**3GPP TSG-RAN4 Meeting #94-eR4-2002763**

**Online, 24th Feb. – 06th March, 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | **xxx** | **rev** | **-** | **Current version:** | **16.2.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | CR on introducing Tx requirements for 5G V2X UE in TS38.101-1 in rel-16 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | LG Electronics, [Huawei, CATT, Qualcomm] | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5G\_V2X\_NRSL-Core | | | | |  | ***Date:*** | | | 2020-03-02 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-16 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This CR is provided to include new feature for 5G V2X UE RF requirements in TS38.101-1 in rel-16. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This CR is introduced for NR V2X UE RF requirmeents for 5G V2X Service.  For the NR V2X UE at licensed band or unlicensed band, the minimum reuqirmeents for general, operating bands, transmitter and receiver are provided. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Completed NR V2X UE RF requirements are not specified. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.3, 4.3, 5.2, 5.2E, 5.3.5, 5.3E, 5.4.2, 5.4E, 6.2.1, 6.2.1E, 6.2.2E, 6.2.3E, 6.2.4E, 6.3E, 6.4E, 6.5.3, 6.5E | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | 38.521-3 | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## *<< Start of changes >>*

# 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.

**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.

**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.

**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.

## 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 Δ Frequency of default TX-RX separation of the FDD *operating band*

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

ΔRIB,4R Reference sensitivity adjustment due to support for 4 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 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 and for the uplink for all FDD 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

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

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

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

P-MPR*c* Maximum allowed UE output power reduction for serving cell *c*

PRB The transmitted power per allocated RB, measured in dBm

PUMAX The measured configured maximum UE output power

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart Indicates the lowest RB index of transmitted resource blocks

SCSc SCS for the component carrier c

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

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

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

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 X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable NR *operating band*

CC Component Carriers

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 TransmissionE-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

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

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

SC Single Carrier

SCS Subcarrier spacing

SDL Supplementary Downlink

SEM Spectrum Emission Mask

SL Sidelink

SNR Signal-to-Noise Ratio

SRS Sounding Reference SymbolSUL Supplementary uplink

SS Synchronization Symbol

TAE Time Alignment Error

Tx Transmitter

UL MIMO Uplink Multiple Antenna 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.

## 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 | NR V2X |

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional clause (suffix A, B, C, D and E) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional clause requirements (suffix A, B, C, D and E) 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.

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.

# 5 Operating bands and channel arrangement

## 5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

Requirements throughout the RF specifications are in many cases defined separately for different frequency ranges (FR). The frequency ranges in which NR can operate according to this version of the specification are identified as described in Table 5.1-1.

Table 5.1-1: Definition of frequency ranges

|  |  |
| --- | --- |
| Frequency range designation | Corresponding frequency range |
| FR1 | 410 MHz – 7125 MHz |
| FR2 | 24250 MHz – 52600 MHz |

The present specification covers FR1 operating bands.

## 5.2 Operating bands

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

Table 5.2-1: NR operating bands in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | Uplink (UL) *operating band* BS receive / UE transmit  FUL\_low  – FUL\_high | Downlink (DL) *operating band* BS transmit / UE receive  FDL\_low – FDL\_high | Duplex Mode |
| n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD |
| n2 | 1850 MHz – 1910 MHz | 1930 MHz – 1990 MHz | FDD |
| n3 | 1710 MHz – 1785 MHz | 1805 MHz – 1880 MHz | FDD |
| n5 | 824 MHz – 849 MHz | 869 MHz – 894 MHz | FDD |
| n7 | 2500 MHz – 2570 MHz | 2620 MHz – 2690 MHz | FDD |
| n8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD |
| n12 | 699 MHz – 716 MHz | 729 MHz – 746 MHz | FDD |
| n14 | 788 MHz – 798 MHz | 758 MHz – 768 MHz | FDD |
| n18 | 815 MHz – 830 MHz | 860 MHz – 875 MHz | FDD |
| n20 | 832 MHz – 862 MHz | 791 MHz – 821 MHz | FDD |
| n25 | 1850 MHz – 1915 MHz | 1930 MHz – 1995 MHz | FDD |
| n28 | 703 MHz – 748 MHz | 758 MHz – 803 MHz | FDD |
| n29 | N/A | 717 MHz – 728 MHz | SDL |
| n303 | 2305 Mhz – 2315 MHz | 2350 MHz – 2360 MHz | FDD |
| n34 | 2010 MHz – 2025 MHz | 2010 MHz – 2025 MHz | TDD |
| n38 | 2570 MHz – 2620 MHz | 2570 MHz – 2620 MHz | TDD |
| n39 | 1880 MHz – 1920 MHz | 1880 MHz – 1920 MHz | TDD |
| n40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD |
| n41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | TDD |
| n47 | 5855 MHz – 5925 MHz | 5855 MHz – 5925 MHz | TDD10 |
| n48 | 3550 MHz – 3700 MHz | 3550 MHz – 3700 MHz | TDD |
| n50 | 1432 MHz – 1517 MHz | 1432 MHz – 1517 MHz | TDD1 |
| n51 | 1427 MHz – 1432 MHz | 1427 MHz – 1432 MHz | TDD |
| n65 | 1920 MHz – 2010 MHz | 2110 MHz – 2200 MHz | FDD4 |
| n66 | 1710 MHz – 1780 MHz | 2110 MHz – 2200 MHz | FDD |
| n70 | 1695 MHz – 1710 MHz | 1995 MHz – 2020 MHz | FDD |
| n71 | 663 MHz – 698 MHz | 617 MHz – 652 MHz | FDD |
| n74 | 1427 MHz – 1470 MHz | 1475 MHz – 1518 MHz | FDD |
| n75 | N/A | 1432 MHz – 1517 MHz | SDL |
| n76 | N/A | 1427 MHz – 1432 MHz | SDL |
| n77 | 3300 MHz – 4200 MHz | 3300 MHz – 4200 MHz | TDD |
| n78 | 3300 MHz – 3800 MHz | 3300 MHz – 3800 MHz | TDD |
| n79 | 4400 MHz – 5000 MHz | 4400 MHz – 5000 MHz | TDD |
| n80 | 1710 MHz – 1785 MHz | N/A | SUL |
| n81 | 880 MHz – 915 MHz | N/A | SUL |
| n82 | 832 MHz – 862 MHz | N/A | SUL |
| n83 | 703 MHz – 748 MHz | N/A | SUL |
| n84 | 1920 MHz – 1980 MHz | N/A | SUL |
| n86 | 1710 MHz – 1780 MHz | N/A | SUL |
| n89 | 824 MHz – 849 MHz | N/A | SUL |
| n90 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | TDD5 |
| n91 | 832 MHz – 862 MHz | 1427 MHz – 1432 MHz | FDD9 |
| n92 | 832 MHz – 862 MHz | 1432 MHz – 1517 MHz | FDD9 |
| n93 | 880 MHz – 915 MHz | 1427 MHz – 1432 MHz | FDD9 |
| n94 | 880 MHz – 915 MHz | 1432 MHz – 1517 MHz | FDD9 |
| n958 | 2010 MHz – 2025 MHz | N/A | SUL |
| NOTE 1: UE that complies with the NR Band n50 minimum requirements in this specification shall also comply with the NR Band n51 minimum requirements.  NOTE 2: UE that complies with the NR Band n75 minimum requirements in this specification shall also comply with the NR Band n76 minimum requirements.  NOTE 3: Uplink transmission is not allowed at this band for UE with external vehicle-mounted antennas.  NOTE 4: A UE that complies with the NR Band n65 minimum requirements in this specification shall also comply with the NR Band n1 minimum requirements.  NOTE 5: Unless otherwise stated, the applicability of requirements for Band n90 is in accordance with that for Band n41; a UE supporting Band n90 shall meet the requirements for Band n41.  NOTE 6: A UE that supports NR Band n66 shall receive in the entire DL operating band.  NOTE 7: A UE that supports NR Band n66 and CA operation in any CA band shall also comply with the minimum requirements specified for the DL CA configurations CA\_n66B and CA\_n66(2A) in the current version of the specification.  NOTE 8: This band is applicable in China only.  NOTE 9: Variable duplex operation does not enable dynamic variable duplex configuration by the network, and is used such that DL and UL frequency ranges are supported independently in any valid frequency range for the band.  NOTE 10: This band is unlicensed band used for NR V2X service. There is no expected network deployment in this band so Frame Structure Type 1 is used. | | | |

