ 5.0 |
| 256QAM | ≤ 6.0 | ≤ 6.0 |

For bandwidth class B with contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner and Outer RB allocations:

An RB allocation is contiguous if LCRB1 = 0 or LCRB2 = 0 or (LCRB1 ≠ 0 and LCRB2 ≠ 0 and RBStart1 + LCRB1 = NRB1 andRBStart2 = 0), where RBStart1, LCRB1, and NRB1 are for SL CC1, RBStart2, LCRB2, and NRB2 are for UL CC2. SL CC1 is the component carrier with lower frequency.

In contiguous NR V2X intra-band con-current operation, a contiguous allocation is an inner allocation if

RBStart,Low ≤ RBStart\_SL&UL ≤ RBStart,High,and NRB\_alloc ≤ ceil(NRB,agg /2),

where

RBStart,Low = max(1, floor(NRB\_alloc /2))

RBStart,High = NRB,agg – RBStart,Low – NRB,alloc,

with

NRB\_alloc= LCRB1 ∙ 2µ1 + LCRB2 ∙ 2µ2

NRB\_alloc= (NRB1 - RBStart1)∙ 2µ1 + (RBStart2 + LCRB2 ) ∙ 2µ2,

NRB,agg=NRB1∙2µ1+ NRB2∙2µ2.

If LCRB1 =0, RBStart\_SL&UL = NRB1∙2µ1+ RBStart2∙2µ2,

if LCRB1 > 0, RBStart\_SL&UL = RBStart1∙2µ1.

Where, µ1 and µ2 is 0, 1 and 2 for SCS of 15kHz, 30kHz and 60kHz respectively.

A contiguous allocation that is not an Inner contiguous allocation is an Outer contiguous allocation.

For the intra-band con-current NR V2X operation with non-contiguous RB allocation, the allowed maximum power reduction (MPR) for NR V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2E.2.3-2 for Power class 3 V2X con-current UE.

Table 6.2E.2.3-2: MPR for non-contiguous RB allocation for power class 3 NR V2X con-current UE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Higher Modulation order between Sidelink and Uplink | | MPR for bandwidth class B(dB) | | |
| Inner RB allocation | Outer1 RB allocation | Outer2 RB allocation |
| CP-OFDM | QPSK | ≤ 2.5 | ≤ 4.0 | ≤ 4.5 |
| 16QAM | ≤ 2.5 | ≤ 4.0 | ≤ 4.5 |
| 64QAM | ≤ 4.5 | ≤ 4.5 | ≤ 5.0 |
| 256QAM | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 |

For bandwidth classes B with non-contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner, Outer1 and Outer2 RB allocations:

Non-Contiguous RB allocation is defined as RBStart1 + LCRB1 < NRB1, orRBStart2 > 0, when both SL CC and UL CC are activated and allocated with RB(s), where RBStart1, LCRB1, and NRB1 are for SL CC1, RBStart2, LCRB2, and NRB2 are for UL CC2. SL CC1 is the component carrier with lower frequency.

In contiguous NR V2X intra-band con-current operation, a non-contiguous RB allocation is a non-contiguous Inner RB allocation if the following conditions are met:

RBStart,Low ≤ RBStart\_CA ≤ RBStart,High and NRB\_alloc ≤ ceil((BWChannel\_SL&UL / 3 – BWgap ) / 0.18MHz),

where

NRB\_alloc = (NRB1 - RBStart1)∙ 2µ1 + (RBStart2 + LCRB2 ) ∙ 2µ2, RBStart\_SL&UL = RBStart1∙2μ1

RBStart,Low = max(1, floor(NRB\_alloc + (BWgap – BWGB,low)/0.18MHz))

RBStart,High = floor((BWChannel\_SL&UL – 2 ∙ BWgap – BWGB,low)/0.18MHz – 2 ∙ NRB\_alloc)

BWGB,low =Foffset,low – (NRB1∙12+1)∙SCS1/2

BWgap is the bandwidth of the gap between NRB1 and NRB2 possible allocations of SL CC1 and UL CC2 respectively.

In contiguous NR V2X intra-band con-current operation, a non-contiguous RB allocation is a non-contiguous outer 1 RB allocation if the following conditions are met:

RBStart,Low ≤ RBStart\_SL&UL ≤ RBStart,High and NRB\_alloc ≤ ceil((3 BWChannel\_SL&UL / 5 – BWgap) / 0.18MHz)

where

RBStart,Low = max(1, 2 ∙ NRB\_alloc – floor( (BWChannel\_SL&UL – 2 ∙ BWgap + BWGB,low)/0.18MHz)),

RBStart,High = floor((2 ∙ BWChannel\_SL&UL – 3 ∙ BWgap – BWGB,low) / 0.18MHz – 3 ∙ NRB\_alloc)

NRB\_alloc , RBStart\_SL&UL , BWgap and BWGB,low are as defined for the Inner region.

In contiguous NR V2X intra-band con-current operation, a non-contiguous allocation is an Outer 2 allocation if it is neither a non-contiguous Inner allocation nor an Outer 1 allocation.

For PSFCH with single RB transmission for PC3 NR V2X intra-band con-current UE, the required MPR is specified in clause 6.2E.2.2 shall be applied.

For the allowed MPR for S-SSB transmission for PC3 NR V2X intra-band con-current UE, the required MPR is specified in clasue 6.2E.2.2 shall be applied.

For the intra-band con-current NR V2X operation with contiguous RB allocation in contiguous carrier, the allowed maximum power reduction (MPR) for NR V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2E.2.3-3 for Power class 2 V2X con-current UE.

Table 6.2E.2.3-3: MPR for contiguous RB allocation for power class 2 NR V2X con-current UE

|  |  |  |  |
| --- | --- | --- | --- |
| Higher Modulation order between Sidelink and Uplink | | MPR for bandwidth class B(dB) | |
| Inner RB allocation | Outer RB allocation |
| CP-OFDM | QPSK | ≤ 3.0 | ≤ 5.5 |
| 16QAM | ≤ 4.0 | ≤ 5.5 |
| 64QAM | ≤ 5.5 | ≤ 6.0 |
| 256QAM | ≤ 7.5 | ≤ 7.5 |

For the intra-band con-current NR V2X operation with non-contiguous RB allocation in contiguous carrier, the allowed maximum power reduction (MPR) for NR V2X physical channels PSCCH and PSSCH shall be as specified in Table 6.2E.2.3-4 for Power class 2 V2X con-current UE.

Table 6.2E.2.3-4: MPR for non-contiguous RB allocation for power class 2 NR V2X con-current UE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Higher Modulation order between Sidelink and Uplink | | MPR for bandwidth class B(dB) | | |
| Inner RB allocation | Outer1 RB allocation | Outer2 RB allocation |
| CP-OFDM | QPSK | ≤ 3.0 | ≤ 5.5 | ≤ 6.0 |
| 16QAM | ≤ 4.5 | ≤ 5.5 | ≤ 6.5 |
| 64QAM | ≤ 5.5 | ≤ 6.5 | ≤ 7.0 |
| 256QAM | ≤ 8.0 | ≤ 8.0 | ≤ 8.0 |

The parameters in clause 6.2E.2.3 are considered to determine MPR values according to RB allocation.

For PSFCH with single RB transmission for PC2 NR V2X intra-band con-current UE, the required MPR is specified in clause 6.2E.2.2 shall be applied.

For the allowed MPR for S-SSB transmission for PC2 NR V2X intra-band con-current UE, the required MPR is specified in clause 6.2E.2.2 shall be applied.

#### 6.2E.2.4 MPR for Power class 1 UE in Band n14

For NR Public Safety (PS) UE with contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed NR PS UE maximum output power reduction for power class 1 UE shall meet the NR V2X MPR values specified in Table 6.2E.2.2-1 of clause 6.2E.2.2.

For NR Public Safety (PS) UE of single or multiple PSFCH simultaneous transmission, the allowed NR PS UE maximum output power reduction for power class 1 UE shall meet the NR V2X MPR values for PC3 UE’s PSFCH transmission in clause 6.2E.2.2.

For NR Public Safety (PS) UE of S-SSB transmission, the allowed NR PS UE maximum output power reduction for power class 1 UE shall meet the NR V2X MPR values specified in Table 6.2E.2.2-2 of clause 6.2E.2.2.

### 6.2E.2F UE maximum output power reduction for Sidelink Unlicensed

#### 6.2E.2F.1 General

When UE is configured for NR sidelink transmissions in the unlicensed operating bands in FR1 defined in Table 5.2E.1F-1, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For wideband operation, only sub-bands which are contiguously transmitted are considered in Table 6.2E.2F-3 for PSCCH/PSSCH.

For wideband operation, sub-bands which are contiguously transmitted and sub-bands which are non-contiguously transmitted in Table 6.2E.2F-3 are considered for PSFCH and S-SSB.

#### 6.2E.2F.2 MPR for NR SL-U UE

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power is specified in Table 6.2E.2F-1 for power class 5 NR sidelink UE.

Table 6.2E.2F-1 Maximum power reduction (MPR) for NR SL-U UE power class 5

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | RB Allocation | | | | |
|  |  | Outer RB set configuration5 | | Inner RB set configuration5 | |  |
|  |  | Full2 (dB) | Partial3 (dB) | Full2 (dB) | Partial3 (dB) | Exception for 100MHz Full4 (dB) |
| CP-OFDM | QPSK | ≤ 3.5 | ≤ 3.5 | ≤ 3.5 | ≤ 2.0 | ≤ 4.5 |
|  | 16 QAM | ≤ 4.0 | ≤ 4.0 | ≤ 4.0 | ≤ 3.0 | ≤ 4.5 |
|  | 64 QAM | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 |  |
|  | 256 QAM | ≤ 7.0 | ≤ 7.0 | ≤ 7.0 | ≤ 7.0 |  |
| NOTE 1: The MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: The MPR for Full RB allocation applies to all RB’s in all transmitted 20 MHz or larger channels that are fully allocated or all RB’s in all transmitted sub-bands for wideband operation that are fully allocated excluding the wideband configurations of Table 6.2E.2F-2.  NOTE 3: The MPR for Partial RB allocation applies to interlaced allocations with uplink resource allocation type 2 as specified in TS 38.214 [10] or transmitted sub-bands for wideband operation are transmitted according to the wideband configurations of Table 6.2E.2F-2.  NOTE 4: Exception for 100MHz Full RB allocation MPR applies when all RB’s in all sub-bands for 100MHz wideband operation are fully allocated and sub-bands are transmitted according to the wideband configurations of Table 6.2E.2F-2.  NOTE 5: Contiguous sub-band configuration in Table 6.2E.2F-3 applies. | | | | | | |

Table 6.2E.2F-2 Exception MPR mapping for NR SL-U wideband operation

|  |  |
| --- | --- |
| Wideband operation channel bandwidth (MHz) | Sub-band configuration exceptions |
| 40 | 10, 01 |
| 60 | None |
| 80 | 1100, 0011, 0100, 0010 |
| 100 | 00111, 11100, 00011, 11000 |
| NOTE 1: The sub-band configuration is represented as a bitmap where ‘1’ indicates that a sub-band is transmitted and ‘0’ indicates a sub-band is not transmitted. The bitmap is ordered with MSB mapped to the lowest frequency sub-band and LSB mapped to highest frequency sub-band within the wideband channel.  NOTE 2: Void. | |

Table 6.2E.2F-3 Outer/Inner sub-band configuration for NR SL-U wideband operation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Wideband operation channel bandwidth (MHz) | **Contiguous sub-band configuration2** | | **Non-contiguous sub-band configuration2** | |
| **Outer** | **Inner** | **Outer** | **Inner** |
| 40 | 11, 10, 01 | N/A | N/A | N/A |
| 60 | 111, 110, 011, 100, 001 | 010 | 101 | N/A |
| 80 | 1111, 1110, 0111, 1100, 0011, 1000, 0001 | 0110, 0100, 0010 | 1101, 1011, 1010, 0101, 1001 | N/A |
| 100 | 11111, 11110, 01111, 11100, 00111, 11000, 00011, 10000, 00001 | 01110, 01100, 00110, 01000, 00010, 00100 | 11011, 11010, 01011, 11001, 10011, 10101, 10110, 01101, 10100, 00101, 10010, 01001, 11101, 10111, 10001 | 01010 |
| NOTE 1: The sub-band configuration is represented as a bitmap where ‘1’ indicates that a sub-band is transmitted and ‘0’ indicates a sub-band is not transmitted. The bitmap is ordered with MSB mapped to the lowest frequency sub-band and LSB mapped to highest frequency sub-band within the wideband channel.  NOTE 2: Only contiguous sub-band configuration applies to PSCCH/PSSCH. Both contiguous and non-contiguous sub-band configuration apply to PSFCH and S-SSB. | | | | |

For PSFCH transmission with single RB set the allowed MPR for the maximum output power is 10dB for power class 5 NR sidelink UE.

For PSFCH transmission with multiple RB sets the allowed MPR for the maximum output power is specified in Table 6.2E.2F-4 for power class 5 NR sidelink UE.

Table 6.2E.2F-4 Maximum power reduction (MPR) for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |
| --- | --- | --- |
|  | RB Allocation | |
| Outer RB set configuration2 | Inner RB set configuration2 |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 12.5 | ≤ 10.0 |
| NOTE 1: The MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel.  NOTE 2: Outer sub-band configuration and inner sub-band configuration in Table 6.2E.2F-3 apply. | | |

For S-SSB transmission, the allowed MPR for the maximum output power is specified in Table 6.2E.2F-5 for power class 5 NR sidelink UE.

Table 6.2E.2F-5 Maximum power reduction (MPR) for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |
| --- | --- | --- |
|  | RB Allocation | |
| Outer RB set configuration | Inner RB set configuration |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 12.5 | ≤ 9.5 |
| NOTE 1: Outer sub-band configuration and inner sub-band configuration in Table 6.2E.2F-3 apply. | | |

#### 6.2E.2F.3 MPR for SL-U con-current operation

For NR SL-U inter-band con-current operation, the allowed maximum power reduction (MPR) for the maximum output power shall be applied per each component carrier. The MPR requirements in clause 6.2.2 apply for NR Uu operation in licensed band, and the MPR requirements in clause 6.2E.2F apply for NR sidelink operation in unlicensed band.

### 6.2E.3 UE additional maximum output power reduction for V2X

#### 6.2E.3.1 General

For the applied maximum output power reduction is obtained by taking the maximum value of MPR requirements specified in clause 6.2E.2 and A-MPR requirements specified in current clause.

Additional emission requirements can be indicated by the network or pre-configured radio parameters. 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 V2X 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. Outer and inner allocation notation used in clause 6.2E.3 is defined in clause 6.2E.2. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

Table 6.2E.3.1-1: Additional Maximum Power Reduction (A-MPR) for PC3 NR V2X

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network Signalling value | Requirements (clause) | NR Band | Channel bandwidth (MHz) | Resources Blocks (*N*RB) | A-MPR (dB) |
| NS\_01 |  | Table 5.2E.1-1 | 10, 20, 30, 40 | Table 5.3.2-1 | N/A |
| NS\_06 | 6.5.2.3.4 (A-SEM) | n14 | 5, 10 | Table 5.3.2-1 | N/A |
| NS\_33 | 6.5E.2.3.1 (A-SEM)  6.5E.3.4 (A-SE) | n47 | 10 | Clause 6.2E.3.2 | |
| NS\_52 | 6.5E.2.3.2 (A-SEM) | n47 | 40 | Clause 6.2E.3.3 | |

Table 6.2E.3.1-2: Mapping of network signaling label

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X operating bands | Value of additionalSpectrumEmission | | | | | | | | |
|  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| n142 | NS\_01 | NS\_06 |  |  |  |  |  |  |
| n38 | NS\_01 |  |  |  |  |  |  |  |
| n47 | NS\_01 | NS\_33 | NS\_52 |  |  |  |  |  |
| NOTE 1: [*additionalSpectrumEmission*] corresponds to an information element of the same name defined in clause 6.3.2 of TS 38.331 [7].  NOTE 2: For the NR PS UE in n14, same A-MPR shall be applied for PC1 PS UE since PC1 PS UE for Band n14 is not targeted for smartphone form factor. | | | | | | | | | |

For UE with two transmit antenna connectors, the A-MPR values specified in clause 6.2E.3.2 and 6.2E.3.3 shall apply to the maximum output power specified in Table 6.2E.1.1-1. The requirements shall be met with the SL MIMO configurations specified in Table 6.2D.1-2. For UE supporting SL MIMO or Tx Diversity, the maximum output power is defined as the sum of the maximum output power from each UE antenna connector. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For the UE maximum output power modified by A-MPR, the power limits specified in clause 6.2E.4 apply.

#### 6.2E.3.2 A-MPR for V2X UE by NS\_33

When NS\_33 is indicated by the network or pre-configured radio parameters for NR V2X UE, the additional maximum output power reduction specified as

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = A-MPRBase + Gpost connector\* A-MPRStep

CEIL{MA, 0.5} means rounding upwards to closest 0.5dB.

A-MPRBase and A-MPRStep are specified in Tables 6.2E.3.2-1, 6.2E.3.2-2 is allowed when network signalling value is provided*.* A-MPRBase is the default A-MPR value when no Gpost connector is declared. The supported post antenna connector gain Gpost connector is declared by the UE following the principle described in annex I in [11]. The A-MPRstep is the increase in A-MPR allowance to allow UE to meet tighter conducted A-SE and A-SEM requirements with higher value of declared Gpost connector.

For the contiguous PSSCH and PSCCH transmission when NS\_33 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements specified in Table 6.2E.3.2-1 and 6.2E.3.2-2 for power class 3. And A-MPR requirements specified in Table 6.2E.3.2-2a and 6.2E.3.2-2b for power class 2 are allowed for NR V2X UE.

