**3GPP TSG-RAN4 Meeting #102-e *R4-*** ***2206523***

**Electronic Meeting, 21st Feb. - 03rd March, 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | **xxxx** | **rev** | **1** | **Current version:** | **17.4.0** |  |
|  | | | | | | | | |
| *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:*** | Draft CR TS 38.101-1: Draft Big CR for Introduction on Public safety UE using sidelink in n14 for NR SL enhancement in Rel-17 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | LG Electronics, AT&T | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NRSL\_Enh-Core | | | | |  | ***Date:*** | | | 2022-02-10 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduce Public safety service UE RF core requirements to support PC1/PC3 operation using sidelink in n14. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Define PC1/PC3 UE RF core requirmeents for public safety service using sidelink operation.   1. Merged endorsed CRs in NRSL\_enh\_Part1  * Add the RF requirements in R4-2202408 * Add the FRC tables in Revision of R4-2204154 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The specification will be not supported for Public safety service using sidelink operation in n14 in Rel-17. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.3, 5.2E, 6.2E, 6.3E, 6.5E, 7.3E, 7.4E, 7.5E, 7.6E, 7.7E, 7.8E and A.7 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS 38.521-1 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revised from R4-2204156 | | | | | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of Changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 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

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

PSCCH Physical Sidelink Control CHannel

PSSCH Physical Sidelink Shared CHannel

QAM Quadrature Amplitude Modulation

RE Resource Element

REFSENS Reference Sensitivity

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

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 General

## 4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT specification for NR UE, covering RF characteristics and minimum performance requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification 3GPP TS 38.521-1 [4].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-1 [4] defines test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU‑R M.1545 [5].

## 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*].

## 4.3 Specification suffix information

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

Table 4.3-1: Definition of suffixes

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

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

A terminal which supports more than one feature in clauses 5, 6 and 7 shall meet all of the separate corresponding requirements.

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

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly. For a terminal that supports SUL, the current version of the specification assumes the terminal is not configured with UL MIMO on SUL carrier.

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

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

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

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

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

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

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

*<Unchanged sections are omitted>*

## 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 |
| 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.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.

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

|  |  |  |
| --- | --- | --- |
| V2X con-current operating Band | NR or V2X Operating Band | Interface |
| 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 |

*<Unchanged sections are omitted>*

## 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 6.2.1-1 in clause 6.2.1.

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, the maximum output power requirements in Table 6.2E.1.1-1 shall be met with the SL MIMO configurations specified in Table 6.2D.1-2. The maximum output power 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).

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) |
| n14 | 31 | +2/-3 |  |  | 23 | +2/-3 |  |  |
| n38 |  |  |  |  | 23 | +2/-3 |  |  |
| n47 |  |  |  |  | 23 | +2/-3 |  |  |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2.1-1 shall apply to the active antenna connector.

*<Unchanged sections are omitted>*

### 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.2.2 MPR for 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.

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 | |

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 is defined as follows

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

= 12.0 ; 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.

Table 6.2E.2.2-2: Maximum Power Reduction (MPR) for S-SSB transmission for power class 3 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 shall apply to the maximum output power specified in Table 6.2E.1.1-1. The requirements shall be met with SL MIMO configurations defined in Table 6.2D.1-2. For UE supporting SL MIMO, 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 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 in clause 6.2E.2 apply for NR sidelink operation in licensed band or Band n47.

#### 6.2E.2.4 MPR for Power class 2 V2X UE

*[Editor Note] This session is for NRSL\_enh\_Part3 to capture the MPR requirements for PC2 V2X UE*

#### 6.2E.2.5 MPR for Power class 2 V2X con-current operation

*[Editor Note] This session is for NRSL\_enh\_Part3 to capture the MPR requirements for PC2 con-current V2X UE*

#### 6.2E.2.6 MPR for Power class 1 UE in 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 be met the NR V2X MPR values specified in clause 6.2E.2.2.

### 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 clause 6.2E.3.

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 6.2.3 shall apply to the maximum output power specified in Table 6.2E.1-1. The requirements shall be met with the SL MIMO configurations specified in Table 6.2D.1-2. For UE supporting SL MIMO, 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.

*<Unchanged sections are omitted>*

## 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.

*<Unchanged sections are omitted>*

### 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 clause 6.3.2 apply.

Table 6.3E.2.1-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -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 for PS UE in n14. | | |

For NR V2X UE supporting SL MIMO, 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.