## *<< Unchanged sections are omitted >>*

## 5.2C Operating band combination for SUL

NR operation is designed to operate in the operating band combination defined in Table 5.2C-1, where all operating bands are within FR1.

Table 5.2C-1: Operating band combination for SUL in FR1

|  |  |
| --- | --- |
| NR Band combination for SUL | NR Band  (Table 5.2-1) |
| SUL\_n41-n80 | n41, n80 |
| SUL\_n41-n81 | n41, n81 |
| SUL\_n77-n802 | n77, n80 |
| SUL\_n77-n842 | n77, n84 |
| SUL\_n78-n802 | n78, n80 |
| SUL\_n78-n812 | n78, n81 |
| SUL\_n78-n822 | n78, n82 |
| SUL\_n78-n832 | n78, n83 |
| SUL\_n78-n842 | n78, n84 |
| SUL\_n78-n862 | n78, n86 |
| SUL\_n79-n802 | n79, n80 |
| SUL\_n79-n812 | n79, n81 |
| SUL\_n79-n84 | n79, n84 |
| NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory.  NOTE 3: For UE supporting SUL band combination, UL MIMO is not configured on SUL carrier | |

## 5.2E Operating band for NR V2X

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

Table 5.2E-1 NR V2X operating bands in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X Operating Band | Sidelink (SL) Transmission operating band | | | Sidelink (SL) Reception operating band | | | Duplex Mode | Interface |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n381 | 2570 MHz | - | 2620 MHz | 2570 MHz | - | 2620 MHz | TDD | PC5 |
| n47 | 5855 MHz | - | 5925 MHz | 5855 MHz | - | 5925 MHz | TDD | PC5 |
| Note 1: For NR band n38, the NR V2X UE shall be operated synchronuous with adjacent n38 NR UE | | | | | | | | |

## *<< Unchanged sections are omitted >>*

## 5.3 UE channel bandwidth

### 5.3.1 General

The UE channel bandwidth supports a single NR RF carrier in the uplink or downlink at the UE. From a BS perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the BS. Transmission of multiple carriers to the same UE (CA) or multiple carriers to different UEs within the BS channel bandwidth can be supported.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the BS channel bandwidth.

The relationship between the channel bandwidth, the guardband and the maximum transmission bandwidth configuration is shown in Figure 5.3.1-1.



Figure 5.3.1-1: Definition of the channel bandwidth and the maximum transmission bandwidth configuration for one NR channel

### *<< Unchanged sections are omitted >>*

### 5.3.5 UE channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1. The transmission bandwidth configuration in Table 5.3.2-1 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the TX and RX path.