Table 6.2E.3.2-1: PC3 A-MPR for PSSCH/PSCCH by NS\_33 (at Fc =5860MHz)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency [MHz] | Resources Blocks (*L*CRB) | Start Resource  Block | A-MPRBase (dB) | | |
|  |  |  | QPSK/16QAM | 64QAM | 256QAM |
| 5860 | ≥ 10 and ≤ 15 | 0 | ≤ 24 | | |
|  |  | ≥ 1 and ≤ 3 | ≤19 | | |
|  | ≥ 10 and ≤ 15 | ≥ 26 and ≤ 38 | ≤6 | | |
|  | ≥ 10 and ≤ 15 | ≥38 | ≤ 6 | | |
|  | ≥ 10 and ≤ 20 | ≥ 12 and ≤ 14 | ≤11 | | |
|  |  | ≥ 15 and ≤ 19 | ≤9.5 | | |
|  |  | ≥ 20 and ≤ 25 | ≤8.0 | | |
|  | > 15 and < 25 | ≥ 25 | ≤ 8 | | |
|  | ≥ 10 and < 40 | ≥ 4 and ≤7 | ≤ 16 | | |
|  |  | ≥ 8 and ≤ 11 | ≤ 13.5 | | |
|  | ≥ 20 and < 40 | ≥ 0 and ≤ 3 | ≤ 22 | | |
|  | ≥ 25 and < 40 | ≥ 16 and ≤ 21 | ≤ 9.5 | | |
|  |  | ≥ 22 and ≤ 27 | ≤ 8.0 | | |
|  | ≥ 24 and ≤ 40 | ≥ 12 and ≤ 15 | ≤ 12 | | |
|  | 40 and 45 | 0 and 1 | ≤ 19 | | |
|  |  | ≥ 2 and ≤ 5 | ≤ 16 | | |
|  |  | ≥ 6 and ≤ 11 | ≤ 13.5 | | |
|  | >45 | ≥ 0 | ≤ 16 | | |
| NOTE 1: A-MPRstep =1.2 dB is applied for RBstart 0 and 1 and A-MPRstep =0.7 dB is applied for all other RBstart  NOTE 2: Applicable for Channel Bandwidth = 10 MHz | | | | | |

Table 6.2E.3.2-2: PC3 A-MPR for PSSCH/PSCCH by NS\_33 (at other carrier frequency)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Carrier frequency [MHz] | RB allocations | A-MPRBase (dB) | | | | A-MPRstep (dB) |
|  |  | QPSK | 16QAM | 64QAM | 256QAM |
| 5870, 5880, 5890, 5900, 5910, 5920 | Inner | ≤ 3.0 | | ≤ 5.0 | ≤ 6.0 | 0.5 |
|  | Outer | ≤ 4.5 | |  |  |  |
| NOTE 1: Inner and Outer RB allocations are defined in clause 6.2E.2.2  NOTE 2: Applicable for Channel Bandwidth = 10 MHz | | | | | | |

Table 6.2E.3.2-2a: PC2 A-MPR for PSCCH/PSSCH by NS\_33 (at Fc=5860MHz)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency [MHz] | Resource Block (LCRB) | Start Resource Block | A-MPR(dB) | | |
| QPSK/16QAM | 64QAM | 256QAM |
| 5860 | ≥ 10 and ≤ 15 | 0 and 1 | ≤ 24 | | |
| 2 and 3 | ≤ 22 | | |
| 4 | ≤ 20 | | |
| ≥ 10 and ≤ 25 | ≥ 5 and ≤ 7 | ≤ 17.5 | | |
| ≥ 10 and ≤ 30 | 10 | ≤ 16 | | |
| ≥ 10 | 8 and 9 | ≤ 16 | | |
| ≥ 11 and ≤ 14 | ≤ 14.5 | | |
| ≥ 15 and ≤ 19 | ≤ 13 | | |
| ≥ 20 and ≤ 24 | ≤ 11.5 | | |
| ≥ 25 and ≤ 29 | ≤ 10 | | |
| ≥ 30 | ≤ 8.5 | | |
| ≥ 20 and ≤ 24 | 1 | ≤ 22 | | |
| ≥ 20 and ≤ 30 | 0 | ≤ 22 | | |
| 2 and 3 | ≤ 20 | | |
| 4 | ≤ 17.5 | | |
| ≥ 25 and ≤ 40 | 1 | ≤ 20 | | |
| ≥ 30 | ≥ 5 and ≤ 7 | ≤ 16 | | |
| ≥ 36 | 0 | ≤ 20 | | |
| ≥ 2 and ≤ 4 | ≤ 17.5 | | |
| 10 | ≤ 14.5 | | |
| ≥ 45 | 1 | ≤ 17.5 | | |
| NOTE 1: A-MPRstep =1.2 dB is applied for RBstart 0 and 1 and A-MPRstep =0.7 dB is applied for all other RBstart  NOTE 2: Applicable for Channel Bandwidth = 10 MHz | | | | | |

Table 6.2E.3.2-2b: PC2 A-MPR for PSSCH/PSCCH by NS\_33 (at other carrier frequency)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency [MHz] | RB allocations | A-MPR (dB) | | | |
| QPSK | 16QAM | 64QAM | 256QAM |
| 5870,5910,5920 | outer | ≤ 8.5 | | | ≤ 8.5 |
| inner | ≤ 6.0 | | |
| 5880,5890,5900 | outer | ≤ 6.0 | | | ≤ 6.5 |
| inner | ≤ 3.5 | | ≤ 4.5 |
| NOTE 1: Inner and Outer RB allocations are defined in clause 6.2E.2.1  NOTE 2: Applicable for Channel Bandwidth = 10 MHz | | | | | |

For the simultaneous PSFCH transmission when NS\_33 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements specified in Table 6.2E.3.2-3 for power class 3 and in Table 6.2E.3.2-3a for power class 2.

Table 6.2E.3.2-3: PC3 A-MPR for simultaneous PSFCH by NS\_33

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Channel Bandwidth  [MHz] | Center Frequency  [MHz] | RB allocation | A-MPRBase (dB) | | | A-MPRstep (dB) |
|  |  |  | 0 ≤ NGap / NRB < 0.15 | 0.15≤ NGap / NRB < 0.3 | 0.3≤ NGap / NRB ≤ 1 |  |
| 10 | 5860 | NRB =1 | 19.0 | | | 1.0 |
|  | NRB > 1 | 22.0 | | |  |
|  | 5870, 5880, 5890, 5900, 5910, 5920 | NRB =1 | 5 | | | 0.8 |
| NRB > 1 | 14 | 7 | 18.5 |  |
| Note 1: NGap is the gap RB amount between RBstart and RBend for contiguous and non-contiguous allocation simultaneous PSFCH transmission. (NGap = RBend - RBstart) | | | | | | |

Table 6.2E.3.2-3a: PC2 A-MPR for simultaneous PSFCH by NS\_33

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Channel Bandwidth  [MHz] | Center Frequency  [MHz] | RB allocation | A-MPRBase (dB) | | | A-MPRstep (dB) |
|  |  |  | 0 ≤ NGap / NRB < 0.2 | 0.2≤ NGap / NRB < 0.4 | 0.4≤ NGap / NRB ≤ 1 |  |
| 10 | 5860 | NRB =1 | 25.0 | | | 1.0 |
|  | NRB > 1 | 22.0 | | |  |
|  | 5870, 5880, 5890, 5900, 5910, 5920 | NRB =1 | 5 | | | 0.8 |
| NRB > 1 | 16.5 | 12 | 20 |  |
| Note 1: NGap is the gap RB amount between RBstart and RBend for contiguous and non-contiguous allocation simultaneous PSFCH transmission. (NGap = RBend - RBstart) | | | | | | |

For the S-SSB transmission when NS\_33 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements specified in Table 6.2E.3.2-4 for power class 3 and in Table 6.2E.3.2-5 for power class 2.

Table 6.2E.3.2-4: PC3 A-MPR for S-SSB transmission by NS\_33

|  |  |  |  |
| --- | --- | --- | --- |
| Carrier Frequency (MHz) | RBStart \* 12\*SCS  [MHz] | A-MPRBase (dB) | AMPRStep (dB) |
| 5860 | ≤1.0 | ≤ 25 | 0.6 |
|  | >1.0 and ≤2.0 | ≤ 19 |  |
|  | >2.0 and ≤3.24 | ≤ 12 |  |
|  | >3.24 and ≤3.6 | ≤ 10 |  |
|  | >3.6 | ≤ 9 |  |
| 5870, 5880, 5890, 5900, 5910, 5920 | ≤1.0 | ≤ 7.0 | 0.85 |
|  | >1.0 and ≤1.6 | ≤ 6.5 |  |
|  | >1.6 and ≤2.6 | ≤ 5.8 |  |
|  | >2.6 and ≤3.24 | ≤ 4.5 |  |
|  | >3.24 and ≤4.32 | ≤ 5.5 |  |
|  | >4.32 | ≤ 6.5 |  |

Table 6.2E.3.2-5: PC2 A-MPR for S-SSB transmission by NS\_33

|  |  |  |  |
| --- | --- | --- | --- |
| Carrier Frequency (MHz) | RBStart \* 12\*SCS  [MHz] | A-MPRBase (dB) | AMPRStep (dB) |
| 5860 | ≤1.0 | ≤ 25 | 0.6 |
|  | >1.0 and ≤2.0 | ≤ 19 |  |
|  | >2.0 and ≤3.24 | ≤ 12 |  |
|  | >3.24 and ≤3.6 | ≤ 10 |  |
|  | >3.6 | ≤ 14 |  |
| 5870, 5880, 5890, 5900, 5910, 5920 | ≤1.0 | ≤ 7.0 | 0.85 |
|  | >1.0 and ≤1.6 | ≤ 6.5 |  |
|  | >1.6 and ≤2.6 | ≤ 5.8 |  |
|  | >2.6 and ≤3.24 | ≤ 4.5 |  |
|  | >3.24 and ≤4.32 | ≤ 5.5 |  |
|  | >4.32 | ≤ 6.5 |  |

#### 6.2E.3.3 A-MPR for Power class 3 V2X UE by NS\_52

When NS\_52 is indicated by the network or pre-configured radio parameters for NR V2X UE, the additional maximum output power reduction specified as

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = A-MPR

CEIL{MA, 0.5} means rounding upwards to closest 0.5dB.

For the contiguous PSSCH and PSCCH transmission when NS\_52 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements.

Table 6.2E.3.3-1: A-MPR for PSSCH/PSCCH by NS\_52

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Modulation | A-MPR(dB) | | |
|  |  | Region 1 | Region 2 | Region 3 |
| 5885 | QPSK | ≤ 15 | ≤ 8.0 | ≤ 5.5 |
|  | 16QAM |  | ≤ 8.0 | ≤ 5.5 |
|  | 64QAM |  | ≤ 8.5 | ≤ 5.5 |
|  | 256QAM |  | ≤ 8.5 | ≤ 6.0 |
| Note1: Void. | | | | |

Where the following parameters are defined to specify valid RB allocation ranges for Region1, Region2 and Region3 according to RB allocations:

Table 6.2E.3.3-1a: A-MPR Region definitions for PSSCH/PSCCH by NS\_52

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier frequency (MHz) | A-MPR parameters for region definitions | | A-MPR |
|  |  | RBstart or RBend | LCRB |  |
| 40 | 5885 | **RBstart** ≤ floor(NRB\*0.2) or **RBend** ≥ NRB - floor(NRB\*0.2) | **LCRB** ≤floor(NRB\*0.2) | Region 1 |
|  |  | The RB allocation is in Region 2 allocation for all other allocations which are not a Region1 or Region3 allocation. | | Region 2 |
|  |  | floor(NRB /3.5) ≤ **RBstart** ≤ NRB –floor(NRB /3.5) – LCRB | **LCRB** ≤ceil(NRB/3.5) | Region 3 |

NRB is the maximum number of RBs for a given Channel bandwidth and sub-carrier spacing defined in Table 5.3.2-1 [3].

For the simultaneous PSFCH transmission when NS\_52 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements

Table 6.2E.3.3-2: A-MPR for simultaneous PSFCH by NS\_52

|  |  |  |
| --- | --- | --- |
| Channel Bandwidth [MHz] | Carrier frequency [MHz] | A-MPR (dB) |
| 40 MHz | 5885 | 23.5 |

For the S-SSB transmission when NS\_52 is indicated by the network or pre-configured radio parameters for NR V2X UE, the NR UE allow the follow A-MPR requirements

Table 6.2E.3.2-3: A-MPR for S-SSB transmission by NS\_52

|  |  |  |
| --- | --- | --- |
| Carrier Frequency [MHz] | RBStart \* 12\*SCS  [MHz] | A-MPR (dB) |
| 5885 | ≤ 7 | ≤ 16 |
|  | > 7 and ≤ 12 | ≤ 10.5 |
|  | > 12 and ≤ 19 | ≤ 4.0 |
|  | > 19 and ≤ 25 | ≤ 10.5 |
|  | > 25 | ≤ 16 |

#### 6.2E.3.4 A-MPR for V2X con-current operation

For the inter-band con-current NR V2X operation, the allowed additional maximum power reduction (A-MPR) for the maximum output power shall be applied per each component carrier. The A-MPR requirements in clause 6.2.3 apply for NR Uu operation in licensed band, and the A-MPR requirements in clause 6.2E.3.2 and 6.2E.3.3 apply for NR sidelink operation in Band n47.

For the intra-band con-current NR V2X operation, the A-MPR requirements in [6.2E.3.4] apply for NR Uu and SL con-current operation in the licensed band.

### 6.2E.3F UE additional maximum output power reduction for Sidelink Unlicensed

#### 6.2E.3F.1 General

Additional emission requirements can be signalled by the network or pre-configured radio parameters. 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 6.2E.1F-1. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPR is defined in clause 6.2E.2F.

Table 6.2E.3F.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. The mapping of NR frequency band numbers and values of the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2E.3F.1-1A.

Table 6.2E.3F.1-1: Additional maximum power reduction (A-MPR)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network signalling label | Requirements (clause) | NR Band | Channel bandwidth (MHz) | Resources blocks (*N*RB) | A-MPR (clause) |
| NS\_01 |  | n46, n96 | 20, 40, 60, 80 |  | N/A |
| NS\_31 | 6.5F.3.3.4 | n46 | 20, 40, 60, 80 |  | 6.2E.3F.2 |
| NS\_53 | 6.5F.3.3.5 | n96 | 20, 40, 60, 80, 100 |  | 6.2E.3F.3 |
| NS\_58 | 6.5F.3.3.6 | n102 | 20, 40, 60, 80 |  | 6.2E.3F.4 |
| NS\_60 | 6.5F.3.3.5 | n96 | 20, 40, 60, 80, 100 |  | 6.2E.3F.5 |
| NS\_61 | 6.5F.3.3.7 | n96 | 20, 40, 60, 80, 100 |  | 6.2E.3F.6 |
| NOTE 1: The A-MPR shall apply to all active 20 MHz sub-bands contiguously allocated in the channel. | | | | | |

[The NS\_01 label with the field *additionalPmax* [7] absent is default for all NR bands.]

Table 6.2E.3F.1-1A: Mapping of network signaling label

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR band | Value of additionalSpectrumEmission | | | | | | | |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| n46 | NS\_01 |  |  |  | NS\_31 |  |  | Reserved |
| n96 | NS\_01 | NS\_53 |  |  | NS\_60 | NS\_61 |  | Reserved |
| n102 | NS\_01 | NS\_58 |  |  |  |  |  | Reserved |
| NOTE: *additionalSpectrumEmission* corresponds to an information element of the same name defined in clause 6.3.2 of TS 38.331 [7]. | | | | | | | | |

#### 6.2E.3F.2 A-MPR for NS\_31

When NS\_31 is indicated by the network or pre-configured radio parameters for NR sidelink UE, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed A-MPR is specified in Table 6.2F.3F.2-1 for power class 5 NR sidelink UE.

Table 6.2E.3F.2-1 A-MPR for NS\_31 NR SL-U UE power class 5

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | RB Allocation (Note 4) | | | | RB Allocation (Note 3) |
|  |  | Outer RB set configuration5 | | Inner RB set configuration5 | |
|  |  | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full/Partial |
| CP-OFDM | QPSK | ≤ 5.5 | ≤ 6.5 | ≤ 4.5 | ≤ 6.5 | See Table 6.2E.2F-1 |
|  | 16 QAM | ≤ 5.5 | ≤ 7.0 | ≤ 4.5 | ≤ 7.0 |
|  | 64 QAM | ≤ 5.5 | ≤ 7.0 | ≤ 4.5 | ≤ 7.0 |
|  | 256 QAM | ≤ 7.5 | ≤ 7.5 | ≤ 7.5 | ≤ 7.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: Full allocation A-MPR applies when all RB’s in a 20 MHz channel or all RB’s in all sub-bands for wideband operation are fully allocated and all sub-bands are transmitted. Partial allocation A-MPR applies when one or more RB’s in one or more sub-bands are not allocated or when not all transmitted sub-bands for wideband operation are transmitted.  NOTE 3: Applicable for 20 MHz channels centered at the nearest NR-ARFCN corresponding to 5180, 5200, 5220, 5280, 5300, 5320, 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5745, 5765, 5785, and 5805 MHz.  NOTE 4: Applicable for all valid channels and bandwidths other than those enumerated in NOTE 3.  NOTE 5: Contiguous sub-band configuration in Table 6.2E.2F-3 applies. | | | | | | |

For PSFCH transmission with single RB set and multiple RB sets, the allowed A-MPR is specified in Table 6.2E.3F.2-2 for power class 5 NR sidelink UE.

Table 6.2E.3F.2-2 A-MPR for NS\_31 for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |
| --- | --- | --- |
|  | RB Allocation | |
| Outer RB set configuration2 | Inner RB set configuration2 |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 12.5 | ≤ 12.5 |
| NOTE 1: The MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel.  NOTE 2: Outer sub-band configuration and inner sub-band configuration in Table 2-5 apply.  NOTE 3: Applicable for 20 MHz channels centered at the nearest NR-ARFCN corresponding to 5180, 5200, 5220, 5280, 5300, 5320, 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5745, 5765, 5785, and 5805 MHz.  NOTE 4: Applicable for all valid channels and bandwidths other than those enumerated in NOTE 3. | | |

For S-SSB transmission, the allowed A-MPR is specified in Table 6.2E.3F.2-3 for power class 5 NR sidelink UE.