*<Unchanged sections are omitted>*

## 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.1.2 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 shall apply for the sidelink in licensed band or Band n47.

### 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 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.2.2.2 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 shall apply for the sidelink in licensed band or Band n47.

#### 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.2.2.1-1 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.2.2.1-1.

Table 6.5E.2.2.1-1: 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 |

##### 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.

*<Unchanged sections are omitted>*

## 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 |
| 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. | | | | | | | |

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 |
| 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. | | | | | | | |

*<Unchanged sections are omitted>*

## 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. | | | | | | |

*<Unchanged sections are omitted>*

## 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. | | | | | | |

*<Unchanged sections are omitted>*

## 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. | | | | |

*<Unchanged sections are omitted>*

### 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. | | | | | |

*<Unchanged sections are omitted>*

## 7.7E Spurious response for V2X

### 7.7.E.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 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 |

*<Unchanged sections are omitted>*

## 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

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 | | | |
|  | 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 | | | | |
|  | 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. | | | | | | | |

*<Unchanged sections are omitted>*

# 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 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 1608 | 3624 | 5632 | 7936 |
| Transport block CRC | Bits | 16 | 16 | 24 | 24 |
| LDPC base graph |  | 2 | 2 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 5160 | 12036 | 18636 | 26556 |
| Max. Throughput averaged over 100ms | Mbps | 0.3216 | 0.7248 | 1.1264 | 1.5872 |
| 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 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 4 | 4 | 4 | 4 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Transport Block Size |  | 456 | 1608 | 2536 | 3624 |
| Transport block CRC | Bits | 16 | 16 | 16 | 16 |
| LDPC base graph |  | 2 | 2 | 2 | 2 |
| Number of Code Blocks per Slot |  | 1 | 1 | 1 | 1 |
| Beta offset for 2nd stage SCI |  | 2.25 | 2.25 | 2.25 | 2.25 |
| value when 2nd stage SCI rate match |  | 7 | 7 | 7 | 1 |
| Binary Channel Bits per Slot |  | 1464 | 5160 | 8328 | 12036 |
| Max. Throughput averaged over 100ms | Mbps | 0.1824 | 0.6432 | 1.0144 | 1.4496 |
| 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 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 11528 | 27144 | 42016 | 60456 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 4 | 5 | 8 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 7 | 1 | 1 | 1 |
| Binary Channel Bits per Slot |  | 15336 | 35964 | 55764 | 79524 |
| Max. Throughput averaged over 100ms | Mbps | 2.3056 | 5.4288 | 8.4032 | 12.091 |
| 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 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 24 | 24 | 24 | 24 |
| MCS Table for TBS determination | 64QAM | | | | |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM |
| Transport Block Size |  | 3240 | 11528 | 18960 | 27144 |
| Transport block CRC | Bits | 16 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 2 | 3 | 4 |
| Beta offset for 2nd stage SCI |  | 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 |
| Max. Throughput averaged over 100ms | Mbps | 1.296 | 4.6112 | 7.584 | 10.858 |
| 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 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Subchannel size |  | 12 | 10 | 15 | 15 |
| Allocated resource blocks |  | 24 | 50 | 75 | 105 |
| MCS Index |  | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 15880 | 36896 | 58384 | 81976 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 2 | 5 | 7 | 10 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 20544 | 48000 | 74400 | 106080 |
| Max. Throughput averaged over 100ms | Mbps | 3.176 | 7.3792 | 11.677 | 16.395 |
| 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 |
| Subcarrier spacing | kHz | 60 | 60 | 60 | 60 |
| Subchannel size |  | 10 | 12 | 12 | 10 |
| Allocated resource blocks |  | 10 | 24 | 36 | 50 |
| MCS Index |  | 23 | 23 | 23 | 23 |
| MCS Table for TBS determination | 256QAM | | | | |
| Modulation |  | 256QAM | 256QAM | 256QAM | 256QAM |
| Transport Block Size |  | 4480 | 15880 | 25608 | 36896 |
| Transport block CRC | Bits | 24 | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  | 1 | 2 | 4 | 5 |
| Beta offset for 2nd stage SCI |  | 6.25 | 6.25 | 6.25 | 6.25 |
| value when 2nd stage SCI rate match |  | 3 | 3 | 3 | 3 |
| Binary Channel Bits per Slot |  | 5760 | 20544 | 33216 | 48000 |
| Max. Throughput averaged over 100ms | Mbps | 1.792 | 6.352 | 10.243 | 14.758 |
| 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. | | | | | |

*<End of Changes>*