Table 5.3.5-1 Channel bandwidths for each NR band

|  |  | | NR band / SCS / UE Channel bandwidth | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | SCS  kHz | 5 MHz | | 101,2 MHz | 152 MHz | 202 MHz | 252 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| n1 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n2 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n5 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n8 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n12 | 15 | Yes | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n14 | 15 | Yes | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n18 | 15 | Yes | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n20 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n25 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n28 | 15 | Yes | | Yes | Yes | Yes7 |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes7 |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n29 | 15 | Yes | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n30 | 15 | Yes | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n34 | 15 | Yes | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| n38 | 15 | Yes | | Yes | Yes | Yes |  | Yes9 | Yes |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  | Yes9 | Yes |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  | Yes9 | Yes |  |  |  |  |  |  |
| n39 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n40 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n41 | 15 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| 60 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| n47 | 15 |  | | Yes9 |  | Yes9 |  | Yes9 | Yes9 |  |  |  |  |  |  |
| 30 |  | | Yes9 |  | Yes9 |  | Yes9 | Yes9 |  |  |  |  |  |  |
| 60 |  | | Yes9 |  | Yes9 |  | Yes9 | Yes9 |  |  |  |  |  |  |
| n48 | 15 | Yes5 | | Yes | Yes | Yes |  |  | Yes | Yes6 |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  | Yes | Yes6 | Yes6 |  | Yes6 | Yes6,4 | Yes6 |
| 60 |  | | Yes | Yes | Yes |  |  | Yes | Yes6 | Yes6 |  | Yes6 | Yes6,4 | Yes6 |
| n50 | 15 | Yes | | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes3 |  |  |
| 60 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes3 |  |  |
| n51 | 15 | Yes | |  |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n65 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n66 | 15 | Yes | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| n70 | 15 | Yes | | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |
| n71 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n74 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n75 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n76 | 15 | Yes | |  |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes4 | Yes |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes4 | Yes |
| n78 | 15 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |
| 60 |  | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |
| n79 | 15 |  | |  |  |  |  |  | Yes | Yes |  |  |  |  |  |
| 30 |  | |  |  |  |  |  | Yes | Yes | Yes |  | Yes |  | Yes |
| 60 |  | |  |  |  |  |  | Yes | Yes | Yes |  | Yes |  | Yes |
| n80 | 15 | Yes | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n81 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n82 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n83 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n84 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n86 | 15 | Yes | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| 60 |  | | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |  |
| n89 | 15 | Yes | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n90 | 15 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| 60 |  | | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| n91 | 15 | Yes | | Yes8 |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n92 | 15 | Yes | | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n93 | 15 | Yes | | Yes8 |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n94 | 15 | Yes | | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes3 | Yes3 |  |  |  |  |  |  |  |  |  |
| 60 |  | |  |  |  |  |  |  |  |  |  |  |  |  |
| n95 | 15 | Yes | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 30 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  | | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
| NOTE 1: 90% spectrum utilization may not be achieved for 30kHz SCS.  NOTE 2: 90% spectrum utilization may not be achieved for 60kHz SCS.  NOTE 3: This UE channel bandwidth is applicable only to downlink.  NOTE 4: This UE channel bandwidth is optional in this release of the specification.  NOTE 5: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an SCell part of DC or CA configuration.  NOTE 6: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an downlink SCell part of CA configuration.  NOTE 7: For the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz.  NOTE 8: This UE channel bandwidth is applicable only to uplink.  NOTE 9: This UE channel bandwidth is applicable only to sidelink operation | | | | | | | | | | | | | | | |

## 5.3A UE channel bandwidth for CA

### 5.3A.1 General

Figure 5.3A.1-1: Void

Figure 5.3A.1-2: Void

## *<< Unchanged sections are omitted >>*

## 5.3E Channel bandwidth for NR V2X

NR V2X operation channel bandwidths for each operating band is specified in Table 5.3.5-1 in subclause 5.3.5. The same (symmetrical) channel bandwidth is specified for both the transmission and reception path.

## *<< Unchanged sections are omitted >>*

## 5.4 Channel arrangement

### 5.4.1 Channel spacing

#### 5.4.1.1 Channel spacing for adjacent NR carriers

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent NR carriers is defined as following:

- For NR operating bands with 100 kHz channel raster,

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2

- For NR operating bands with 15 kHz channel raster,

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2+{-5 kHz, 0 kHz, 5 kHz} for ∆FRaster equals 15 kHz

Nominal Channel spacing = (BWChannel(1) + BWChannel(2))/2+{-10 kHz, 0 kHz, 10 kHz} for ∆FRaster equals 30 kHz

where BWChannel(1) and BWChannel(2) are the channel bandwidths of the two respective NR carriers. The channel spacing can be adjusted depending on the channel raster to optimize performance in a particular deployment scenario.

### 5.4.2 Channel raster

#### 5.4.2.1 NR-ARFCN and channel raster

The global frequency channel raster defines a set of RF reference frequencies FREF. The RF reference frequency is used in signalling to identify the position of RF channels, SS blocks and other elements.

The global frequency raster is defined for all frequencies from 0 to 100 GHz. The granularity of the global frequency raster is ΔFGlobal.

RF reference frequencies are designated by an NR Absolute Radio Frequency Channel Number (NR-ARFCN) in the range (0…2016666) on the global frequency raster. The relation between the NR-ARFCN and the RF reference frequency FREF in MHz is given by the following equation, where FREF-Offs and NRef-Offs are given in table 5.4.2.1-1 and NREF is the NR-ARFCN.

FREF = FREF-Offs + ΔFGlobal (NREF – NREF-Offs)

Table 5.4.2.1-1: NR-ARFCN parameters for the global frequency raster

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency range (MHz) | ΔFGlobal (kHz) | FREF-Offs (MHz) | NREF-Offs | Range of NREF |
| 0 – 3000 | 5 | 0 | 0 | 0 – 599999 |
| 3000 – 24250 | 15 | 3000 | 600000 | 600000 – 2016666 |

The channel raster defines a subset of RF reference frequencies that can be used to identify the RF channel position in the uplink and downlink. The RF reference frequency for an RF channel maps to a resource element on the carrier. For each operating band, a subset of frequencies from the global frequency raster are applicable for that band and forms a channel raster with a granularity ΔFRaster, which may be equal to or larger than ΔFGlobal.