Table 6.2E.3F.2-3 A-MPR for NS\_31 for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | RB Allocation | | | |
| Outer RB set configuration | | Inner RB set configuration | |
| # of S-SSB repetition/RBset | > 2 | 2 | > 2 | 2 |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 13.5 | ≤ 10.0 | ≤ 10.0 | ≤ 10.0 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel.  NOTE 2: Applicable for 20 MHz channels centered at the nearest NR-ARFCN corresponding to 5180, 5200, 5220, 5280, 5300, 5320, 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5745, 5765, 5785, and 5805 MHz.  NOTE 3: Applicable for all valid channels and bandwidths other than those enumerated in NOTE 2. | | | | |

#### 6.2E.3F.3 A-MPR for NS\_53

When NS\_53 is indicated by the network or pre-configured radio parameters for NR sidelink UE, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed A-MPR is specified in Table 6.2F.3F.3-1 for power class 5 NR sidelink UE.

Table 6.2E.3F.3-1 A-MPR for NS\_53 NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) |
| CP-OFDM | QPSK | ≤ 9.0 | ≤ 12.0 | ≤ 6.5 | ≤ 8.5 | ≤ 4.5 | ≤ 6.5 | ≤ 4.0 | ≤ 5.5 | ≤ 4.0 | ≤ 4.5 |
| 16 QAM | ≤ 9.0 | ≤ 12.0 | ≤ 6.5 | ≤ 8.5 | ≤ 4.5 | ≤ 6.5 | ≤ 4.0 | ≤ 5.5 | ≤ 4.0 | ≤ 4.5 |
| *64 QAM* | ≤ 9.0 | ≤ 12.0 | ≤ 6.5 | ≤ 8.5 | ≤ 5.5 | ≤ 6.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 |
| 256 QAM | ≤ 9.0 | ≤ 12.0 | ≤ 8.0 | ≤ 8.5 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: Full allocation A-MPR applies when all RB’s in a 20 MHz channel or all RB’s in all sub-bands for wideband operation are fully allocated and all sub-bands are transmitted. Partial allocation A-MPR applies when one or more RB’s in one or more sub-bands are not allocated but when all sub-bands within the channel are transmitted. When not all sub-bands within the channel are transmitted, the A-MPR associated with the channel bandwidth according to the bandwidth of the contiguously transmitted sub-bands and according to the allocation type applies. | | | | | | | | | | | |

For PSFCH transmission with single RB set and multiple RB sets, the allowed A-MPR is specified in Table 6.2E.3F.3-2 for power class 5 NR sidelink UE.

Table 6.2E.3F.3-2 A-MPR for NS\_53 for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | |
| 20MHz | 40MHz | 60MHz | 80MHz | 100MHz |
| Contiguous/Non-contiguous | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | |

For S-SSB transmission, the allowed A-MPR is specified in Table 6.2E.3F.3-3 for power class 5 NR sidelink UE.

Table 6.2E.3F.3-3 A-MPR for NS\_53 for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| # of S-SSB repetition/RBset | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 |
| Contiguous/Non-contiguous | ≤13.5 | ≤17.5 | ≤13.5 | ≤17.5 | ≤13.5 | ≤14.5 | ≤13.5 | ≤14.5 | ≤13.5 | ≤13.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | | | | | | |

#### 6.2E.3F.4 A-MPR for NS\_58

When NS\_58 is indicated by the network or pre-configured radio parameters for NR sidelink UE, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed A-MPR is specified in Table 6.2F.3F.4-1 for power class 5 NR sidelink UE.

Table 6.2E.3F.4-1 A-MPR for NS\_58 NR SL-U UE power class 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | RB Allocation (Note 4) | | | |
|  |  | Outer RB set configuration5 | | Inner RB set configuration5 | |
|  |  | Full (dB)2 | Partial (dB)3 | Full (dB) 2 | Partial (dB) 3 |
| CP-OFDM | QPSK | ≤ 3.5 | ≤ 4.5 | ≤ 3.5 | ≤ 2.5 |
|  | 16 QAM | ≤ 4.0 | ≤ 4.5 | ≤ 4.0 | ≤ 3.0 |
|  | 64 QAM | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 |
|  | 256 QAM | ≤ 8.0 | ≤ 8.0 | ≤ 8.0 | ≤ 8.0 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: The A-MPR for Full RB allocation applies to all RB’s in all transmitted 20 MHz or larger channels that are fully allocated or all RB’s in all transmitted sub-bands for wideband operation that are fully allocated excluding the wideband configurations of Table 6.2F.2-2.  NOTE 3: The A-MPR for Partial RB allocation applies to interlaced allocations with uplink resource allocation type 2 as specified in TS 38.214 [10] or transmitted sub-bands for wideband operation are transmitted according to the wideband configurations of Table 6.2F.2-2.  NOTE 4: The A-MPR applies instead of MPR for 20 MHz channel centered at the nearest NR-ARFCN corresponding to 5955 MHz, 40 MHz channel at the nearest NR-ARFCN corresponding to 5965 MHz, 60 MHz channel at the nearest NR-ARFCN corresponding to 5975 MHz, and 80 MHz channel at the nearest NR-ARFCN corresponding to 5985 MHz. For all other channels, A-MPR is zero and MPR applies.  NOTE 5: Contiguous sub-band configuration in Table 6.2E.2F-3 applies. | | | | | |

For PSFCH transmission with single RB set and multiple RB sets, the allowed A-MPR is specified in Table 6.2E.3F.4-2 for power class 5 NR sidelink UE.

Table 6.2E.3F.4-2 A-MPR for NS\_58 for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |
| --- | --- | --- |
|  | RB Allocation | |
| Outer RB set configuration2 | Inner RB set configuration2 |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 12.5 | ≤ 10.5 |
| NOTE 1: The MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel.  NOTE 2: Outer sub-band configuration and inner sub-band configuration in Table 2-5 apply.  NOTE 3: The A-MPR applies instead of MPR for 20 MHz channel centered at the nearest NR-ARFCN corresponding to 5955 MHz, 40 MHz channel at the nearest NR-ARFCN corresponding to 5965 MHz, 60 MHz channel at the nearest NR-ARFCN corresponding to 5975 MHz, and 80 MHz channel at the nearest NR-ARFCN corresponding to 5985 MHz. For all other channels, A-MPR is zero and MPR applies. | | |

For S-SSB transmission, the allowed A-MPR is specified in Table 6.2E.3F.4-3 for power class 5 NR sidelink UE.

Table 6.2E.3F.4-3 A-MPR for NS\_58 for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | RB Allocation | | | |
| Outer RB set configuration | | Inner RB set configuration | |
| # of S-SSB repetition/RBset | > 2 | 2 | > 2 | 2 |
| Contiguous/Non-contiguous sub-band RB sets | ≤ 13.5 | ≤ 10.0 | ≤ 9.5 | ≤ 7.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel.  NOTE 2: The A-MPR applies instead of MPR for 20 MHz channel centered at the nearest NR-ARFCN corresponding to 5955 MHz, 40 MHz channel at the nearest NR-ARFCN corresponding to 5965 MHz, 60 MHz channel at the nearest NR-ARFCN corresponding to 5975 MHz, and 80 MHz channel at the nearest NR-ARFCN corresponding to 5985 MHz. For all other channels, A-MPR is zero and MPR applies. | | | | |

#### 6.2E.3F.5 A-MPR for NS\_60

When NS\_60 is indicated by the network or pre-configured radio parameters for NR sidelink UE, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed A-MPR is specified in Table 6.2F.3F.5-1 for power class 5 NR sidelink UE.

Table 6.2E.3F.5-1 A-MPR for NS\_60 NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) |
| CP-OFDM | QPSK | ≤ 6.0 | ≤ 8.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.0 | ≤ 5.5 | ≤ 4.5 | ≤ 5.5 | ≤ 4.5 | ≤ 5.5 |
| 16 QAM | ≤ 6.0 | ≤ 8.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.0 | ≤ 5.5 | ≤ 4.5 | ≤ 5.5 | ≤ 4.5 | ≤ 5.5 |
| *64 QAM* | ≤ 6.0 | ≤ 8.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 | ≤ 5.5 |
| 256 QAM | ≤ 8~~.~~0 | ≤ 8.5 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: Full allocation A-MPR applies when all RB’s in a 20 MHz channel or all RB’s in all sub-bands for wideband operation are fully allocated and all sub-bands are transmitted. Partial allocation A-MPR applies when one or more RB’s in one or more sub-bands are not allocated but when all sub-bands within the channel are transmitted. When not all sub-bands within the channel are transmitted, the A-MPR associated with the channel bandwidth according to the bandwidth of the contiguously transmitted sub-bands and according to the allocation type applies | | | | | | | | | | | |

For PSFCH transmission with single RB set and multiple RB sets, the allowed A-MPR is specified in Table 6.2E.3F.5-2 for power class 5 NR sidelink UE.

Table 6.2E.3F.5-2 A-MPR for NS\_60 for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | |
| 20MHz | 40MHz | 60MHz | 80MHz | 100MHz |
| Contiguous/Non-contiguous | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | |

For S-SSB transmission, the allowed A-MPR is specified in Table 6.2E.3F.5-3 for power class 5 NR sidelink UE.

Table 6.2E.3F.5-3 A-MPR for NS\_60 for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| # of S-SSB repetition/RBset | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 |
| Contiguous/Non-contiguous | ≤13.5 | ≤14.5 | ≤13.5 | ≤14.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | | | | | | |

#### 6.2E.3F.6 A-MPR for NS\_61

When NS\_61 is indicated by the network or pre-configured radio parameters for NR sidelink UE, this clause specifies the allowed Maximum Power Reduction (MPR) power for NR sidelink physical channels and signals due to PSCCH/PSSCH, PSFCH and S-SSB transmission.

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed A-MPR is specified in Table 6.2F.3F.6-1 for power class 5 NR sidelink UE.

Table 6.2E.3F.6-1 A-MPR for NS\_61 NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pre-coding | Modulation | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) | Full (dB) | Partial (dB) |
| CP-OFDM | QPSK | ≤ 7.5 | ≤ 10.0 | ≤ 6.5 | ≤ 6.5 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 |
| 16 QAM | ≤ 7.5 | ≤ 10.5 | ≤ 6.5 | ≤ 6.5 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 |
| *64 QAM* | ≤ 7.5 | ≤ 10.5 | ≤ 6.5 | ≤ 6.5 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 | ≤ 6.0 |
| 256 QAM | ≤ 8.0 | ≤ 10.5 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 | ≤ 8.0 | ≤ 7.0 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously allocated in the channel.  NOTE 2: Full allocation A-MPR applies when all RB’s in a 20 MHz channel or all RB’s in all sub-bands for wideband operation are fully allocated and all sub-bands are transmitted. Partial allocation A-MPR applies when one or more RB’s in one or more sub-bands are not allocated but when all sub-bands within the channel are transmitted. When not all sub-bands within the channel are transmitted, the A-MPR associated with the channel bandwidth according to the bandwidth of the contiguously transmitted sub-bands and according to the allocation type applies | | | | | | | | | | | |

For PSFCH transmission with single RB set and multiple RB sets, the allowed A-MPR is specified in Table 6.2E.3F.6-2 for power class 5 NR sidelink UE.

Table 6.2E.3F.6-2 A-MPR for NS\_61 for PSFCH transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | |
| 20MHz | 40MHz | 60MHz | 80MHz | 100MHz |
| Contiguous/Non-contiguous | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 | ≤12.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | |

For S-SSB transmission, the allowed A-MPR is specified in Table 6.2E.3F.6-3 for power class 5 NR sidelink UE.

Table 6.2E.3F.6-3 A-MPR for NS\_61 for S-SSB transmission for NR SL-U UE power class 5

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| RB set configuration | Channel bandwidth (Sub-band allocation) / RB Allocation | | | | | | | | | |
| 20MHz | | 40MHz | | 60MHz | | 80MHz | | 100MHz | |
| # of S-SSB repetition/RBset | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 | > 2 | 2 |
| Contiguous/Non-contiguous | ≤13.5 | ≤15.5 | ≤13.5 | ≤15.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 | ≤13.5 |
| NOTE 1: The A-MPR shall apply to all SCS in all active 20 MHz sub-bands contiguously or non-contiguously allocated in the channel. | | | | | | | | | | |

#### 6.2E.3F.7 A-MPR for SL-U con-current operation

For NR SL-U inter-band con-current operation, the allowed additional maximum power reduction (A-MPR) for the maximum output power shall be applied per each component carrier. The A-MPR requirements in clause 6.2.3 apply for NR Uu operation in licensed band, and the A-MPR requirements in clause 6.2E.3F apply for NR sidelink operation in unlicensed band, n46, n96 and n102.

### 6.2E.4 Configured transmitted power for V2X

#### 6.2E.4.1 General

The NR V2X 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*, PPowerClass, V2X – MAX(MAX(MPR*c* , A-MPR*c*) + TIB,*c* , P-MPR*c*), PRegulatory,c }

PCMAX\_H,f, c = MIN {PEMAX,c, PPowerClass, V2X, PRegulatory,c }

where

- PCMAX,f,*c* is configured for PSSCH\PSCCH, S-SSB and PSFCH, respectively;

- For the total transmitted power PCMAX,PSSCH/PSCCH, PEMAX,c is the value given by IE *sl-maxTransPower*, defined by TS 38.331

- For the total transmitted power PCMAX,S-SSB, the PCMAX\_L,f,*c* and PCMAX\_H,f,*c* are defined as follows:

PCMAX\_L,f,*c* = MIN {PPowerClass, V2X – MAX(MAX(MPR*c* , A-MPR*c*) + TIB,*c* , P-MPR*c*), PRegulatory,c}

PCMAX\_H,f,*c* = MIN {PPowerClass, V2X, PRegulatory,c}

- For the total transmitted power PCMAX,PSFCH, PEMAX,c is the value given by IE *sl-maxTransPower* when single resource pool configured is transmitted at a given time and sum of the IEs *sl-maxTransPower* when multiple resource pools configured are transmitted at a given time, defined by TS 38.331.

- PPowerClass,V2X is the maximum UE power specified in Table 6.2E.1.1-1 without taking into account the tolerance specified in the Table 6.2E.1.1-1;

- MPR*c* and A-MPR*c* for serving cell *c* are specified in clause 6.2E.2 and clause 6.2E.3 for PSSCH\PSCCH, S-SSB and PSFCH, respectively;

- TIB,c, and P-MPR*c* are specified in clause 6.2.4

- PRegulatory,c= 10 - Gpost connector dBm the V2X UE is within the protected zone [12] of CEN DSRC tolling system and operating in Band n47; PRegulatory,c= 33 - Gpost connector dBm otherwise.

The maximum output power P*CMAX,PSSCH* and P*CMAX,PSCCH* are derived from PCMAX,c based on 0dB PSD offset between PSSCH and PSCCH.

For the measured configured maximum output power PUMAX,*c* for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions, the same requirement as in clause 6.2.4 shall be applied.

When NR V2X UE is configured to co-channel coexistence operation with LTE V2X and NR SCS is configured to 30kHz the evaluation period for PUMAX,c for NR V2X sidelink is the first slot of NR SL slots overlapping with an LTE SL subframe and the PCMAX,f,c tolerances in Table 6.2.4-1 are relaxed by 1dB i.e. T(PCMAX,f,c) = T(PCMAX,f,c) +1 (dB).

For NR V2X UE supporting SL MIMO or Tx Diversity, the transmitted power is configured per each UE.

For NR V2X UE with two transmit antenna connectors at the same time, the tolerance is specified in Table 6.2E.4.1-1. The requirements shall be met with SL MIMO configurations specified in Table 6.2D.1-2.

Table 6.2E.4.1-1: PCMAX,*c* tolerance schemes for MIMO

|  |  |  |
| --- | --- | --- |
| PCMAX,*c*(dBm) | Tolerance TLOW(PCMAX\_L,*c*) (dB) | Tolerance THIGH(PCMAX\_H,*c*) (dB) |
| PCMAX,*c* = 26 | 3.0 | 2.0 |
| 23 ≤ PCMAX,*c* < 26 | 3.0 | 2.0 |
| 22 ≤ PCMAX,*c* < 23 | 5.0 | 2.0 |
| 21 ≤ PCMAX,*c* < 22 | 5.0 | 3.0 |
| 20 ≤ PCMAX,*c* < 21 | 6.0 | 4.0 |
| 16 ≤ PCMAX,*c* < 20 | 5.0 | |
| 11 ≤ PCMAX,*c* < 16 | 6.0 | |
| -40 ≤ PCMAX,*c* < 11 | 7.0 | |

#### 6.2E.4.2 Configured transmitted power for inter-band V2X con-current operation

When a UE is configured for simultaneous NR V2X sidelink and NR uplink transmissions for inter-band con-current operation, the UE is allowed to set its configured maximum output power PCMAX,*c*,*NR*and PCMAX,*c*,*V2X*for the configured NR uplink carrier and the configured NR V2X carrier, respectively, and its total configured maximum output power PCMAX,c.

The configured maximum output power PCMAX *c*,*NR(p)* in slot *p* for the configured NR uplink carrier shall be set within the bounds:

PCMAX\_L,*c,NR* (*p*) ≤ PCMAX,*c,NR* (*p*) ≤ PCMAX\_H,*c,NR* (*p*)

where PCMAX\_L,*c,NR* andPCMAX\_H,*c,NR* are the limit as specified in clause 6.2.4.1.

The configured maximum output power PCMAX *c*,*V2X (q)* in slot *q* for the configured NR V2X carrier shall be set within the bounds:

PCMAX,*c,V2X* (*q*) ≤ PCMAX\_H,*c,V2X* (*q*)

where PCMAX\_H,*c,V2X* is the limit as specified in clause 6.2E.4.1.

The total UE configured maximum output power PCMAX (*p,q*) in a slot *p* of NR uplink carrier and a slot *q* of NR V2X sidelink that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

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

with

PCMAX\_L (*p,q*) = PCMAX\_L,*c,NR* (*p*)

PCMAX\_H (*p,q*) = 10 log10 [pCMAX\_H,*c,NR*(*p*) + pCMAX\_H,*c,V2X*(*q*)]

where pCMAX\_H*,c,V2X* and pCMAX\_H,*c,NR*are the limits PCMAX\_H,*c,V2X* (*q*) and PCMAX\_H,*c,NR* (*p*) expressed in linear scale.

The measured total maximum output power PUMAX over both the NR uplink and NR V2X carriers is

PUMAX = 10 log10 [pUMAX,*c,NR* + pUMAX,*c,V2X*],

where pUMAX,*c,NR*  denotes the measured output power of serving cell *c* for the configured NR uplink carrier, and pUMAX,*c,V2X* denotes the measured output power for the configured NR V2X carrier expressed in linear scale.