For SUL bands except n95 and for the uplink of all FDD bands defined in Table 5.2-1 and for Band n90

FREF, shift = FREF + Δshift, Δshift = 0 kHz or 7.5 kHz.

where Δshift is signalled by the network in higher layer parameter *frequencyShift7p5khz* [7].

The mapping between the channel raster and corresponding resource element is given in Clause 5.4.2.2. The applicable entries for each operating band are defined in Clause 5.4.2.3

#### 5.4.2.2 Channel raster to resource element mapping

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 UL and DL. The mapping must apply to at least one numerology supported by the UE.

Table 5.4.2.2-1: Channel raster to resource element mapping

|  |  |  |
| --- | --- | --- |
|  | NRBmod2 = 0 | NRBmod2 = 1 |
| Resource element index | 0 | 6 |
| Physical resource block number |  |  |

, *nPRB*, *NRB* are as defined in TS 38.211[6].

#### 5.4.2.3 Channel raster entries for each operating band

The RF channel positions on the channel raster in each NR 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 operating bands with 100 kHz channel raster, ΔFRaster = 20 × ΔFGlobal. In this case every 20th 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 <20>.

For NR operating bands with 15 kHz channel raster below 3GHz, ΔFRaster = *I* × ΔFGlobal, where *I ϵ {3,6}*. 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* >.

For NR operating bands with 15 kHz channel raster above 3GHz, ΔFRaster = *I* × ΔFGlobal, where *I ϵ {1,2}.* 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*>.

In frequency bands with two ΔFRaster, the higher ΔFRaster applies to channels using only the SCS that is equal to or larger than the higher ΔFRaster and SSB SCS is equal to the higher ∆FRaster .

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band

|  |  |  |  |
| --- | --- | --- | --- |
| NR operating band | ΔFRaster  (kHz) | Uplink  Range of NREF  (First – <Step size> – Last) | Downlink  Range of NREF  (First – <Step size> – Last) |
| n1 | 100 | 384000 – <20> – 396000 | 422000 – <20> – 434000 |
| n2 | 100 | 370000 – <20> – 382000 | 386000 – <20> – 398000 |
| n3 | 100 | 342000 – <20> – 357000 | 361000 – <20> – 376000 |
| n5 | 100 | 164800 – <20> – 169800 | 173800 – <20> – 178800 |
| n7 | 100 | 500000 – <20> – 514000 | 524000 – <20> – 538000 |
| n8 | 100 | 176000 – <20> – 183000 | 185000 – <20> – 192000 |
| n12 | 100 | 139800 – <20> – 143200 | 145800 – <20> – 149200 |
| n14 | 100 | 157600 – <20> – 159600 | 151600 – <20> – 153600 |
| n18 | 100 | 163000 – <20> – 166000 | 172000 – <20> – 175000 |
| n20 | 100 | 166400 – <20> – 172400 | 158200 – <20> – 164200 |
| n25 | 100 | 370000 – <20> – 383000 | 386000 – <20> – 399000 |
| n28 | 100 | 140600 – <20> – 149600 | 151600 – <20> – 160600 |
| n29 | 100 | N/A | 143400 – <20> – 145600 |
| n30 | 100 | 461000 – <20> – 463000 | 470000 – <20> – 472000 |
| n34 | 100 | 402000 – <20> – 405000 | 402000 – <20> – 405000 |
| n38 | 100 | 514000 – <20> – 524000 | 514000 – <20> – 524000 |
| n39 | 100 | 376000 – <20> – 384000 | 376000 – <20> – 384000 |
| n40 | 100 | 460000 – <20> – 480000 | 460000 – <20> – 480000 |
| n41 | 15 | 499200 – <3> – 537999 | 499200 – <3> – 537999 |
| 30 | 499200 – <6> – 537996 | 499200 – <6> – 537996 |
| n47 | 15 | 790334 – <1> – 795000 | 790334 – <1> – 795000 |
| 30 | [790334 – <2> – 795000] | [790334 – <2> – 795000] |
| 60 | [790334 – <4> – 795000] | [790334 – <4> – 795000] |
| n48 | 15 | 636667 – <1> – 646666 | 636667 – <1> – 646666 |
| 30 | 636668 – <2> – 646666 | 636668 – <2> – 646666 |
| n50 | 100 | 286400 – <20> – 303400 | 286400 – <20> – 303400 |
| n51 | 100 | 285400 – <20> – 286400 | 285400 – <20> – 286400 |
| n65 | 100 | 384000 – <20> – 402000 | 422000 – <20> – 440000 |
| n66 | 100 | 342000 – <20> – 356000 | 422000 – <20> – 440000 |
| n70 | 100 | 339000 – <20> – 342000 | 399000 – <20> – 404000 |
| n71 | 100 | 132600 – <20> – 139600 | 123400 – <20> – 130400 |
| n74 | 100 | 285400 – <20> – 294000 | 295000 – <20> – 303600 |
| n75 | 100 | N/A | 286400 – <20> – 303400 |
| n76 | 100 | N/A | 285400 – <20> – 286400 |
| n77 | 15 | 620000 – <1> – 680000 | 620000 – <1> – 680000 |
| 30 | 620000 – <2> – 680000 | 620000 – <2> – 680000 |
| n78 | 15 | 620000 – <1> – 653333 | 620000 – <1> – 653333 |
| 30 | 620000 – <2> – 653332 | 620000 – <2> – 653332 |
| n79 | 15 | 693334 – <1> – 733333 | 693334 – <1> – 733333 |
| 30 | 693334 – <2> – 733332 | 693334 – <2> – 733332 |
| n80 | 100 | 342000 – <20> – 357000 | N/A |
| n81 | 100 | 176000 – <20> – 183000 | N/A |
| n82 | 100 | 166400 – <20> – 172400 | N/A |
| n83 | 100 | 140600 – <20> –149600 | N/A |
| n84 | 100 | 384000 – <20> – 396000 | N/A |
| n86 | 100 | 342000 – <20> – 356000 | N/A |
| n89 | 100 | 164800 – <20> – 169800 | N/A |
| n90 | 15 | 499200 – <3> – 537999 | 499200 – <3> – 537999 |
| 30 | 499200 – <6> – 537996 | 499200 – <6> – 537996 |
| 100 | 499200 – <20> – 538000 | 499200 – <20> – 538000 |
| n91 | 100 | 166400 – <20> – 172400 | 285400 – <20> – 286400 |
| n92 | 100 | 166400 – <20> – 172400 | 286400 – <20> – 303400 |
| n93 | 100 | 176000 – <20> – 183000 | 285400 – <20> – 286400 |
| n94 | 100 | 176000 – <20> – 183000 | 286400 – <20> – 303400 |
| n95 | 100 | 402000 – <20> – 405000 | N/A |

## *<< Unchanged sections are omitted >>*

## 5.4E Channel arrangement for NR V2X

### 5.4E.1 Channel spacing

The channel spacing defined in subclause 5.4.1 are applied for NR V2X according to support channel raster.

### 5.4E.2 Channel raster

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

The NR-ARFCN and channel raster defined in subclause 5.4.2.1 are applied for NR V2X.

For NR V2X UE at n47, 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}, are signalled by the network in higher layer parameters or configured by pre-configuration parameters.

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

The channel raster to resource element mapping defined in subclause 5.4.2.2 are applied for NR V2X.

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

The channel raster entries for each operating band defined in subclaue 5.4.2.3 are applied for NR V2X. 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 subclause 5.4E.2.2.

## *<< Unchanged sections are omitted >>*

# 6 Transmitter characteristics

## 6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single or multiple transmit antenna(s). For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

Transmitter requirements for UL MIMO operation apply when the UE transmits on 2 ports on the same CDM group. The UE may use higher MPR values outside this limitation.

The applicability of transmitter requirements for Band n90 is in accordance with that for Band n41; a UE supporting Band n90 shall meet the minimum requirements for Band n41.

## 6.1A General

The minimum requirements for band combinations including Band n41 also apply for the corresponding band combinations with Band n90 replacing Band n41 but with otherwise identical parameters. For brevity the said band combinations with Band n90 are not listed in the tables below but are covered by this specification.

## 6.2 Transmitter power

### 6.2.1 UE maximum output power

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

Table 6.2.1-1: UE Power Class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR  band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) |
| n1 |  |  |  |  | 23 | ±2 |
| n2 |  |  |  |  | 23 | ±23 |
| n3 |  |  |  |  | 23 | ±23 |
| n5 |  |  |  |  | 23 | ±2 |
| n7 |  |  |  |  | 23 | ±23 |
| n8 |  |  |  |  | 23 | ±23 |
| n12 |  |  |  |  | 23 | ±23 |
| n14 | 31 | +2/-3 |  |  | 23 | ±23 |
| n18 |  |  |  |  | 23 | ±2 |
| n20 |  |  |  |  | 23 | ±23 |
| n25 |  |  |  |  | 23 | ±2 |
| n28 |  |  |  |  | 23 | +2/-2.5 |
| n30 |  |  |  |  | 23 | ±2 |
| n34 |  |  |  |  | 23 | ±2 |
| n38 |  |  |  |  | 23 | ±2 |
| n39 |  |  |  |  | 23 | ±2 |
| n40 |  |  |  |  | 23 | ±2 |
| n41 |  |  | 26 | +2/-33 | 23 | ±23 |
| n47 |  |  |  |  | 23 | ±2 |
| n48 |  |  |  |  | 23 | +2/-3 |
| n50 |  |  |  |  | 23 | ±2 |
| n51 |  |  |  |  | 23 | ±2 |
| n65 |  |  |  |  | 23 | ±2 |
| n66 |  |  |  |  | 23 | ±2 |
| n70 |  |  |  |  | 23 | ±2 |
| n71 |  |  |  |  | 23 | +2/-2.5 |
| n74 |  |  |  |  | 23 | ±2 |
| n77 |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n78 |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n79 |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n80 |  |  |  |  | 23 | ±2 |
| n81 |  |  |  |  | 23 | ±2 |
| n82 |  |  |  |  | 23 | ±2 |
| n83 |  |  |  |  | 23 | ±2/-2.5 |
| n84 |  |  |  |  | 23 | ±2 |
| n86 |  |  |  |  | 23 | ±2 |
| n89 |  |  |  |  | 23 | ±2 |
| n91 |  |  |  |  | 23 | ±23, 4 |
| n92 |  |  |  |  | 23 | ±23, 4 |
| n93 |  |  |  |  | 23 | ±23, 4 |
| n94 |  |  |  |  | 23 | ±23, 4 |
| n95 |  |  |  |  | 23 | ±2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 2: Powerclass 3 is default power class unless otherwise stated  NOTE 3: Refers to the transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB.  NOTE 4: The maximum output power requirement is relaxed by reducing the lower tolerance limit by 0.3 dB | | | | | | |

## *<< Unchanged sections are omitted >>*

## 6.2E Transmitter power for NR V2X

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

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, the allowed NR V2X UE maximum output power for shall be applied in Table 6.2.1-1 in subclause 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 or NS\_34 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 G.

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

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, this subclause specifies the allowed Maximum Power Reduction (MPR) power for V2X physical channels and signals due to PSCCH and PSSCH simultaneous transmission.

#### 6.2E.2.1 MPR for Power class 3 NR 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.2.1-1 for Power class 3 NR V2X UE.

Table 6.2E.2.1-1: Maximum Power Reduction (MPR) for power class 3 NR V2X (Contiguous PSCCH and PSSCH transmission)

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation** | | **Channel bandwidth/MPR (dB)** | |
| **Outer RB allocations** | **Inner RB allocations** |
| CP-OFDM | QPSK/ 16QAM | ≤ [4.0] | ≤ [2.0] |
| 64 QAM | ≤ [4.5] | ≤ [3.5] |
| 256 QAM | ≤ [6.0] | |

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.