When a UE is configured for synchronous V2X sidelink and uplink transmissions,

PCMAX\_L(*p, q*)  – TLOW (PCMAX\_L(*p, q*)) ≤ PUMAX  ≤ PCMAX\_H(*p, q*) + THIGH (PCMAX\_H(*p, q*))

where PCMAX\_L (*p,q*) and PCMAX\_H (*p,q*) are the limits for the pair (*p,q*) and with the tolerances TLOW(PCMAX) and THIGH(PCMAX) for applicable values of PCMAX specified in Table 6.2E.4.1-1.. PCMAX\_L may be modified for any overlapping portion of slots *(p, q)* and *(p +1, q+1).*

#### 6.2E.4.3 Configured transmitted power for intra-band V2X con-current operation

For intra-band con-current operation, if transmission of Uu and SL does not overlap in time, the configured output power PCMAX,*c* specified in clause 6.2E.4.1 and 6.2.4 apply for SL and Uu transmission respectively; otherwise, if transmission of Uu and SL overlap in time, the configured maximum output power PCMAX,*c* on serving cell *c* for SL and Uu shall be set as specified in clause 6.2E.4.1 and in clause 6.2.4, but with MPR*c* = MPR and A-MPR*c* = A-MPR with MPR and A-MPR as determined by subclause 6.2E.2.3 for both PC3 and PC2 and subclause 6.2E.3.4, respectively. There is one power management term for the UE, denoted P-MPR, and P-MPR*c* = P-MPR.

The total configured maximum output power PCMAX shall be set within the following bounds:

PCMAX\_L ≤ PCMAX ≤ PCMAX\_H

For intra-band concurrent operation when same slot pattern is used in all aggregated serving cells,

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

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

where

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

- PPowerClass,con-current is the maximum UE power specified in Table 6.2E.1.2-2 without taking into account the tolerance;

- MPR and A-MPR are specified in clause 6.2E.2 and 6.2E.3, respectively;

- TIB,c is the additional tolerance for serving cell *c* as specified in clause 6.2E.4.3

- P-MPR is the power management term for the UE;

- TC is the highest value TC,c among all serving cells *c*;

For intra-band concurrent operation, 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 same band for intra-band operation:

PCMAX\_L (p,q) = MIN {10 log10 [pCMAX\_L,f,c(i),Uu,i (p) + pCMAX\_L,f,c(i),V2X,j (q)], PPowerClass,con-current}

PCMAX\_H (p,q) = MIN {10 log10 [pCMAX\_ H,f,c(i), Uu,,i (p) + pCMAX\_ H,f,c(i),V2X,j (q)], PPowerClass,con-current}

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

TREF and Teval are specified in Table 6.2E.4.3-1 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. PPowerClass,Concurrent shall not be exceeded by the UE during any period of time.

Table 6.2E.4.3-1: PCMAX evaluation window for different slot and channel durations

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

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 6.2E.4.3-2. The tolerance TL is the absolute value of the lower tolerance for applicable NRV2X concurrent operation configuration as specified in Table 6.2 E.1.2-2 for intra-band NR V2X concurrent operation.

The measured maximum output power PUMAX over all serving cells, when at least one slot has a different transmission numerology or slot 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 6.2E.4.3-2. The tolerance TL is the absolute value of the lower tolerance for applicable NR V2X concurrent operation configuration as specified in Table 6.2E.1.2-2 for intra-band NR V2X concurrent operation.

where:

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

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

Table 6.2E.4.3-2: PCMAX tolerance for SL intra-band con-current operation

|  |  |  |
| --- | --- | --- |
| PCMAX (dBm) | Tolerance TLOW(PCMAX) (dB) | Tolerance THIGH(PCMAX) (dB) |
| 26 ≤ PCMAX < 23 | 3 | 2 |
| 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 | |

A UE supporting sidelink operation can be configured by higher layers with one or more sidelink resource pools. A sidelink resource pool can be associated with either sidelink resource allocation mode 1 or sidelink resource allocation mode 2.

For sidelink resource allocation in either mode 1 or mode 2, if UE is in RRC\_CONNECTED state, and the preparation procedure time for transmission of sidelink physical channel is available before of PUSCH preparation procedure time, for transmission of Uu and SL not overlap in time, the configured output power PCMAX,*c* specified in clause 6.2E.4.1 and in clause 6.2.4 apply for SL and Uu transmission respectively, otherwise, the configured maximum output power PCMAX specified in this clause shall apply.

For sidelink resource allocation mode 2, if UE is in RRC\_IDLE state, sidelink transmission is based on pre-configured sidelink resource pool, the UE configured output power is determined by sidelink only, where the configured output power specified in clause 6.2E.4.1 apply.

For sidelink resource allocation mode 2, if UE is in RRC\_INACTIVE state, and Uu does not support SDT, the configured output power specified in clause 6.2E.4.1 apply, otherwise, the configured maximum output power PCMAX in this clause shall apply.

### 6.2E.4A Configured transmitted power for Sidelink CA

For intra-band contiguous SL CA operation, MPR*c* = MPR and A-MPR*c* = A-MPR with MPR and A-MPR specified in subclause 6.3.2 and subclause 6.3.4 respectively. There is one power management term for the UE, denoted P-MPR, and P-MPR*c* = P-MPR. PCMAX,*c* is calculated under the assumption that the transmit power is increased by the same amount in dB on all component carriers.

The total configured maximum output power PCMAX shall be set within the following bounds:

PCMAX\_L ≤ PCMAX,  ≤ PCMAX\_H

For SL transmission of intra-band contiguous CA when same slot pattern is used in all aggregated component carriers.

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

PCMAX\_H = MIN{10 log10 ∑ pEMAX,CA , PPowerClass, SL\_CA, PRegulatory }

where

- For the total transmitted power PCMAX,PSSCH/PSCCH, pEMAX,CA is the value given by [the sum of IE *sl-maxTransPower* from each CC or new IE for maximum transmitted power of SL CA], defined by TS 38.331;

- PPowerClass, SL\_CA is the maximum UE power specified in Table 6.3.1-1 without taking into account the tolerance;

- MPR and A-MPR are specified in subclause 6.3.2 and subclause 6.3.3 respectively;

- TIB,c and P-MPR are specified in clause 6.2.4 in TS38.101-1;

- TC is the highest value TC,c among all component carriers *c* in the subframe over both timeslots. TC,c = 1.5 dB when NOTE 3 in Table 6.2.1-1 in TS38.101-1 applies, otherwise TC,c = 0 dB;

- PRegulatory= 10 - Gpost connector dBm when V2X UE is within the protected zone in ETSI TS 102 792 of CEN DSRC tolling system and operating in Band n47; PRegulatory= 33 - Gpost connector dBm otherwise.

The maximum output power P*CMAX,PSSCH* and P*CMAX,PSCCH* are derived from PCMAX,c based on 0dB PSD offset between PSSCH and PSCCH.

For intra-band SL CA operation, when at least one different numerology/slot pattern is used in aggregated cells, the same requirement as specified in clause 6.2E.4.3 in TS38.101-1 shall be applied.

The measured configured maximum output power PUMAX,*c* for sidelink CA operation, when at least one slot has a different transmission numerology or slot pattern, the same requirement as specified in clause 6.2E.4.3 in TS38.101-1 shall be applied.

### 6.2E.4F Configured transmitted power for Sidelink Unlicensed

#### 6.2E.4F.1 General

The requirements for configured transmitted power in clause 6.2E.4 apply for SL-U operation..

#### 6.2E.4F.1 Configured transmitted power for inter-band con-current operation

* When a UE is configured for simultaneous NR sidelink and NR uplink transmissions for inter-band con-current operation, the UE is allowed to set its configured maximum output power PCMAX,*c*,*NR*and PCMAX,*c*,SL for the configured NR uplink carrier and the configured NR SL carrier, respectively, and its total configured maximum output power PCMAX,c.
* The configured maximum output power PCMAX *c*,*NR(p)* in slot *p* for the configured NR uplink carrier shall be set within the bounds:
* PCMAX\_L,*c,NR* (*p*) ≤ PCMAX,*c,NR* (*p*) ≤ PCMAX\_H,*c,NR* (*p*)
* where PCMAX\_L,*c,NR* andPCMAX\_H,*c,NR* are the limit as specified in TS 38.101-1 clause 6.2E.4.1.
* The configured maximum output power PCMAX *c*,SL*(q)* in slot *q* for the configured NR SL carrier shall be set within the bounds:
* PCMAX,*c,SL* (*q*) ≤ PCMAX\_H,*c,SL* (*q*)
* where PCMAX\_H,*c,SL* is the limit as specified in TS 38.101-1 clause 6.2E.4.
* The total UE configured maximum output power PCMAX (*p,q*) in a slot *p* of NR uplink carrier and a slot *q* of NR sidelink that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:
* PCMAX\_L (*p,q*) ≤ PCMAX (*p,q*) ≤ PCMAX\_H (*p,q*)
* with
* PCMAX\_L (*p,q*) = PCMAX\_L,*c,NR* (*p*)
* PCMAX\_H (*p,q*) = 10 log10 [pCMAX\_H,*c,NR*(*p*) + pCMAX\_H,*c,SL*(*q*)]
* where pCMAX\_H*,c,SL* and pCMAX\_H,*c,NR*are the limits PCMAX\_H,*c,SL* (*q*) and PCMAX\_H,*c,NR* (*p*) expressed in linear scale.
* The measured total maximum output power PUMAX over both the NR uplink and NR SL carriers is
* PUMAX = 10 log10 [pUMAX,*c,NR* + pUMAX,*c,SL*],
* where pUMAX,*c,NR*  denotes the measured output power of serving cell *c* for the configured NR uplink carrier, and pUMAX,*c,SL* denotes the measured output power for the configured NR SL carrier expressed in linear scale.
* When a UE is configured for synchronous NR sidelink and uplink transmissions,
* PCMAX\_L(*p, q*)  – TLOW (PCMAX\_L(*p, q*)) ≤ PUMAX  ≤ PCMAX\_H(*p, q*) + THIGH (PCMAX\_H(*p, q*))
* where PCMAX\_L (*p,q*) and PCMAX\_H (*p,q*) are the limits for the pair (*p,q*) and with the tolerances TLOW(PCMAX) and THIGH(PCMAX) for applicable values of PCMAX specified in Table 6.2E.4.1-1.. PCMAX\_L may be modified for any overlapping portion of slots *(p, q)* and *(p +1, q+1).*

## 6.3E Output power dynamics for V2X

### 6.3E.1 Minimum output power for V2X

#### 6.3E.1.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands in Table 5.2E.1-1, the minimum output power is specified in Table 6.3E.1.1-1. The minimum output power is defined as the mean power in at least one sub-frame 1 ms.

Table 6.3E.1.1-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 51 | -30 | 4.515 |
| 10 | -30 | 9.375 |
| 20 | -30 | 19.095 |
| 30 | -28.2 | 28.815 |
| 40 | -27 | 38.895 |
| Note 1: The CBW is only applicable to PS UE in n14. | | |

For NR V2X UE with two transmit antenna connectors, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1 ms). The minimum output power shall not exceed the values specified for single carrier.

If the UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

#### 6.3E.1.1A Minimum output power for sidelink CA

For SL intra-band contiguous CA, the minimum output power requirement as specified in Table 6.3E.1.1A -1 shall be applied per component carrier.

Table 6.3E.1.1A -1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -30 | MBW=REF\_SCS\*(12\*NRB+1)/1000 |
| 20 | -30 |
| 30 | -28.2 |
| 40 | -27 |

#### 6.3E.1.2 Minimum output power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.3.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.1.1 shall apply for the sidelink in licensed band or Band n47.

For intra-band con-current NR V2X operation, the minimum output power is defined per carrier and the requirement for NR uplink is specified in clause 6.3.1 and the requirement for NR sidelink is specified in clause 6.3E.1, respectively.

### 6.3E.1F Minimum output power for Sidelink Unlicensed

The requirements for minimum output power in clause 6.3.1 apply.

#### 6.3E.1F.1 Minimum output power for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.3.1 shall apply for NR Uu operation in licensed band and the requirements specified in clause 6.3E.1F shall apply for NR sidelink operation in unlicensed band.

### 6.3E.2 Transmit OFF power for V2X

#### 6.3E.2.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands in Table 5.2E.1-1, the requirements specified in current clause apply.

Table 6.3E.2.1-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 51 | -50 | 4.515 |
| 10 | -50 | 9.375 |
| 20 | -50 | 19.095 |
| 30 | -50 | 28.815 |
| 40 | -50 | 38.895 |
| Note 1: The CBW is only applicable to PS UE in n14. | | |

For NR V2X UE supporting SL MIMO or Tx Diversity, the transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3E.2.1-1 for single carrier. Transmit off power is defined as the mean power in at least one sub-frame 1 ms.

#### 6.3E.2.1A Transmit OFF power for sidelink CA

For SL intra-band contiguous CA, the transmit OFF power requirement as specified in Table 6.3E.2.1A -1 shall be applied per component carrier.

Table 6.3E.2.1A -1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50 | MBW=REF\_SCS\*(12\*NRB+1)/1000 |
| 20 | -50 |
| 30 | -50 |
| 40 | -50 |

#### 6.3E.2.2 Transmit OFF power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.3.2 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.2.1 shall apply for the sidelink in licensed band or Band n47.

For intra-band con-current NR V2X operation, the transmit OFF power requirement is defined per carrier and the requirement for NR uplink is specified in clause 6.3.2 and the requirement for NR sidelink is specified in clause 6.3E.2, respectively.

### 6.3E.2F Transmit OFF power for Sidelink Unlicensed

The requirements for Transmit OFF power in clause 6.3.2 apply for SL-U operation.

#### 6.3E.2F.1 Transmit OFF power for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in TS 38.101-1 clause 6.3.2 shall apply for NR Uu operation in licensed band and the requirements specified in clause 6.3E.2F shall apply for NR sidelink operation in unlicensed band.

### 6.3E.3 Transmit ON/OFF time mask for V2X

#### 6.3E.3.1 General

For NR V2X UE, additional requirements on ON/OFF time masks for V2X physical channels and signals are specified in this clause.

#### 6.3E.3.1A Transmit ON/OFF time mask for sidelink CA

For SL intra-band contiguous CA, the SL ON/OFF time masks specified in clause 6.3E.3.2, 6.3E.3.3 and 6.3E.3.4 are applicable to each component carrier during the ON power period and the transient periods. The OFF period shall only be applicable to each component carrier when all the component carriers are OFF.

#### 6.3E.3.2 General time mask

The General ON/OFF time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSCCH, and PSSCH transmissions in a slot wherein the last symbol is punctured to create a guard period.



Figure 6.3E.3.2-1: General PSCCH/PSSCH time mask for NR V2X UE

For NR V2X UE supporting SL MIMO or Tx Diversity, the ON/OFF time mask requirements apply at each transmit antenna connector.

For UE with two transmit antenna connectors, the general ON/OFF time mask requirements specified in current subclause apply to each transmit antenna connector. The requirements shall be met with the SL MIMO configurations described in subclause 6.2D.1.

If the UE transmits on one antenna connector at a time, the general ON/OFF time mask requirements apply to the active antenna connector.

#### 6.3E.3.3 S-SSB time mask

The S-PSS/S-SSS/PSBCH time mask for NR V2X UE defines the observation period between transmit OFF and ON S-PSS power and between transmit ON PSBCH and OFF power in a slot wherein the last symbol is punctured to create a guard period.

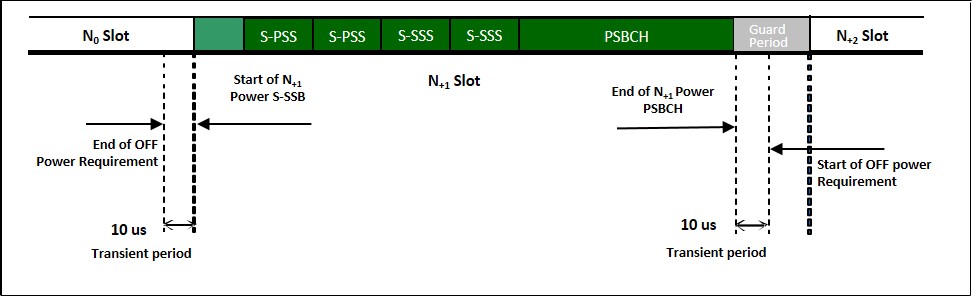


Figure 6.3E.3.3-1: S-SSB time mask for NR V2X UE

For NR V2X UE supporting SL MIMO or Tx Divesity, the ON/OFF time mask requirements apply at each transmit antenna connector.

For UE with two transmit antenna connectors, the S-SSB ON/OFF time mask requirements specified in current subclause apply to each transmit antenna connector. The requirements shall be met with the SL MIMO configurations described in subclause 6.2D.1.

If the UE transmits on one antenna connector at a time, the S-SSB ON/OFF time mask requirements apply to the active antenna connector.

#### 6.3E.3.4 Transmit ON/OFF time mask for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.3.3 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.3.2 and 6.3E.3.3 shall apply for the sidelink in licensed band or Band n47.

For intra-band V2X con-current operation band specified in subclause 5.2.E.2, the general output power ON/OFF time mask is defined per carrier during the ON power period and the transient periods. The ON/OFF time mask specified in clause 6.3.3.1 is applicable for NR uplink and the ON/OFF time mask in 6.3E.3.1 is applicable for NR sidelink. The OFF period as specified in clause 6.3.3.1 shall only be applicable for each component carrier when all the component carriers are OFF.

For the TDM operation in same carrier with same bandwidth, the switching time mask in Figure 6.3E.3.4-1 shall be applied.