For non-contiguous allocation for simultaneous PSFCH transmission for NR V2X will be specified as follow

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

Where MA is defined as follows

MA\_PSFCH = TBD ; 0.00< A ≤ TBD

TBD ; TBD< A ≤TBD

TBD ; TBD< A ≤1.00

Where

A = NRB\_alloc / NRB.

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

The allowed MPR for the maximum output power for NR V2X physical channels PSBCH and PSSS shall be applied the NR Uplink requirements in subclause 6.2.2 for the corresponding modulation and transmission bandwidth.

The allowed MPR for the maximum output power for NR V2X physical signal SSSS is FFS.

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

For the applied maximum output power reduction is obtained by taking the maximum value of MPR requirements specified in subclause 6.2E.2 and A-MPR requirements specified in subclause 6.2E.3.

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, the 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.3-1, 6.2E.3-2 is allowed when network signalling value is provided*.* The supported post antenna connector gain Gpost connector is declared by the UE following the principle described in annex G.

NOTE: 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. A-MPRBase is the default A-MPR value when no Gpost connector is declared. A-MPRBase and A-MPRstep vary depending on channel frequency and RB allocation. For channel frequencies and RB allocations that are close to the frequency range 5815-5855MHz, those value are much higher due to stringent emission requirement in this range.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Network Signalling value | Requirements (subclause) | NR Band | Channel bandwidth (MHz) | A-MPR (dB) |
| NS\_33 | 6.5E.2.2.1 (A-SEM)  6.5.3.2 (A-SE) | n47 | 10 | Table 6.2E.3-2  Table 6.2E.3-3  Table 6.2E.3-4 |
| NS\_48 | 6.5E.2.2.2 (A-SEM) | n47 | 40 | Table 6.2E.3-5 |

Table 6.2E.3-2: A-MPR for NS\_33 (15kHz SCS)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Resources Blocks (*N*RB) Note1 | Start Resource  Block | A-MPR (dB) | | |
| QPSK/16QAM | 64QAM | 256QAM |
| 5860 | ≤15 | 0 | 20 | | |
| > 15 and ≤25 | 0 | 18.5 | | |
| > 25 and ≤40 | 0 | 17 | | |
| > 40 | 0 | 15.5 | | |
| ≤ 40 | 10 | 12 | | |
| ≤ 30 | 15 | 9.5 | | |
| ≤ 30 | 20 | 7.5 | | |
| ≤ 25 | 25 | 6 | | |
| ≤ 20 | ≥ 30 | 5 | | |
| 5870, 5910, 5920, 5880, 5890, 5900 | ≤ 50 | 0 | 3 | | 4 |
| ≤ 40 | 10 | 2.5 | 2.5 | 4 |
| ≤ 20 | 15, 20, 40 | 1 | 2 | 4 |
| > 20 | 20 | 2.5 | 2.5 | 4 |
| ≤ 25 | 25, 30 | 2.5 | 2.5 | 4 |
| NOTE 1: The resource blocks are limited by LCRB. LCRB = {10,15,20,25,30,40,45,50}. | | | | | |

Table 6.2E.3-3: A-MPR for NS\_33 (30kHz SCS)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Resources Blocks (*N*RB) Note1 | Start Resource  Block | A-MPR (dB) | | |
| QPSK/16QAM | 64QAM | 256QAM |
| 5860 | 10,15 | 0 | 19 | | |
| 20 | 0 | 17 | | |
| 10 | 10 | 9 | | |
| 5870, 5910, 5920, 5880, 5890, 5900 | ≤ 20 | 0 | 2.5 | | 4 |
| 10 | 10 | 1.5 | 2 | 4 |
| NOTE 1: The resource blocks are limited by LCRB. LCRB = {10,15,20}. | | | | | |

Table 6.2E.3-4: A-MPR for NS\_33 (60kHz SCS)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Resources Blocks (*N*RB) | Start Resource  Block | A-MPR (dB) | | |
| QPSK/16QAM | 64QAM | 256QAM |
| 5860 | 10 | 0 | 18 | | |
| 5870, 5910, 5920 | 5 | | |
| 5880, 5890, 5900 | 2.5 | | 4.5 |

Table 6.2E.3-5: A-MPR for NS\_48

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Carrier frequency(MHz)** | **Modulation** | **A-MPR(dB)** | | |
| **Edge RB allocations** | **Outer RB allocations** | **Inner RB allocation** |
| 5885 | QPSK | ≤ (9.5 + ΔNote1) | ≤ 8.0 | ≤ 3.5 |
| 16QAM | ≤ 8.0 | ≤ 3.5 |
| 64QAM | ≤ 8.5 | ≤ 4.5 |
| 256QAM | ≤ 8.5 | ≤ 6.0 |
| Note1: Δ is 0, 3, and 5 for 60kHz, 30kHz, and 15kHz SCS, respectively. | | | | |

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 [3].

RBStart,Low = max(1, floor(NRB /3.5))

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/3.5)

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

An Edge RB allocation is the one for which the RB(s) is (are) allocated at the lowermost or uppermost edge of the channel with LCRB ≤ floor(NRB\*0.2) RBs.

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

The allowed additional Maximum Power Reduction (A-MPR) for the maximum output power for NR V2X physical signal PSBCH and PSSS/SSSS is FFS.

### [6.2E.4 Configured transmitted power for NR V2X]

[The NR V2X UE is allowed to set its configured maximum output power PCMAX,*c* for carrier f of serving cell *c* in each slot. The configured maximum output power PCMAX,*c* is set within the following bounds:

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

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

PCMAX\_H,f, *c* = MIN {PEMAX,*c*, (PPowerClass– ΔPPowerClass), PRegulatory,c }

where

- For the total transmitted power PCMAX,c of PSSCH and PSCCH, PEMAX,c is the value given by IE *maxTxPower*, defined by [TS 38.331], when the UE is not associated with a serving cell on the NR V2X carrier .