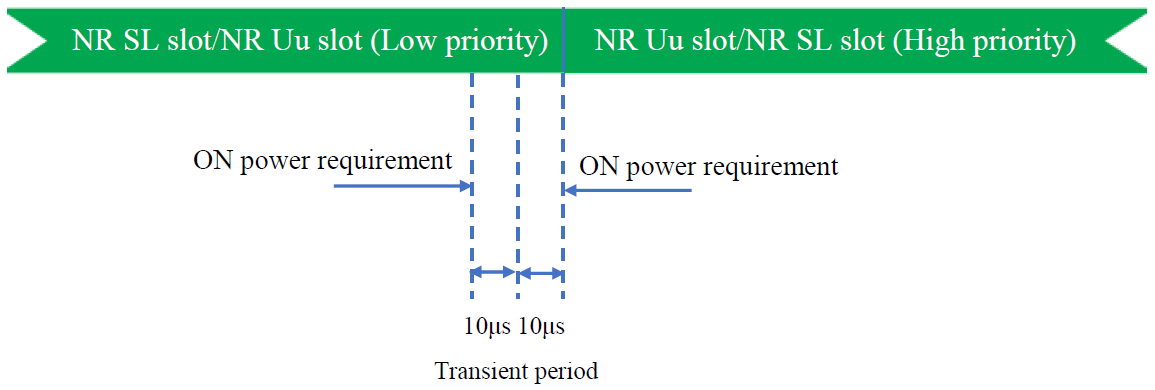


Figure 6.3E.3.4-1: Time mask for switching between Uu and SL for same carrier case with same bandwidth

For intra-band V2X con-current operation band specified in subclause 5.3.E.2, the switching time mask in Figure 6.3E.3.4-2 shall apply for the different carrier case. The switching time shall be located on the RAT of low priority when NR Uu and NR SL have different priorities based on priority information specified in TS 38.321 and TS38.213. It is up to UE implementation when NR Uu and NR SL have the same priority based on priority information specified in TS 38.213.

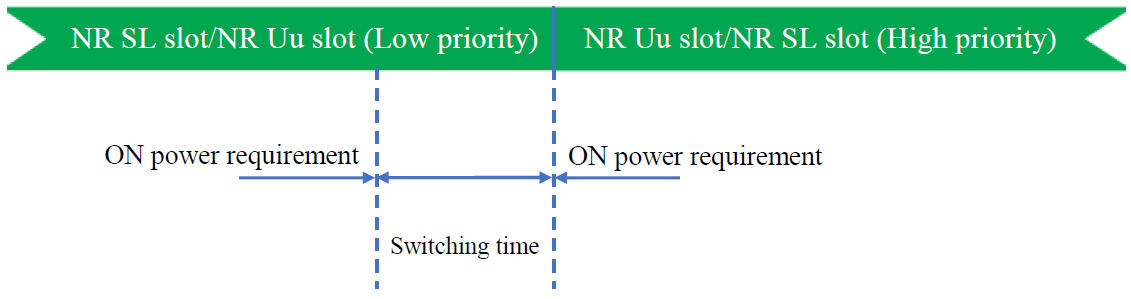


Figure 6.3E.3.4-2: Time mask for switching between Uu and SL for different carrier case

In the real field, there is a timing advance difference, i.e. between NR Uu slot and NR SL slot due to different timing advance of NR Uu and NR SL. The switching time masks do not include timing advance difference but the timing advance difference should be considered with the switching time for same carrier case and different carrier case.

### 6.3E.3F Transmit ON/OFF time mask for Sidelink Unlicensed

#### 6.3E.3F.1 General

The transmit power time mask defines the transient period(s) allowed between transmit OFF power as defined in clause 6.3E.2F and transmit ON power symbols (transmit ON/OFF). The transmit power ON/OFF time mask specified in clause 6.3E.3F.2 supercedes the ON/OFF masks specified in clause 6.3.3; however, between continuous ON-power transmissions the requirements in clause 6.3.3 apply. Unless otherwise stated the requirements in clause 6.5F apply also in transient periods.

#### 6.3E.3F.2 General ON/OFF time mask

The general ON/OFF time mask defines the observation period between transmit OFF and ON power and between transmit ON and OFF power for each SCS as illustrated below in Figure 6.3E.3F.2-1. ON/OFF scenarios include: contiguous, and non-contiguous transmission, etc.

The OFF power measurement period is defined in a duration of at least one slot excluding any transient periods. The ON power is defined as the mean power over the duration of at least one slot excluding any transient period and non-transmitted symbols. The leading transient period starts 5us before the beginning of the first symbol of transmission and extends 10us into the transmission including the CP extension if applicable. The last symbol is punctured to create a guard period where the trailing transient period of 10us is located inside.



Guard

Period



N+1 Slot (incl. transmission gap)



CP

-

E

N

+2

Slot

5us

10us

10us

Transient Period

Transient Period

End of OFF

Power Requirement

N

0

Slot

Start of N

+1

power

End of N

+1

power

Start of OFF power

requirement

Figure 6.3E.3F-1 General ON/OFF time mask for SL-U PSSCH and PSCCH

#### 6.3E.3F.3 S-SSB time mask

The S-PSS/S-SSS/PSBCH time mask for NR Sidelink Unlicensed UE defines the observation period between transmit OFF and ON S-PSS power and between transmit ON PSBCH and OFF power in a slot wherein the last symbol is punctured to create a guard period. The leading transient period starts 5us before the beginning of the first symbol of transmission and extends 10us into the transmission including the CP extension if applicable. The last symbol is punctured to create a guard period where the trailing transient period of 10us is located inside.



Figure 6.3E.3F-2 ON/OFF time mask for SL-U S-SSB

#### 6.3E.3F.4 Transmit ON/OFF time mask for NR SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.3.3 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.3F.2 and 6.3E.3F.3 shall apply for NR sidelink operation in unlicensed band.

### 6.3E.4 Power control for V2X

#### 6.3E.4.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands in Table 5.2E.1-1, the following requirements are applied for NR V2X sidelink transmission.

For NR V2X UE supporting SL MIMO or Tx Diversity, the power control tolerance for single carrier shall apply to the sum of output power at each transmit antenna connector.

If the UE transmits on one antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

* The relative slot power tolerance for V2X UE supporting co-channel coexistence with LTE SL is the ability of the NR V2X UE operating with 30kHz SCS to control the output power of transmitted slots during PSCCH/PSSCH transmission consisting of two slots overlapping with an LTE SL subframe (500us). The reference slot is the 1st slot overlapping with LTE SL subframe and target slot is the subsequent NR SL slot overlapping with the LTE SL subframe. The measurement period for reference and target slot is one NR SL slot with guard symbol omitted. The power of the target slot must be the same or lower than the power of the reference slot using the tolerance equal to relaxation given for Table 6.2.4-1 values in 6.2E.4.1.

#### 6.3E.4.1A Power control for sidelink CA

For SL intra-band contiguous CA, the power control requirement as specified in clause 6.3E.4.2 shall be applied per component carrier.

#### 6.3E.4.2 Absolute power tolerance

The requirements in clause 6.3.4.2 shall apply for NR V2X transmission.

#### 6.3E.4.3 Power control for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.3.4 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.4.1 and 6.3E.4.2 shall apply for the sidelink in licensed band or Band n47.

For the intra-band con-current NR V2X operation, the requirements specified in clause 6.3.4 shall apply for the uplink in licensed band and the requirements specified in clause 6.3E.4 shall apply for the sidelink in licensed band.

### 6.3E.4F Power control for Sidelink Unlicensed

#### 6.3E.4F.1 General

The requirements on power control accuracy apply under normal conditions.

#### 6.3E.4F.2 Absolute power tolerance

The absolute power tolerance requirements of clause 6.3.4.2 apply at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 40 ms.

#### 6.3E.4F.3 Power control for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.3.4 shall apply for NR Uu operation in licensed band and the requirements specified in clause 6.3E.4F.1 and 6.3E.4F.2 shall apply for NR sidelink operation in unlicensed band.

## 6.4E Transmit signal quality for V2X

### 6.4E.1 Frequency error for V2X

#### 6.4E.1.1 General

The UE modulated carrier frequency for NR V2X sidelink transmissions in Table 5.2E.1-1, shall be accurate to within ±0.1 PPM observed over a period of 1 ms compared to the absolute frequency in case of using GNSS synchronization source. The same requirements applied over a period of 1 ms compared to the carrier frequency received from the gNB or V2X synchronization reference UE in case of using the gNB or V2X synchronization reference UE sidelink synchronization signals.

For NR V2X UE supporting SL MIMO or Tx Diversity, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±0.1 PPM observed over a period of 1 ms in case of using GNSS synchronization source. The same requirements apply over a period of 1 ms compared to the relative frequency in case of using the NR gNode B or V2X synchronization reference UE sidelink synchronization signals.

If the UE transmits on one antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

#### 6.4E.1.1A Frequency error for sidelink CA

For SL intra-band contiguous CA, ±0.1 PPM observed over a period of 1 ms will be applied per CC compared to the absolute frequency in case of using GNSS synchronization source. The same requirements will be applied to all SL synchronous reference sources (the gNB or V2X synchronization reference UE).

#### 6.4E.1.2 Frequency error for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.4.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.4E.1.1 shall apply for the sidelink in licensed band or Band n47.

For the intra-band con-current NR V2X operation, the requirements specified in clause 6.4.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.4E.1 shall apply for the sidelink in licensed band.

### 6.4E.1F Frequency error for Sidelink Unlicensed

The requirements for frequency error in 6.4E.1 apply for SL-U operation.

#### 6.4E.1F.1 Frequency error for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.4.1 shall apply for NR Uu operation in licensed band and the requirements specified in clause 6.4E.1 shall apply for NR sidelink operation in unlicensed band.

### 6.4E.2 Transmit modulation quality for V2X

#### 6.4E.2.1 General

The transmit modulation quality requirements in this clause apply to V2X sidelink transmissions.

For NR V2X UE supporting SL MIMO or Tx Diversity, the transmit modulation quality requirements for single carrier shall apply to each transmit antenna connector.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier apply to the active antenna connector.

#### 6.4E.2.2 Error Vector Magnitude for V2X

For V2X sidelink physical channels PSCCH and PSSCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in Table 6.4.2.1-1 except pi/2-BPSK for NR V2X operating bands in Table 5.2E.1-1. When sidelink transmissions are shortened due to transmission gap of one symbol at the end of the slot, the EVM measurement interval is reduced by one symbol, accordingly.

#### 6.4E.2.2A Error Vector Magnitude for sidelink CA

For SL intra-band contiguous CA, the EVM requirement as specified in clause 6.4E.2.2 shall be applied per component carrier.

#### 6.4E.2.3 Carrier leakage for V2X

Carrier leakage of NR V2X sidelink transmission, the requirements for NR PUSCH in Table 6.4.2.2-1 shall be applied.

#### 6.4E.2.3A Carrier leakage for sidelink CA

For SL intra-band contiguous CA, the carrier leakage requirement as specified in clause 6.4E.2.3 shall be applied per component carrier when only one SL transmission carrier is activated in a time.

#### 6.4E.2.4 In-band emissions for V2X

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.4.2.3 for the corresponding modulation and transmission bandwidth. When V2X transmissions are shortened due to transmission gap of one symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

#### 6.4E.2.4A In-band emissions for sidelink CA

For SL intra-band contiguous CA, the In-band emission requirement as specified in clause 6.4E.2.4 shall be applied to the SL aggregated transmission bandwidth. This is same as NR intra-band CA UE.

#### 6.4E.2.5 EVM equalizer spectrum flatness for V2X

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the EVM equalizer spectrum flatness requirements shall be as specified for PUSCH in clause 6.4.2.4 for the corresponding modulation and transmission bandwidth.

#### 6.4E.2.6 Transmit modulation quality for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.4.2 shall apply for the uplink in licensed band and the requirements specified in clause 6.4E.2.1 through 6.4E.2.5 shall apply for the sidelink in licensed band or Band n47.

For the intra-band con-current NR V2X operation, the requirements specified in clause 6.4.2 shall apply for the uplink in licensed band and the requirements specified in clause 6.4E.2 shall apply for the sidelink in licensed band.

### 6.4E.2F Transmit modulation quality for Sidelink Unlicensed

#### 6.4E.2F.0 General

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

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

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

- Carrier leakage

- In-band emissions for the non-allocated RB

All the parameters defined in clause 6.4.2 are defined using the measurement methodology specified in Annex F.

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [7]), carrier leakage measurement requirement in clause 6.4E.2F.2 and 6.4E.2F.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.

#### 6.4E.2F.1 Error Vector Magnitude

The requirements for Error Vector Magnitude in clause 6.4E.2.2 apply for SL-U operation.

#### 6.4E.2F.2 Carrier leakage

The requirements for carrier leakage in clause 6.4.2.2 apply for SL-U operation.

#### 6.4E.2F.3 In-band emissions

The requirements for in-band emission in clause 6.4F.2.3 apply for SL-U operation.

#### 6.4E.2F.4 EVM equalizer spectrum flatness

The requirements for EVM equalizer spectrum flatness in clause 6.4.2.4 apply for SL-U operation.

#### 6.4E.2F.5 Transmit modulation quality for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.4.2 shall apply for the uplink in licensed band and the requirements specified in clause 6.4E.2F.0 through 6.4E.2F.4 shall apply for NR sidelink operation in unlicensed band.

## 6.5E Output RF spectrum emissions for V2X

### 6.5E.1 Occupied bandwidth for V2X

#### 6.5E.1.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the requirements in clause 6.5.1 shall apply for NR V2X sidelink transmission.

For NR V2X UE with two transmit antenna connectors, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified in Table 6.5.1-1. The requirements shall be met with SL MIMO configurations described in clause 6.2D.1.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

#### 6.5E.1.1A Occupied bandwidth for sidelink

For SL intra-band contiguous CA, the occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated power of the aggregated CBW. The occupied bandwidth shall be less than the aggregated channel bandwidth.

#### 6.5E.1.2 Occupied bandwidth for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.5.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.5E.1.1 shall apply for the sidelink in licensed band or Band n47.

For the intra-band con-current NR V2X operation, the requirements specified in clause 6.5.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.5E.1 shall apply for the sidelink in licensed band.

### 6.5E.1F Occupied bandwidth for Sidelink Unlicensed

The requirements for occupied bandwidth in clause 6.5.1 apply for the specified SL-U channel bandwidths in Table 5.3E.1F-1.

#### 6.5E.1F.1 Occupied bandwidth for SL-U con-current operation

For NR SL-U inter-band con-current operation, the requirements specified in clause 6.5.1 shall apply for the uplink in licensed band and the requirements specified in clause 6.5E.1F shall apply for NR sidelink operation in unlicensed band.

### 6.5E.2 Out of band emission for V2X

#### 6.5E.2.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the requirements in clause 6.5E.2.2.1, 6.5E.2.3 and 6.5E.2.4.1 apply for NR V2X sidelink transmission.

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with SL MIMO configurations described in clause 6.2D.1.

#### 6.5E.2.2 Spectrum emission mask

##### 6.5E.2.2.1 General

For NR V2X UE, the existing NR general spectrum emission mask in subclause 6.5.2.2 applies for all supporting NR V2X channel bandwidths. The spectrum emission mask of the UE applies to frequencies (ΔfOOB) starting from the ± edge of the assigned NR channel bandwidth. For frequencies greater than (ΔfOOB), the power of any UE emission shall not exceed the levels specified in Table 6.5.2.2-1 for the specified channel bandwidth for NR V2X operating bands in Table 5.2E.1-1.

##### 6.5E.2.2.1A Spectrum emission mask for sidelink CA

For SL intra-band contiguous CA, the SEM requirement for NR intra-band contiguous CA as specified in clause 6.5A.2.2.1 shall be applied to the aggregated channel bandwidth with SL CA bandwidth class B.

##### 6.5E.2.2.2 Spectrum emission mask for V2X con-current operation

For the inter-band con-current NR V2X operation, the general/additional SEM requirements specified in clause 6.5.2 shall apply for the uplink in licensed band and the general/additional SEM requirements specified in clause 6.5E.2.2.1 shall apply for the sidelink in licensed band or Band n47.

For intra-band NR V2X transmission with bandwidth class B where Uu and SL overlap in time the specifications in section 6.5A.2.2.1 and 6.5A.2.2.2 apply.

#### 6.5E.2.3 Additional Spectrum emission mask

##### 6.5E.2.3.1 Requirements for network signalling value "NS\_33"

The additional spectrum mask in Table 6.5E.2.3.1-1 applies for NR V2X UE within 5 855 MHz to 5 950 MHz according to ETSI EN 302 571. Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_33" is indicated in the cell or pre-configured radio parameters, the power of any V2X UE emission shall not exceed the levels specified in Table 6.5E.2.3.1-1.

Table 6.5E.2.3.1-1: Additional spectrum mask requirements for 10MHz channel bandwidth

|  |  |  |
| --- | --- | --- |
| Spectrum emission limit (dBm EIRP)/ Channel bandwidth | | |
| ΔfOOB  (MHz) | 10 MHz | Measurement bandwidth |
| ± 0-0.5 | [] | 100 kHz |
| ± 0.5-5 | [] | 100 kHz |
| ± 5-10 | [] | 100 kHz |

NOTE 1: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE 2: Additional SEM for NR V2X overrides any other requirements in frequency range 5855-5950MHz.

NOTE 3: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I in [11].

##### 6.5E.2.3.2 Requirements for network signalling value "NS\_52"

The additional spectrum mask in Table 6.5E.2.3.2-1 applies for NR V2X UE within 5 765 MHz to 6 005 MHz according to FCC regulation. Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS\_52" is indicated in the cell or pre-configured radio parameters, the power of any V2X UE emission shall not exceed the levels specified in Table 6.5E.2.3.2-1.

Table 6.5E.2.3.2-1: Additional spectrum mask requirements for 40MHz channel bandwidth (fc = 5885MHz)

|  |  |  |
| --- | --- | --- |
| ΔfOOB (MHz) | Emission Limit (dBm) | Measurement Bandwidth |
| ±0-2 | -32 | 100kHz |
| ±2-10 | -36 | 100kHz |
| ±10-20 | -38 | 100kHz |
| ±20-40 | -43 | 100kHz |
| ±40-100 | -50 | 100kHz |

NOTE: The ASE requirements for NS\_52 will not be verified until the corresponding regulation release a formal rule for C-V2X emission limits.

##### 6.5E.2.3.3 Requirements for network signalling value "NS\_06"

The additional spectrum mask are signalled by the network to indicate that the public safety (PS) UE in NR band n14 shall meet an additional for a specific deployement scenarios.

When "NS\_06" is indicated by serving cell or pre-configured radio parameters, the power of any PS UE emission shall not exceed the levels specified in Table 6.5.2.3.4-1.

#### 6.5E.2.4 Adjacent channel leakage ratio

##### 6.5E.2.4.1 General

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

For NR V2X UE, the existing ACLR requirement for NR uplink transmission in clause 6.5.2.4 are applied for NR V2X UE for NR V2X operating bands in 5.2E.1-1.

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with SL MIMO configurations described in clause 6.2D.1.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

##### 6.5E.2.4.1A ACLR for sidelink CA

For SL intra-band contiguous CA, the general NR CA ACLR requirements for CA Bandwidth Class B specified in subclause 6.5A.2.4.1.1 shall be applied to the aggregated channel bandwidth with SL CA bandwidth class B.

##### 6.5E.2.4.2 ACLR for V2X con-current operation

For the inter-band con-current NR V2X operation, the ACLR requirement specified in clause 6.5.2.4 shall apply for the uplink in licensed band and the ACLR requirement specified in clause 6.5E.2.4.1 shall apply for the sidelink in licensed band or Band n47.

For the intra-band NR V2X operation with bandwidth classes B where Uu and SL transmission overlaps in time, the ACLR requirement specified in clause 6.5A.2.4.1 shall apply for the both uplink and sidelink transmission in licensed band.

### 6.5E.2F Out of band emission for Sidelink Unlicensed

#### 6.5E.2F.1 General

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

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

#### 6.5E.2F.2 Spectrum emission mask for operation with shared spectrum channel access

The requirements for spectrum emission mask in clause 6.5F.2.2 apply for SL-U operation.

##### 6.5E.2F.2.1 Spectrum emission mask for SL-U con-current operation

For NR SL-U inter-band con-current operation, the general/additional SEM requirements specified in clause 6.5.2 shall apply for NR Uu operation in licensed band and the general/additional SEM requirements specified in clause 6.5E.2F shall apply for NR sidelink operation in unlicensed band.

#### 6.5E.2F.3 Additional spectrum emission mask

There are no additional spectrum emission mask requirements for SL-U operation. in this version of the specification.

#### 6.5E.2F.4 Adjacent channel leakage ratio

The requirements for ACLR in clause 6.5F.2.4 apply for SL-U operation.

##### 6.5E.2F.4.1 Adjacent channel leakage ratio for SL-U con-current operation

For NR SL-U inter-band con-current operation, the ACLR requirement specified in clause 6.5.2.4 shall apply for NR Uu operation in licensed band and the ACLR requirement specified in clause 6.5E.2F.4 shall apply for NR sidelink operation in unlicensed band.

### 6.5E.3 Spurious emissions for V2X

#### 6.5E.3.1 General spurious emissions

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the general spurious emission requirements in clause 6.5.3.1 shall apply for NR V2X sidelink transmission.

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with the SL MIMO configurations described in clause 6.2D.1.

#### 6.5E.3.1A Spurious emissions for sidelink CA

For SL intra-band contiguous CA, the general NR CA general SE for CA Bandwidth specified in subclause 6.5A.3.1 shall be applied to the aggregated channel bandwidth with SL CA bandwidth class B.

#### 6.5E.3.2 Spurious emissions for UE co-existence

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the requirements in clause 6.5.3.2 shall apply for NR V2X sidelink transmission.

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with the SL MIMO configurations described in clause 6.2D.1.

#### 6.5E.3.2A Spurious emissions band UE co-existence for sidelink CA

For SL intra-band contiguous CA, the protection operating band lists for n47 transmission is defined in Table 6.5.3.2-1 which shall be applied to NR SL intra-band contiguous CA UE.

#### 6.5E.3.3 Spurious emissions for UE co-existence for V2X con-current operation

For the inter-band con-current NR V2X operation, the UE-coexistence requirements in Table 6.5E.3.3-1 apply for the corresponding inter-band con-current operation with transmission assigned to both uplink in licensed band and sidelink in Band n47.

**Table 6.5E.3.3-1: Requirements for inter-band con-current V2X operation**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| V2X | Spurious emission | | | | | | |
| con-current operating band configuration | Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| V2X\_n1A-n47A | E-UTRA Band 1, 3, 5, 7, 8, 22 26, 28, 34, 40, 41, 42, 44, 45, 65, 68, 72, 73 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n3A-n47A | E-UTRA Band 1, 3, 5, 7, 8, 26, 28, 34, 39, 40, 41, 44, 45, 65, 68, 72, 73 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n5A-n47A | E-UTRA Band 1, 3, 5, 7, 8, 26, 28, 34, 40, 42, 45, 65, 73 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
| V2X\_n8A-n47A | E-UTRA Band 1, 3, 7, 8, 22, 28, 34, 39, 40, 41, 42, 45, 65, 68, 72, 73 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n34A-n47A | E-UTRA Band 1, 3, 7, 8, 22, 26, 28, 39, 40, 41, 42, 44, 45, 65, 72 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n39A-n47A | E-UTRA Band 1, 8, 22, 26, 28, 34, 40, 41, 42, 44, 45  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n40A-n47A | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 42, 44, 45, 68, 72  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n41A-n47A | E-UTRA Band 1, 3, 5, 8, 26, 28, 34, 39, 42, 44, 45, 65, 73  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n71A-n47A | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 66, 85, 103 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | E-UTRA Band 2, 25, 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
|  | E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 2 |
|  | NR Band n71 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n78A-n47A | E-UTRA Band 1, 3, 5, 7, 8, 26 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
|  | Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| V2X\_n79A-n47A | E-UTRA Band 1, 3, 5, 8, 28, 34, 39, 40, 41, 42, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NOTE 1: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. In case the exceptions are allowed due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3 or 4 for the 2nd, 3rd or 4th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 2: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.  NOTE 3: Applicable when NS\_33 is configured by the pre-configured radio parameters for power class 3 V2X UE.  NOTE 4: In the frequency range x-5950MHz, SE requirement of -30dBm/MHz should be applied; where x = max (5925, fc + 15), where fc is the channel centre frequency. | | | | | | | |

For the intra-band NR V2X transmission where Uu and SLoverlap in time , the UE-coexistence requirements in Table 6.5A.3.2.1-1 apply for the corresponding intra-band con-current operation for the both uplink and sidelink transmission in licensed band.

#### 6.5E.3.4 Additional spurious emissions requirements for V2X

##### 6.5E.3.4.1 General

This clause specifies additional spurious emission requirements for V2X operation

##### 6.5E.3.4.2 Requirements for network signalling value "NS\_33"

Table 6.5E.3.4.2-1: Additional requirements for "NS\_33"

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Protected band | | Frequency range (MHz) | | | Maximum Level (EIRP2) | MBW (MHz) | NOTE |
| Frequency range | 5925 | | - | 5950 | -30 | 1 | 1 |
| Frequency range | 5815 | | - | 5855 | -30 | 1 | 3 |
| NOTE 1: In the frequency range x-5950MHz, SE requirement of -30dBm/MHz should be applied; where x = max (5925, fc + 15), where fc is the channel centre frequency.  NOTE 2: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I in [11].  NOTE 3: Resolution BW is 10% of the measurement BW and the result should be integrated to achieve the measurement bandwidth. The sweep time shall be set larger than (symbol length)\*(number of points in sweep) to improve the measurement accuracy. | | | | | | | |

When "NS\_33" is configured from pre-configured radio parameters or the cell, and the indication from upper layers has indicated that the UE is within the protection zone of CEN DSRC devices or HDR DSRC devices, the power of any NR V2X UE emission shall fulfil either one of the two sets of conditions.

Table 6.5E.3.4.2-2: Requirements for spurious emissions to protect CEN DSRC for V2X UE

|  |  |  |
| --- | --- | --- |
|  | Maximum Transmission Power (dBm EIRP1) | Emission Limit in Frequency Range 5795-5815 (dBm/MHz EIRP1) |
| Condition 1 | 10 | -65 |
| Condition 2 | 10 | -45 |
| NOTE 1: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I in [11]. | | |

##### 6.5E.3.4.3 Void

### 6.5E.3F Spurious emissions for Sidelink Unlicensed

#### 6.5E.3F.0 General

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements in line with SM.329 [9] and NR operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

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

#### 6.5E.3F.1 General spurious emissions

The requirements for general spurious emission requirements in clause 6.5.3.1 apply for SL-U operation..

#### 6.5E.3F.2 Spurious emissions for UE co-existence

Spurious emissions requirements for UE coexistence are not applicable to bands restricted to stand-alone operation with shared spectrum channel access as identified in Table 5.2-1.

##### 6.5E.3F.2.1 Spurious emissions for UE co-existence for SL-U con-current operation

For NR SL-U inter-band con-current operation, the UE-coexistence requirements in Table 6.5A.3.2.3-1 apply for the corresponding inter-band con-current operation with transmission assigned to both uplink in licensed band and NR sidelink in unlicensed band.

#### 6.5E.3F.3 Additional spurious emissions

##### 6.5E.3F.3.0 General

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

Editor’s note: Further new NS values with new requirements can be added here.

### 6.5E.4 Transmit intermodulation

#### 6.5E.4.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the requirements in clause 6.5.4 apply for NR V2X sidelink transmission.

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with the SL MIMO configurations described in clause 6.2D.1.

#### 6.5E.4.1A Transmit intermodulation for sidelink CA

For SL intra-band contiguous CA, the general NR CA Transmit Intermodulation requirements for CA Bandwidth Class B specified in clause 6.5A.4.2.1 shall be applied to the aggregated channel bandwidth with SL CA bandwidth class B.

#### 6.5E.4.2 Transmit intermodulation for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.5.4 shall apply for the uplink in licensed band and the requirements specified in clause 6.5E.4.1 shall apply for the sidelink in licensed band or Band n47.

For the intra-band NR V2X operation where Uu and SLtransmission overlaps in time, the requirements specified in clause 6.5A.4 shall apply for both uplink and sidelink in licensed band

### 6.5E.4F Transmit intermodulation for sidelink Unlicensed

The requirements for transmit intermodulation in clause 6.5.4 apply for SL-U operation.

#### 6.5E.4F.1 Transmit intermodulation for SL-U con-current operation

For NR-U SL inter-band con-current operation, the requirements specified in clause 6.5.4 shall apply for NR Uu operation in licensed band and the requirements specified in clause 6.5E.4F shall apply for NR sidelink operation in unlicensed band.

## 7.3E Reference sensitivity for V2X

### 7.3E.1 General

The reference sensitivity power level PREFSENS\_V2X is the minimum mean power applied to each one of the UE antenna port for V2X UE, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

### 7.3E.2 Minimum requirements

When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters specified in Table 7.3E.2-1.

Table 7.3E.2-1: Reference sensitivity of NR V2X Bands (PC5)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X Band | SCS kHz | Channel bandwidth / PREFSENS\_V2X(dBm) | | | | | |
| 5MHz4 | 10 MHz | 20 MHz | 30 MHz | 40 MHz | Duplex Mode |
| n14 | 15 | -95.9 | -92.7 |  |  |  | HD |
| 30 |  | -93.0 |  |  |  |
| 60 |  |  |  |  |  |
| n38 | 15 |  | -96.5 | -93.2 | -91.4 | -90.1 | HD |
|  | 30 |  | -96.1 | -93.4 | -91.7 | -90.2 |
|  | 60 |  | -96.9 | -93.1 | -91.9 | -90.4 |
| n47 | 15 |  | -92.5 | -89.2 | -87.4 | -86.1 | HD |
|  | 30 |  | -92.1 | -89.4 | -87.7 | -86.2 |
|  | 60 |  | -92.9 | -89.1 | -87.9 | -86.4 |
| n795 | 15 |  | -95.5 | -92.2 | -90.4 | -89.1 | HD |
| 30 |  | -95.1 | -92.4 | -90.7 | -89.2 |
| 60 |  | -95.9 | -92.1 | -90.9 | -89.4 |
| NOTE 1: Reference measurement channel is defined in A.7.2.  NOTE 2: The signal power is specified per antenna port.  NOTE 3: Void.  NOTE 4: The CBW is only applicable for PS UE in n14.  NOTE 5: These REFSENS values do not consider the impact of the near/far effect | | | | | | | |

Table 7.3E.2-2: Sidelink TX configuration for reference sensitivity of NR V2X Bands (PC5)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | NR Band / SCS / Channel bandwidth / Duplex mode | | | | | |
| NR V2X Band | SCS  kHz | 5 MHz3 | 10 MHz | 20 MHz | 30 MHz | 40 MHz | Duplex Mode |
| n14 | 15 | 20 | 20 |  |  |  | HD |
| 30 |  | 10 |  |  |  |
| 60 |  |  |  |  |  |
| n38 | 15 |  | 50 | 105 | 160 | 216 | HD |
|  | 30 |  | 24 | 50 | 75 | 105 |
|  | 60 |  | 102 | 24 | 36 | 50 |
| n47 | 15 |  | 50 | 105 | 160 | 216 | HD |
|  | 30 |  | 24 | 50 | 75 | 105 |
|  | 60 |  | 102 | 24 | 36 | 50 |
| n79 | 15 |  | 50 | 105 | 160 | 216 | HD |
| 30 |  | 24 | 50 | 75 | 105 |
| 60 |  | 102 | 24 | 36 | 50 |
| NOTE 1: The sidelink allocated RB (LCRB) size could be adjusted according to resource pool configuration in [7].  NOTE 2: For the case, 11 RB is allowed for S-SSB Block.  NOTE 3: The CBW is only applicable for PS UE in n14. | | | | | | | |

### 7.3E.2A Minimum requirements for Sidelink CA

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

### 7.3E.2A.1 Reference sensitivity power level for Sidelink CA

For intra-band contiguous NR SL CA operation, the reference sensitivity requirement specified in Table 7.3E.2-1 shall apply for each component carrier with all carriers active. The requirement is applied for each carrier reception when 2 carrier transmissions are activated at the same time.

### 7.3E.2F Minimum requirements for Sidelink Unlicensed

### 7.3E.2F.1 General

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

In later clauses of Clause 7 where the value of REFSENS is used as a reference to set the corresponding requirement, the UE shall be verified against those requirements by applying the REFSENS value in Table 7.3E.2F.2-1 with 2 Rx antenna ports tested.

### 7.3E.2F.2 Reference sensitivity power level

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters specified in Table 7.3E.2F.2-1, Table 7.3E.2F.2-2, and Table 7.3E.2F.2-3.

Table 7.3E.2F.2-1: Two antenna port reference sensitivity QPSK PREFSENS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Operating band / SCS / Channel bandwidth / REFSENS** | | | | |
| **Operating band** | **SCS**  **kHz** | **Channel bandwidth (MHz)** | **REFSENS (dBm)8** | **Duplex Mode** |
| n46 | 15 | 20, 40 | -89.2 + 10log10(NRB/105) | HD |
| 30 | 20, 40, 60, 80, 100 | -89.4 + 10log10(NRB/50) |
| 60 | 20, 40, 60, 80, 100 | -89.6 + 10log10(NRB/24) |
| n96, n102 | 15 | 20, 40 | -88.7 + 10log10(NRB/105) | HD |
| 30 | 20, 40, 60, 80, 100 | -88.9 + 10log10(NRB/50) |
| 60 | 20, 40, 60, 80, 100 | -89.1 + 10log10(NRB/24) |
| NOTE 1: The REFSENS value is rounded to the nearest number down to one decimal point. “NRB” in REFSENS formula is the maximum transmission bandwidth configuration as defined in Table 7.3E.2F.2-3 | | | | |

For UE(s) equipped with 4 Rx antenna ports, reference sensitivity for 2Rx antenna ports in Table 7.3E.2F.2-1 shall be modified by the amount given in ΔRIB,4R in Table 7.3E.2F.2-2 for the applicable operating bands.

Table 7.3E.2F.2-2: Four antenna port reference sensitivity allowance ΔRIB,4R

|  |  |
| --- | --- |
| Operating band | ΔRIB,4R (dB) |
| n46, n96, n102 | -2.2 |

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3E.2F.2-1 and Table 7.3E.2F.2-2 shall be met with sidelink transmission bandwidth less than or equal to that specified in Table 7.3E.2F.2-3.

Table 7.3E.2F.2-3: Transmitted sidelink configuration for reference sensitivity

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Operating band / SCS / Channel bandwidth** | | | | | | |
| **Operating Band** | **SCS kHz** | **20 MHz** | **40 MHz** | **60 MHz** | **80 MHz** | **100 MHz** |
| n46 | 15 | 105 | 216 |  |  |  |
|  | 30 | 50 | 105 | 160 | 216 | 270 |
|  | 60 | 24 | 50 | 75 | 105 | 135 |
| n96, n102 | 15 | 105 | 216 |  |  |  |
|  | 30 | 50 | 105 | 160 | 216 | 270 |
|  | 60 | 24 | 50 | 75 | 105 | 135 |

Unless given by Table 7.3E.2F.2-4, the minimum requirements specified in Tables 7.3E.2F.2-1 and 7.3E.2F.2-2 shall be verified with the network signalling value NS\_01 (Table 6.2F.3.1-1) configured.

Table 7.3F.2-4: Network signaling value for reference sensitivity

|  |  |
| --- | --- |
| Operating band | Network Signalling value |
| n46 | NS\_01 |
| n96 | NS\_53 |
| n102 | NS\_01 |

### 7.3E.3 Reference sensitivity power level for V2X con-current operation

7.3E.3.1 General

When UE is configured for NR V2X reception on V2X carrier con-current with NR uplink and downlink, NR V2X sidelink throughput for the carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters specified in Table 7.3E.2-1 and 7.3E.2-2. Also, the NR downlink throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.3 with parameters specified in table 7.3.2-1a, 7.3.2-1b, 7.3.2-2 and 7.3.2-3. The reference sensitivity is defined to be met with all downlink component carriers active. The REFSENS of Uu downlink and PC5 sidelink will be tested at the same time. Exceptions to reference sensitivity with different transmission and reception configurations are allowed for the combinations of aggressor and victim bands specified in table 7.3E.3-3 and 7.3E.3-4. The limited test configurations are specified in table 7.3E.3-3 and 7.3E.3-4 to verify MSD requirements.

For the intra-band con-current NR V2X operation, the reference sensitivity power level shall be applied per carrier. The requirements in clause 7.3.2 shall be appled for NR downlink carrier and the requirements in clause 7.3E.2 shall be applied for NR sidelink carrier. NR V2X sidelink throughput for the carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2. Also, the NR downlink throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.3.2 in TS38.101-1.