- For P*CMAX, PSBCH/S-PSS*, PEMAX,*c* is the value given by the IE *maxTxPower* in [TS 38.331] when the UE is not associated with a serving cell on the V2X carrier.

- For P*CMAX, S-SSS*, the value is as calculated for P*CMAX, SSB* and applying the MPR for SSSS as specified in maximum output power reduction in subclause 6.2E.2.

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

- MPR*c* and A-MPR*c* for serving cell *c* are specified in subclause 6.2E.2 and subclause 6.2E.3, respectively;

- TIB,c, TC,*c*, ∆TRxSRS, PPoweclass and P-MPR*c* are specified in subclause 6.2.4

- PRegulatory,c= 10 dBm when the CEN DSRC tolling system is nearby NR V2X UE; PRegulatory,c= 33 dBm otherwise.

The maximum output power P*CMAX,PSSCH* and P*CMAX,PSCCH* are derived from PCMAX,c based on 0dB 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 subclause 6.2.4 shall be applied.

When a UE is configured for simultaneous NR V2X sidelink and NR uplink transmissions for inter-band con-current NR V2X / NR bands specified in Table 5.5E-2, the UE is allowed to set its configured maximum output power PCMAX,*c*,*NR*and PCMAX,*c*,NR *V2X*for the configured NR uplink carrier and the configured NR V2X carrier, respectively, and its total configured maximum output power PCMAX,c. The TIB,c of PCMAX,*c*,NRis specified in Table 6.2E.4-1.]

## *<< Unchanged sections are omitted >>*

## 6.3 Output power dynamics

### 6.3.1 Minimum output power

The minimum controlled output power of the UE is defined as the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

The minimum output power is defined as the mean power in at least one sub-frame 1 ms. The minimum output power shall not exceed the values specified in Table 6.3.1-1.

Table 6.3.1-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40 | 4.515 |
| 10 | -40 | 9.375 |
| 15 | -40 | 14.235 |
| 20 | -40 | 19.095 |
| 25 | -39 | 23.955 |
| 30 | -38.2 | 28.815 |
| 40 | -37 | 38.895 |
| 50 | -36 | 48.615 |
| 60 | -35.2 | 58.35 |
| 70 | -34.6 | 68.07 |
| 80 | -34 | 78.15 |
| 90 | -33.5 | 88.23 |
| 100 | -33 | 98.31 |

## *<< Unchanged sections are omitted >>*

## 6.3E Output power dynamics for NR V2X

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

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, it is proposed that the existing requirements as specified for legacy NR UE shall apply. The minimum output power is defined as the mean power in at least one sub-frame 1 ms.

Table 6.3E.1-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -30 | 9.375 |
| 20 | -30 | 19.095 |
| 30 | -28.2 | 28.815 |
| 40 | -27 | 38.895 |

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

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, it is proposed that the existing requirements as specified for legacy NR UE shall apply. Transmit off power is defined as the mean power in at least one sub-frame 1 ms.

Table 6.3E.2-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50 | 9.375 |
| 20 | -50 | 19.095 |
| 30 | -50 | 28.815 |
| 40 | -50 | 38.895 |

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

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

#### 6.3E.3.1 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 subframe wherein the last symbol is punctured to create a guard period.



Figure 6.3E.3.1-1: General PSCCH/PSSCH time mask for NR V2X UE

#### 6.3E.3.2 S-PSS/S-SSS/S-PBCH time mask

The S-PSS/S-SSS/S-PBCH time mask is FFS.

### 6.3E.4 Power control for NR V2X

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, the following requirements are applied for NR V2X sidelink transmission.

#### 6.3E.4.1 Absolute power tolerance

The existing absolute power tolerance requirements of legacy NR UE shall apply for NR V2X transmission.

Table 6.3E.4.1-1: Absolute power tolerance

|  |  |
| --- | --- |
| Conditions | Tolerance |
| Normal | ± 9.0 dB |

## *<< Unchanged sections are omitted >>*

## 6.4 Transmit signal quality

### 6.4.1 Frequency error

The UE basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

### 6.4.2 Transmit modulation quality

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 6.4.2.2 and 6.4.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

## *<< Unchanged sections are omitted >>*

## 6.4E Transmit signal quality for NR V2X

### 6.4E.1 Frequency error for NR V2X

The UE modulated carrier frequency for NR V2X sidelink transmissions in Table 5.2E-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.

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

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

#### 6.4E.2.1 Error Vector Magnitude for NR V2X

For V2X sidelink physical channels PSCCH and PSSCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in Table 6.4E.2.1-1 for the corresponding modulation and transmission bandwidth for NR V2X operating bands in Table 5.2E-1. When sidelink transmissions are shortened due to transmission gap of 1 symbol at the end of the slot, the EVM measurement interval is reduced by one symbol, accordingly.

Table 6.4E.2.1-1: Minimum requirements for Error Vector Magnitude

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Average EVM Level | Reference Signal EVM Level |
| QPSK | % | 17.5 | 17.5 |
| 16QAM | % | 12.5 | 12.5 |
| 64QAM | % | 8 | 8 |
| 256QAM | % | 3.5 | 3.5 |

Table 6.4E.2.1-2: Parameters for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| UE Output Power | dBm | ≥Table 6.4E.2.1-1 |
| UE Output Power for 256QAM | dBm | ≥ Table 6.4E.2.1-1 + 10dB |
| Operating conditions |  | Normal conditions |

#### 6.4E.2.2 Carrier leakage for NR 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.2.3 In-band emissions for NR 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 1 symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

#### 6.4E.2.4 EVM equalizer spectrum flatness for NR V2X

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

## *<< Unchanged sections are omitted >>*

## 6.5 Output RF spectrum emissions

### 6.5.1 Occupied bandwidth

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.5.1-1.