For reference sensitivity exception test points where the specified carrier frequency does not correspond to a valid NR-ARFCN, the closest NR-ARFCN as specified in clause 5.4.2 applies.

Table 7.3E.3-1: Void

Table 7.3E.3-2: ΔRIB,V2X (two bands)

|  |  |  |
| --- | --- | --- |
| V2X inter-band con-current band Combination | NR Band | ΔRIB,V2X [dB] |
| V2X\_n71-n47 | n71 | 0.0 |

Table 7.3E.3-3: Reference sensitivity exceptions (MSD) due to cross band isolation for inter-band con-current operation

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Aggressor band** | **Victim band** | **Aggressor band Fc** | **Aggressor band BW** | **SCS of Aggressor band** | **Aggressor band RB Allocation** | **Victim band Fc** | **Victim band BW** | **MSD** |
| **(MHz)** | **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(MHz)** | **(dB)** |
| n79 | n47 | 4980 | 40 | 15 | 216  (RBstart=0) | 5860 | 10 | 3.3 |
| n47 | n79 | 5860 | 10 | 15 | 50 (RBstart=0) | 4980 | 40 | 3.3 |

Table 7.3E.3-4: Reference sensitivity exceptions (MSD) due to harmonic interference for inter-band con-current operation

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Aggressor band** | **Victim band** | **Aggressor band BW** | **SCS of Aggressor band** | **Aggressor band RB Allocation** | **Victim band BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n1 | n47 | 5 | 15 | 16 (RBstart=4) | 10 | 20.1 | NOTE 2 | UL3/DL1  direct-hit |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd / 3rd / 4th / 5th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL NR ARFCN of the aggressor (lower) band (superscript LB) such that  in MHz and  with the carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the low band. | | | | | | | | |

### 7.3E.3F.1 Reference sensitivity power level for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.3E.2F.2 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.3.2 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

For the REFSENS exception of SL\_n78-n46 inter-band con-current NR SL-U operation, the existing CA\_n46-n78 MSD requirements in Table 7.3A.5-1 are applied. Also, the existing ΔRIB of CA\_n46-n78 in Table 7.3A.3.2.1-1 is applied for SL\_n78-n46 inter-band con-current NR SL-U operation UE.

## 7.4E Maximum input level for V2X

### 7.4E.1 General

Maximum input level is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel. When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.3 and A.7.4 with parameters specified in Table 7.4E.1-1.

Table 7.4E.1-1: Maximum input level of NR V2X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz3 | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in Transmission Bandwidth Configuration | dBm | -251 | -251 | -251 | -231 | -221 |
|  |  | -272 | -272 | -272 | -252 | -242 |
| NOTE 1: Reference measurement channel is A.7.3 for 64 QAM.  NOTE 2: Reference measurement channel is A.7.4 for 256 QAM.  NOTE 3: The CBW is only applicable for PS UE in n14. | | | | | | |

### 7.4E.1A Maximum input level for Sidelink CA

For intra-band contiguous NR SL CA operation, the following maximum input level requirement shall be applied to the SL CA bandwidth class B.

**Table 7.4E.1A-1 Maximum input levels for intra-band contiguous CA UE**

|  |  |  |  |
| --- | --- | --- | --- |
| Rx Parameter | Units | SL CA Bandwidth Class | |
| A | B |
| Power in largest Transmission Bandwidth Configuration CC | dBm |  | -25 + 10log10(BWChannel /20)Note 1 |
|  | -27 + 10log10(BWChannel /20)Note 2 |
| NOTE 1: Reference measurement channel is A.7.3 for 64 QAM.  NOTE 2: Reference measurement channel is A.7.4 for 256 QAM.  NOTE 3: 10log10(x) is rounded to the nearest 0.5dB | | | |

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A.7.3 and A.7.4. The requirements apply with all downlink carriers active.

### 7.4E.1F General requirement for Sidelink Unlicensed

The maximum input level requirement of SL-U operation in clause 7.4 apply.

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.3 and A.7.4..

### 7.4E.2 Maximum input level for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.4E.1 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2-1 and the requirements specified in clause 7.4 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.4E.2F.1 Maximum input level for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.4E.1F shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.4 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## 7.5E Adjacent channel selectivity for V2X

### 7.5E.1 General

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

The UE shall fulfil the minimum requirements specified in Table 7.5E.1-1 for NR V2X UE. These requirements apply for all values of an adjacent channel interferer up to -25 dBm and for any SCS specified for the channel bandwidth of the wanted signal. However, it is not possible to directly measure the ACS; instead the lower and upper range of test parameters are chosen as in Table 7.5E.1-2 and Table 7.5E.1-3 for verification of the requirements specified in Table 7.5E.1-1. For these test parameters, when UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2.

In licensed band, the minimum requirements shall reuse the same ACS values with NR UE.

Table 7.5E.1-1: Adjacent channel selectivity for NR V2X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz1 | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| ACS | dB | 33.0 | 33.0 | 27.0 | 25.5 | 24.0 |
| NOTE 1: The CBW is only applicable for PS UE in n14. | | | | | | |

Table 7.5E.1-2: Test parameters for Adjacent channel selectivity for V2X, Case 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | |
|  |  | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + 14 dB | | | |
| Pinterferer | dBm | PREFSENS\_V2X + 45.5 dB | PREFSENS\_V2X + 39.5 dB | PREFSENS\_V2X + 38.0 dB | PREFSENS\_V2X + 36.5 dB |
| BWinterferer | MHz | 10 | 10 | 10 | 10 |
| Finterferer (offset) | MHz | 10 / -10 | 15 / -15 | 20 / -20 | 25 / -25 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. | | | | | |

Table 7.5E.1-2a: Test parameters for Adjacent channel selectivity in n14, Case 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + 14 dB | | | | |
| Pinterferer | dBm | PREFSENS\_V2X + 45.5 dB | PREFSENS\_V2X + 45.5 dB |  |  |  |
| BWinterferer | MHz | 5 | 5 |  |  |  |
| Finterferer (offset) | MHz | 5 / -5 | 7.5 / -7.5 |  |  |  |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. | | | | | | |

Table 7.5E.1-3: Test parameters for Adjacent channel selectivity for V2X, Case 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | | Channel bandwidth | | | | |
|  | |  | | 10 MHz | 20 MHz | 30 MHz | 40 MHz | |
| Power in transmission bandwidth configuration | | dBm | | -56.5 | -50.5 | -49.0 | -47.5 | |
| Pinterferer | | dBm | | -25 | | | | |
| BWinterferer | | MHz | | 10 | 10 | 10 | 10 | |
| Finterferer (offset) | | MHz | | 10 / -10 | 15 / -15 | 20 / -20 | 25 / -25 | |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. | | | | | | | | |

Table 7.5E.1-3a: Test parameters for Adjacent channel selectivity in n14, Case 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | -56.5 | -56.5 |  |  |  |
| Pinterferer | dBm | -25 | | | | |
| BWinterferer | MHz | 5 | 5 |  |  |  |
| Finterferer (offset) | MHz | 5/ -5 | 7.5 / -7.5 |  |  |  |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. | | | | | | |

### 7.5E.1A Adjacent channel selectivity requirement for Sidelink CA

For intra-band contiguous NR SL CA operation, the UE shall fulfil the minimum requirement specified in Table 7.5E.1A-1 to Table 7.5E.1A-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2.

**Table 7.5E.1A-1 ACS for intra-band contiguous NR SL CA UE**

|  |  |  |
| --- | --- | --- |
|  |  | SL CA bandwidth class |
| Rx Parameter | Units | B |
| ACS | dB | 20.0 |

**Table 7.5E.1A-2 Test parameters for intra-band contiguous SL CA UE, case 1**

|  |  |  |
| --- | --- | --- |
| Rx Parameter | Units | SL CA bandwidth class |
|  |  | B |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | PREFSENS\_SL + 14 dB |
| PInterferer | dBm | Aggregated power + 18.5 dB |
| BWInterferer | MHz | 10 |
| FInterferer (offset) | MHz | 5+Aggreagted BWChannel/2  /  -(5+Aggregated BWChannel/2) |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the carrier closest to the interferer in MHz. The interferer is an NR signal with 15 kHz SCS. | | |

**Table 7.5E.1A-3 Test parameters for intra-band contiguous SL CA UE, case 2**

|  |  |  |
| --- | --- | --- |
| Rx Parameter | Units | SL CA Bandwidth Class |
|  |  | B |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | -43.5 + 10log(NRB,c/NRB\_agg) |
| PInterferer | dBm | -25 |
| BWInterferer | MHz | 10 |
| FInterferer (offset) | MHz | 5+Aggreagted BWChannel/2  /  -(5+Aggregated BWChannel/2) |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the carrier closest to the interferer in MHz. The interferer is an NR signal with 15 kHz SCS. | | |

### 7.5E.1F General requirement for Sidelink Unlicensed

The ACS requirement of SL-U operation in clause 7.5F.1 apply.

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2.

### 7.5E.2 Adjacent channel selectivity for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.5E.1 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2-1 and the requirements specified in clause 7.5 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.5E.2F.1 Adjacent channel selectivity for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.5E.1F shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.5 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## 7.6E Blocking characteristics for V2X

### 7.6E.1 General

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

### 7.6E.2 In-band blocking

#### 7.6E.2.1 General

When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with parameters specified in Table 7.6E.2.1-1 and Table 7.6E.2.1-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6E.2.1-1: In-band blocking parameters for NR V2X

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | |
|  |  | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | |
|  | dB | 6 | 9 | 11 | 12 |
| BWinterferer | MHz | 10 | | | |
| FIoffset, case 1 | MHz | 15 | | | |
| FIoffset, case 2 | MHz | 25 | | | |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. | | | | | |

Table 7.6E.2.1-1a: In-band blocking parameters in n14

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | | |
|  | dB | 6 | 6 |  |  |  |
| BWinterferer | MHz | 5 | | | | |
| FIoffset, case 1 | MHz | 7.5 | | | | |
| FIoffset, case 2 | MHz | 12.5 | | | | |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. | | | | | | |

Table 7.6E.2.1-2: In-band blocking for NR V2X

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR band | Parameter | Unit | Case 1 | Case 2 |
| n14 | PInterferer | dBm | -56 | -44 |
| FInterferer (offset) | MHz | -BW/2 – FIoffset,case 1  &  BW/2 + FIoffset,case 1 | ≤-BW/2 – FIoffset,case 2  &  ≥BW/2 + FIoffset,case 2 |
| FInterferer | MHz | NOTE 2 | FDL\_low – 15  to  FDL\_high + 15 |
| n38, n47 | Pinterferer | dBm | -44 | -44 |
|  | Finterferer (offset) | MHz | -BW/2 – FIoffset, case 1  and  BW/2 + FIoffset, case 1 | ≤ -BW/2 – FIoffset, case 2  and  ≥ BW/2 + FIoffset, case 2 |
|  | Finterferer | MHz | NOTE 2 | FDL\_low – 30  to  FDL\_high + 30 |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band.  NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  a. the carrier frequency -BW/2 – FIoffset, case 1 and  b. the carrier frequency +BW/2 + FIoffset, case 1  NOTE 3: FInterferer range values for unwanted modulated interfering signal are interferer center frequencies  NOTE 4: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. | | | | |

#### 7.6E.2.1A In-band blocking for Sidelink CA

For intra-band contiguous SL CA operation, the UE shall fulfil the minimum requirement specified in Table 7.6E.2.1A-1 to Table 7.6E.2.1A-2 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2.

**Table 7.6E.2.1A-1 In-band blocking parameters for intra-band contiguous SL CA UE**

|  |  |  |
| --- | --- | --- |
| Rx Parameter | Units | SL CA bandwidth class |
|  |  | B |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | PREFSENS\_SL + NR SL CA bandwidth class specific value below |
|  | dB | 16.0 |
| BWInterferer | MHz | 10 |
| FIoffset, case 1 | MHz | 15 |
| FIoffset, case 2 | MHz | 25 |
| NOTE 1: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. | | |

**Table 7.6E.2.1A-2 In-band blocking for intra-band contiguous SL CA UE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR SL CA band | Parameter | Unit | Case 1 | Case 2 |
| PInterferer | dBm | -44 | -44 |
| SL\_n47B | FInterferer  (offset) | MHz | - BWchannel CA/2 – FIoffset,case 1  &  + BWchannel CA/2 + FIoffset,case 1 | ≤- BWchannel CA/2 – FIoffset,case 2  &  ≥+ BWchannel CA/2 + FIoffset,case 2 |
| FInterferer (Range) | MHz | NOTE 2 | FDL\_low – 30  to  FDL\_high + 30 |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 30 MHz below or above the UE receive band  NOTE 2: For each carrier frequency the requirement is valid for two frequencies:  a. the carrier frequency - BWchannel CA/2 - FIoffset, case 1 and  b. the carrier frequency + BWchannel CA/2 + FIoffset, case 1  NOTE 3: BWchannel CA denotes the aggregated channel bandwidth of the wanted signal | | | | |

#### 7.6E.2.2 In-band blocking for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.6E.2.1 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2-1 and the requirements specified in clause 7.6.2 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

#### 7.6E.2.2F.1 In-band blocking for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.6E.2F shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.6.2 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.6E.2F In-band blocking for Sidelink Unlicensed

#### 7.6E.2F.1 General

In-band blocking (IBB) is defined for an unwanted interfering signal falling into the UE receive band or into the first 60 MHz below or above the UE receive band. The throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6E.2F.1-1 and Table 7.6E.2F.1-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6E.2F.1-1: In-band blocking parameters for shared access bands

|  |  |  |
| --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth** |
|  |  | **20, 40, 60, 80, 100 MHz** |
| Power in transmission bandwidth configuration | dBm | REFSENS + 9 dB + 10log10(BWChannel /20) dB |
| BWinterferer | MHz | 20 |
| FIoffset, case 1 | MHz | 30 |
| FIoffset, case 2 | MHz | ≥ 50 |

Table 7.6E.2F.1-2: In-band blocking for shared access bands

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating band | Parameter | Unit | Case 1 | Case 2 |
|  | Pinterferer | dBm | -56 | -44 |
|  | Finterferer (offset) | MHz | -CBW/2 –  FIoffset, case 1  and  CBW/2 +  FIoffset, case 1 | ≤ -CBW/2 –  FIoffset, case 2  and  ≥ CBW/2 +  FIoffset, case 2 |
| n46, n96, n102 | Finterferer |  | NOTE 2 | FDL\_low – 3\*CBW  to  FDL\_high + 3\*CBW,  NOTE 4 |
| NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.  NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – FIoffset, case 1; b: CBW/2 + FIoffset, case 1  NOTE 3: CBW denotes the channel bandwidth of the wanted signal  NOTE 4: Interferer carrier frequencies in the frequency range for Case 2 shall be located at discrete frequencies in integer multiples of 20 MHz offset from -CBW/2 – FIoffset, case 2 and CBW/2 + FIoffset, case 2 | | | | |

### 7.6E.3 Out-of-band blocking

#### 7.6E.3.1 General

For NR V2X bands out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 30 MHz below or above the UE receive band. When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters specified in Table 7.6E.3.1-1 and Table 7.6E.3.1-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6E.3.1-1: Out-of-band blocking parameters for NR V2X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz2 | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | | |
|  | dB | 6 | 6 | 9 | 11 | 12 |
| NOTE 1: Reference measurement channel is A.7.2.  NOTE 2: The CBW is only applicable for PS UE in n14. | | | | | | |

Table 7.6E.3.1-2: Out of-band blocking for NR V2X

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NR band | Parameter | Units | Range 1 | Range 2 | Range 3 |
| n14 | Pinterferer | dBm | -44 | -30 | -15 |
| Finterferer (CW) | MHz | -60 < f – FDL\_low < -15  or  15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60  or  60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85  or  FDL\_high + 85 ≤ f  ≤ 12750 |
| n47 | Pinterferer | dBm | -44 | -30 | -15 |
|  | Finterferer (CW) | MHz | FDL\_low -30 to  FDL\_low -60 | FDL\_low -60 to  FDL\_low -85 | FDL\_low -85 to  1 MHz |
|  |  |  | FDL\_high +30 to  FDL\_high + 60 | FDL\_high +60 to  FDL\_high +85 | FDL\_high +85 to  +12750 MHz |
| n38 | Pinterferer | dBm | -44 | -30 | -15 |
|  | Finterferer (CW) | MHz | FDL\_low -30 to  FDL\_low -60 | FDL\_low -60 to  FDL\_low -85 | FDL\_low -85 to  1 MHz |
| NOTE 1: The power level of the interferer (PInterferer) for Range 3 shall be modified to -20 dBm for FInterferer > 4400 MHz. | | | | | |

#### 7.6E.3.1A Out-of-band blocking for Sidelink CA

For intra-band contiguous SL CA operation, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with parameters specified in Tables 7.6E.3.1A-1 and 7.6E.3.1A-2.

For Table 7.6E.3.1A-2 in frequency range 1, 2 and 3, up to exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.3.5 spurious response are applicable.

Table 7.6E.3.1A-1: Out-of-band blocking parameters for intra-band contiguous SL CA UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | SL CA Bandwidth Class | | | | |
| B |  |  |  |  |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | PREFSENS\_SL + SL CA Bandwidth Class specific value below | | | | |
| 9 |  |  |  |  |

Table 7.6E.3.1A-2: Out of band blocking for intra-band contiguous SL CA UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NR SL  CA band | Parameter | Units | Frequency | | |
| Range 1 | Range 2 | Range 3 |
| PInterferer | dBm | -44 | -30 | -15 |
| V2X\_47B | FInterferer (CW) | MHz | -60 < f – FDL\_low < -30  or  30 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60  or  60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85  or  FDL\_high + 85 ≤ f  ≤ 12750 |
| NOTE 1: The power level of the interferer (PInterferer) for Range 3 shall be modified to -20 dBm for FInterferer > 6000 MHz.  NOTE 2: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. | | | | | |

#### 7.6E.3.2 Out-of-band blocking for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.6E.3.1 shall apply for the NR sidelink reception in Band n47 and the requirements specified in clause 7.6.3 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

#### 7.6E.3.2F Out-of-band blocking for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.6E.3F shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.6.3 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.6E.3F Out-of-band blocking for Sidelink Unlicensed

Out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 60 MHz or greater below or above the UE receive band. The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex 7.2 with parameters specified in Table 7.6F.3.1-1 and Table 7.6F.3.1-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

## 7.7E Spurious response for V2X

### 7.7E.1 General

Spurious response is a measure of the receiver’s ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency for which a response is obtained, i.e. for which the out-of-band blocking limit as specified in clause 7.6E.3.1 is not met.

When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters for the wanted signal as specified in Table 7.7E.1-1 and Table 7.7E.1-2 for NR V2X bands. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.7E.1-1: Spurious response parameters for NR V2X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth | | | | |
|  |  | 5 MHz2 | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | | |
|  | dB | 6 | 6 | 9 | 11 | 12 |
| NOTE 1: Reference measurement channel is A.7.2  NOTE 2: The CBW is only applicable for PS UE in n14. | | | | | | |

Table 7.7E.1-2: Spurious response for NR V2X

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

### 7.7E.1A Spurious response requirements for Sidelink CA

For intra-band contiguous SL CA operation, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with parameters specified in Table 7.7E.1A-1 and Table 7.7E.1A-2.

Table 7.7E.1A-1: Spurious response parameters for intra-band contiguous SL CA UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx Parameter | Units | SL CA Bandwidth Class | | | | |
| B |  |  |  |  |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | PREFSENS\_SL + SL CA Bandwidth Class specific value below | | | | |
| 9 |  |  |  |  |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.  NOTE 2: Reference measurement channel is A.7.2 | | | | | | |

Tables 7.7E.1A-2: Spurious response for intra-band contiguous SL CA UE

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer  (CW) | dBm | -44 |
| FInterferer | MHz | Spurious response frequencies |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time. | | |

### 7.7E.1F General requirement for Sidelink Unlicensed

The spurious response requirement in clause 7.7F.1 apply.

For spurious responses, the throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex 7.2

### 7.7E.2 Spurious response for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.7E.1 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2-1 and the requirements specified in clause 7.7 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.7E.2F.1 Spurious response for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.7E.1F shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2F-1 and the requirements specified in clause 7.7 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## 7.8E Intermodulation characteristics for V2X

### 7.8E.1 General

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

### 7.8E.2 Wide band Intermodulation

#### 7.8E.2.1 General

The wide band intermodulation requirement is defined using modulated NR carrier and a CW signal as interferer 1 and interferer 2 respectively. When UE is configured for NR V2X reception non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 5.2E.1-1, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.7.2 with parameters specified in Table 7.8E.2-1 for NR V2X bands. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.8E.2-1: Wide band intermodulation parameters for NR V2X

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR band | Rx parameter | Units | Channel bandwidth | | | |
|  |  |  | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| n38, n47 | Power in Transmission Bandwidth Configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | |
|  | dB | 6 | 9 | 11 | 12 |
|  | PInterferer 1 (CW) | dBm | -46 | | | |
|  | PInterferer 2 (Modulated) | dBm | -46 | | | |
|  | BWInterferer 2 | MHz | 10MHz | | | |
|  | FInterferer 1 (Offset) | MHz | -BW/2 – 15  /  +BW/2 + 15 | | | |
|  | FInterferer 2 (Offset) | MHz | 2 \* FInterferer 1 | | | |
| NOTE 1: Reference measurement channel is A.7.2  NOTE 2: The interferer is QPSK modulated PUSCH containing data and reference symbols. Normal cyclic prefix is used. | | | | | | |

Table 7.8E.2-1a: Wide band intermodulation parameters in n14

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR band | Rx parameter | Units | Channel bandwidth | | | | |
|  |  |  | 5 MHz | 10 MHz | 20 MHz | 30 MHz | 40 MHz |
| n14 | Power in Transmission Bandwidth Configuration | dBm | PREFSENS\_V2X + channel bandwidth specific value below | | | | |
|  | dB | 6 | 6 |  |  |  |
|  | PInterferer 1 (CW) | dBm | -46 | | | | |
|  | PInterferer 2 (Modulated) | dBm | -46 | | | | |
|  | BWInterferer 2 | MHz | 5MHz | | | | |
|  | FInterferer 1 (Offset) | MHz | -BW/2 – 7.5  /  +BW/2 + 7.5 | | | | |
|  | FInterferer 2 (Offset) | MHz | 2 \* FInterferer 1 | | | | |
| NOTE 1: Reference measurement channel is A.7.2.  NOTE 2: The interferer is QPSK modulated PSSCH containing data and reference symbols. Normal cyclic prefix is used. | | | | | | | |

#### 7.8E.2.2 Wide band Intermodulation for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 7.8E.2.1 shall apply for the NR sidelink reception in the operating bands in Table 5.2E.2-1 and the requirements specified in clause 7.8 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

#### 7.8E.2.1A Wide band intermodulation for Sidelink CA

For intra-band contiguous SL CA operation, the UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.7.2 with parameters specified in Table 7.8E.2.1A-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8E.2.1A-1: Wide band intermodulation for intra-band contiguous SL CA UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rx parameter | Units | SL CA Bandwidth Class | | | | |
| B |  |  |  |  |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | PREFSENS\_SL + SL CA Bandwidth Class specific value below | | | | |
| 9 |  |  |  |  |
| PInterferer 1  (CW) | dBm | -46 | | | | |
| PInterferer 2  (Modulated) | dBm | -46 | | | | |
| BWInterferer 2 | MHz | 10 |  |  |  |  |
| FInterferer 1  (Offset) | MHz | –Foffset-15  /  + Foffset+15 |  |  |  |  |
| FInterferer 2  (Offset) | MHz | 2\*FInterferer 1 | | | | |
| NOTE 1: The requirement is applied for multi-carrier intra-band con-current receptions when 2 carrier transmissions are activated at the same time.  NOTE 2: The Finterferer 1 (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the CW interferer and Finterferer 2 (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the modulated interferer. | | | | | | |

#### 7.8E.2.2F.2 Wide band Intermodulation for SL-U con-current operation

For the inter-band con-current NR SL-U operation, the requirements specified in clause 7.8E.2F shall apply for the NR sidelink reception in the operating bands in Table [5.2E.2F-1] and the requirements specified in clause 7.8 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

### 7.8E.2F Wide band Intermodulation for Sidelink Unlicensed

The spurious response requirement in clause 7.8F.2 apply.

Instead of the general wideband intermodulation requirements specified in clause 7.8.2, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex 7.2 with parameters specified in Table 7.8F.2-1. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

# A.7 V2X reference measurement channels

## A.7.1 General

The algorithm for determining the payload size A is as follows; given a desired coding rate R and radio block allocation NRB

1. Calculate the RE number of 2nd stage SCI Q\_SCI2^' that can be transmitted in a given sub-frame, where in order to make sure that the code-rate of 2-A is approximate to SCI 1-A, a beta offset is selected based on MCS, and vacant resource elements γ value is determined based on NRB and DMRS frequency density.

2. Transport Block Size is determined according to clause 8.1.3.2 of TS 38.214 [13] based on Table A.7.1-1.

3. Calculate Binary Channel Bits per Slot for PSSCH as below

Binary Channel Bits per Slot = (NRB\* Subcarriers per resource block\*CP-OFDM symbols per slot – DMRS resource REs – PSCCH resource Res - Q\_SCI2^') \* Qm

Where Qm is the modulation order corresponding to MCS.

In Table A.7.1-1 Common reference channel parameters are listed the Sidelink reference measurement channels specified in annexes A.7.2 to A.7.6.

Table A.7.1-1: Common reference channel parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | remark |
| Number of HARQ Processes | 1 |  |
| Channel state | AWGN |  |
| Subcarriers per resource block | 12 |  |
| sl-PSSCH-DMRS-TimePatternList | 2 | symbol4 and symbol 10 in each slot  FDMed with PSSCH within DMRS symbol  Frequency density is ½ |
| CP-OFDM symbols per slot (Note1) | 12 for all slots | Excluding the first OFDM symbol in one SL slot used for AGC |
| PSCCH resource | 10 PRBs, 3 symbols in time domain |  |
| Slot number in 10ms |  | for 15kHz, 30kHz, 60kHz |
| PT-RS | disable |  |
| CSI-RS | disable |  |
| x-overhead | 0 |  |
| PSFCH period | 0 |  |
| 2nd stage SCI payload size | 59 | 35bits SCI-2A + 24bits CRC |
| Redundancy Version | RV0 | For channel coding |
| Alpha value for SCI-2 | 1 |  |

## A.7.2 FRC for V2X receiver requirements for QPSK

For V2X transmission over PC5, Table A.7.2-1, Table A.7.2-2 and Table A.7.2-3 are applicable for measurements on the Receiver Characteristics with the exception of Maximum input level.

Table A.7.2-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, QPSK)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | |
| Channel bandwidth | MHz | 53 | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 |
| Subchannel size |  | 12 | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 24 | 50 | 105 | 160 | 216 |
| MCS Index |  | 4 | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 1608 | 3624 | 7936 | 12296 | 16896 |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 2 | 3 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 5160 | 12036 | 26556 | 41076 | 55860 |
| Max. Throughput averaged over 100ms | Mbps | 0.1608 | 0.3624 | 0.7936 | 1.2296 | 1.6896 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs.  NOTE 3: The CBW is only applicable for PS UE in n14. | | | | | | |

Table A.7.2-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, QPSK)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | [30] | [30] | [30] |
| Subchannel size |  | 12 | 10 | 15 | 15 | [10] | [12] | [15] |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 | [160] | [216] | [270] |
| MCS Index |  | 4 | 4 | 4 | 4 | [4] | [4] | [4] |
| MCS Table for TBS determination | 64QAM | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | [QPSK] | [QPSK] | [QPSK] |
| Transport Block Size |  | 1608 | 3624 | 5632 | 7936 | [12296] | [16392] | [21000] |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 | [24] | [24] | [24] |
| LDPC base graph |  | 2 | 2 | 1 | 1 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 | [2] | [2] | [3] |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 | [2.25] | [2.25] | [2.25] |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 | [1] | [1] | [1] |
| Binary Channel Bits per Slot |  | 5160 | 12036 | 18636 | 26556 | [41076] | [55860] | [70116] |
| Max. Throughput averaged over 100ms | Mbps | 0.3216 | 0.7248 | 1.1264 | 1.5872 | [2.4592] | [3.2784] | [4.2] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |

Table A.7.2-3: Fixed reference channel for V2X receiver requirements (SCS 60 kHz, QPSK)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 | [60] | [60] | [60] |
| Subchannel size |  | 10 | 12 | 12 | 10 | [15] | [15] | [15] |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 | [75] | [105] | [135] |
| MCS Index |  | 4 | 4 | 4 | 4 | [4] | [4] | [4] |
| MCS Table for TBS determination | 64QAM | | | | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | [QPSK] | [QPSK] | [QPSK] |
| Transport Block Size |  | 456 | 1608 | 2536 | 3624 | [5504] | [7936] | [10248] |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 | [24] | [24] | [24] |
| LDPC base graph |  | 2 | 2 | 2 | 2 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 | [1] | [1] | [2] |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 | [2.25] | [2.25] | [2.25] |
| value when 2nd stage SCI rate match |  | 7 | 7 | 7 | 1 | [1] | [1] | [1] |
| Binary Channel Bits per Slot |  | 1464 | 5160 | 8328 | 12036 | [18636] | [26556] | [34476] |
| Max. Throughput averaged over 100ms | Mbps | 0.1824 | 0.6432 | 1.0144 | 1.4496 | [2.2016] | [3.1744] | [4.0992] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |

## A.7.3 FRC for maximum input level for 64QAM

For V2X transmission over PC5, Table A.7.3-1, Table A.7.3-2 and TableA.7.3-3 are applicable for Maximum input level when the maximum modulation order is 64QAM.

Table A.7.3-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, 64QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | |
| Channel bandwidth | MHz | 53 | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 |
| Subchannel size |  | 12 | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 24 | 50 | 105 | 160 | 216 |
| MCS Index |  | 24 | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 11528 | 27144 | 60456 | 92200 | 127080 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 4 | 8 | 11 | 16 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 15336 | 35964 | 79524 | 123084 | 167436 |
| Max. Throughput averaged over 100ms | Mbps | 1.1528 | 2.7144 | 6.0456 | 9.22 | 12.708 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs.  NOTE 3: The CBW is only applicable for PS UE in n14. | | | | | | |

Table A.7.3-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, 64QAM)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | [30] | [30] | [30] |
| Subchannel size |  | 12 | 10 | 15 | 15 | [10] | [12] | [15] |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 | [160] | [216] | [270] |
| MCS Index |  | 24 | 24 | 24 | 24 | [24] | [24] | [24] |
| MCS Table for TBS determination | 64QAM | | | | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM | [64QAM] | [64QAM] | [64QAM] |
| Transport Block Size |  | 11528 | 27144 | 42016 | 60456 | [92200] | [125016] | [155776] |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | [24] | [24] | [24] |
| LDPC base graph |  | 1 | 1 | 1 | 1 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 2 | 4 | 5 | 8 | [11] | [15] | [19] |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | [6.25] | [6.25] | [6.25] |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 | [1] | [1] | [1] |
| Binary Channel Bits per Slot |  | 15336 | 35964 | 55764 | 79524 | [123084] | [167436] | [210204] |
| Max. Throughput averaged over 100ms | Mbps | 2.3056 | 5.4288 | 8.4032 | 12.091 | [18.44] | [25.0032] | [31.1552] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |

TableA.7.3-3: Fixed reference channel for V2X receiver requirements (SCS 60 kHz, 64QAM)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 | [60] | [60] | [60] |
| Subchannel size |  | 10 | 12 | 12 | 10 | [15] | [15] | [15] |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 | [75] | [105] | [135] |
| MCS Index |  | 24 | 24 | 24 | 24 | [24] | [24] | [24] |
| MCS Table for TBS determination | 64QAM | | | | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM | [64QAM] | [64QAM] | [64QAM] |
| Transport Block Size |  | 3240 | 11528 | 18960 | 27144 | [42016] | [59432] | [77896] |
| Transport block CRC | Bits | 16 | 24 | 24 | 24 | [24] | [24] | [24] |
| LDPC base graph |  | 2 | 1 | 1 | 1 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 1 | 2 | 3 | 4 | [5] | [8] | [10] |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | [6.25] | [6.25] | [6.25] |
| value when 2nd stage SCI rate match |  | 7 | 7 | 7 | 1 |  |  |  |
| Binary Channel Bits per Slot |  | 4248 | 15336 | 24840 | 35964 | [55764] | [79524] | [103284] |
| Max. Throughput averaged over 100ms | Mbps | 1.296 | 4.6112 | 7.584 | 10.858 | [16.8064] | [23.7728] | [31.1584] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |

## A.7.4 FRC for maximum input level for 256QAM

For V2X transmission over PC5, Table A.7.4-1, Table A.7.4-2 and Table A.7.4-3 are applicable for Maximum input level when the 256QAM is supported.

Table A.7.4-1: Fixed reference channel for V2X receiver requirements (SCS 15 kHz, 256QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | |
| Channel bandwidth | MHz | 53 | 10 | 20 | 30 | 40 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 |
| Subchannel size |  | 12 | 10 | 15 | 10 | 12 |
| Allocated resource blocks |  | 24 | 50 | 105 | 160 | 216 |
| MCS Index |  | 23 | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 15880 | 36896 | 81976 | 127080 | 172176 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 5 | 10 | 16 | 21 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 20544 | 48000 | 106080 | 164160 | 223296 |
| Max. Throughput averaged over 100ms | Mbps | 1.588 | 3.6896 | 8.1976 | 12.708 | 17.218 |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs.  NOTE 3: The CBW is only applicable for PS UE in n14. | | | | | | |

Table A.7.4-2: Fixed reference channel for V2X receiver requirements (SCS 30 kHz, 256QAM)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | [30] | [30] | [30] |
| Subchannel size |  | 12 | 10 | 15 | 15 | [10] | [12] | [15] |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 | [160] | [216] | [270] |
| MCS Index |  | 23 | 23 | 23 | 23 | [24] | [24] | [24] |
| MCS Table for TBS determination | 256QAM | | | | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM | [256QAM] | [256QAM] | [256QAM] |
| Transport Block Size |  | 15880 | 36896 | 58384 | 81976 | [127080] | [172176] | [217128] |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | [24] | [24] | [24] |
| LDPC base graph |  | 1 | 1 | 1 | 1 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 2 | 5 | 7 | 10 | [16] | [21] | [26] |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | [6.25] | [6.25] | [6.25] |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 | [3] | [3] | [3] |
| Binary Channel Bits per Slot |  | 20544 | 48000 | 74400 | 106080 | [164160] | [223296] | [280320] |
| Max. Throughput averaged over 100ms | Mbps | 3.176 | 7.3792 | 11.677 | 16.395 | [25.416] | [34.4352] | [43.4256] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |

Table A.7.4-3: Fixed reference channel for V2X receiver requirements (SCS 60kHz, 256QAM)



|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | | | | |
| Channel bandwidth | MHz | 10 | 20 | 30 | 40 | 60 | 80 | 100 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 | [60] | [60] | [60] |
| Subchannel size |  | 10 | 12 | 12 | 10 | [15] | [15] | [15] |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 | [75] | [105] | [135] |
| MCS Index |  | 23 | 23 | 23 | 23 | [23] | [23] | [23] |
| MCS Table for TBS determination | 256QAM | | | | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM | [256QAM] | [256QAM] | [256QAM] |
| Transport Block Size |  | 4480 | 15880 | 25608 | 36896 | [57376] | [81976] | [106576] |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 | [24] | [24] | [24] |
| LDPC base graph |  | 1 | 1 | 1 | 1 | [1] | [1] | [1] |
| Number of Code Blocks per Slot |  | 1 | 2 | 4 | 5 | [7] | [10] | [13] |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 | [6.25] | [6.25] | [6.25] |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 | [3] | [3] | [3] |
| Binary Channel Bits per Slot |  | 5760 | 20544 | 33216 | 48000 | [74400] | [106080] | [137760] |
| Max. Throughput averaged over 100ms | Mbps | 1.792 | 6.352 | 10.243 | 14.758 | [22.9504] | [32.7904] | [42.6304] |
| NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).  NOTE 2: is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs. | | | | | | | | |