Table 6.5.1-1: Occupied channel bandwidth

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | NR channel bandwidth | | | | | | | | | | | |
| 5 MHz | 10 MHz | | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| **Occupied channel bandwidth (MHz)** | 5 | 10 | | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

### 6.5.2 Out of band emission

#### 6.5.2.1 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.

### *<< Unchanged sections are omitted >>*

### 6.5.3 Spurious emissions

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.

##### 6.5.3.1 General spurious emissions

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1-2 apply for all transmitter band configurations (NRB) and channel bandwidths.

Table 6.5.3.1-1: Boundary between NR out of band and general spurious emission domain

|  |  |
| --- | --- |
| Channel bandwidth | OOB boundary FOOB (MHz) |
| BWChannel | BWChannel + 5 |

Table 6.5.3.1-2: Requirement for general spurious emissions limits

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | Maximum Level | Measurement bandwidth | NOTE |
| 9 kHz ≤ f < 150 kHz | -36 dBm | 1 kHz |  |
| 150 kHz ≤ f < 30 MHz | -36 dBm | 10 kHz |  |
| 30 MHz ≤ f < 1000 MHz | -36 dBm | 100 kHz |  |
| 1 GHz ≤ f < 12.75 GHz | -30 dBm | 1 MHz |  |
| -25 dBm | 1 MHz | 3 |
| 12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz | -30 dBm | 1 MHz | 1 |
| 12.75 GHz < f < 26 GHz | -30 dBm | 1 MHz | 2 |
| NOTE 1: Applies for Band that the upper frequency edge of the UL Band more than 2.69 GHz  NOTE 2: Applies for Band that the upper frequency edge of the UL Band more than 5.2 GHz  NOTE 3: Applies for Band n41, CA configurations including Band n41, and EN-DC configurations that include n41 specified in clause 5.2B of TS 38.101-3 [3] when NS\_04 is signalled. | | | |

##### 6.5.3.2 Spurious emissions for UE co-existence

This clause specifies the requirements for NR bands for coexistence with protected bands.

Table 6.5.3.2-1: Requirements for spurious emissions for UE co-existence

| NR Band | Spurious emission for UE co-existence | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| n1, n84 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76,  NR Band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 15, 27 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 15, 26, 27 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 15, 26, 27 |
| n2 | E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 48, 50, 51, 53, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| n3, n80 | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 41, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73,74, 75, 76.  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 13 |
| E-UTRA Band 22, 42, 52,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |
| n5, n89 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 18, 19, 24, 25, 26, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 50, 51, 53, 65, 66, 70, 71, 73, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 39 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8,39 |
| n7 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 20, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 66, 67, 68, 72, 74, 75, 76, 85,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 15, 21, 26 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 15, 21, 26 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 15, 21 |
| n8, n81 | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3, 7, 22, 41, 42, 43, 52,  NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA 8 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| n12 | E-UTRA Band 2, 5, 13, 14, 17, 24, 25, 26, 27, 30, 41, 48, 50, 51, 53, 71, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10, 66, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 12, 85 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| n14 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 23, 24, 25, 26, 27, 29, 30, 41, 48, 53, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 769 | - | 775 | -35 | 0.00625 | 12, 15 |
| Frequency range | 799 | - | 805 | -35 | 0.00625 | 11, 12, 15 |
| n18 | E-UTRA Band 1, 3, 11, 21, 34, 42, 65  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 758 | - | 799 | -50 | 1 |  |
| Frequency range | 799 | - | 803 | -40 | 1 |  |
| Frequency range | 860 | - | 890 | -40 | 1 |  |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 2545 | - | 2575 | -50 | 1 |  |
| Frequency range | 2595 | - | 2645 | -50 | 1 |  |
| n20, n82 | E-UTRA Band 1, 3, 7, 8, 22, 31, 32, 33, 34, 40, 42, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 20 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 38, 42, 69,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 758 | - | 788 | -50 | 1 |  |
| n25 | E-UTRA Band 4, 5, 10,12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 48, 53, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 25 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| n28, n83 | E-UTRA Band 1, 4, 10, 22, 32, 42, 43, 50, 51, 52, 65, 66, 73, 74, 75, 76,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 1 | FDL\_low | - | FDL\_high | -50 | 1 | 19, 25 |
| E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 40, 41, 66, 72,  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 19, 24 |
| Frequency range | 470 | - | 694 | -42 | 8 | 15, 35 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 34 |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
| Frequency range | 758 | - | 773 | -32 | 1 | 15 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 19 |
| n30 | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 24, 25, 26, 27, 29, 30, 38, 41, 48, 53, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| n34 | E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 26, 28, 31, 32, 33, 38,39, 40, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 69, 72, 74, 75, 76,  NR Band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| n38 | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 66, 67, 68, 72, 74, 75, 76, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 15, 22, 26 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 15, 22 |
| n39 | E-UTRA Band 1, 8, 22, 26, 34, 40, 41, 42, 44, 45, 50, 51, 52, 74,  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1805 | - | 1855 | -40 | 1 | 33 |
| Frequency range | 1855 | - | 1880 | -15.5 | 5 | 15, 26, 33 |
| n40 | E-UTRA Band 1, 3, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 33, 34, 38, 39, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 74, 75, 76,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| n41 | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 34, 39, 42, 44, 45, 48, 50, 51, 52, 65, 66, 70, 71, 73, 74, 85,  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 9, 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 30 |
| Frequency range | 1884.5 |  | 1915.7 | -41 | 0.3 | 8, 30 |
| n47 | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 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 |  |
| Frequency range | 5925 | - | 5950 | -30 EIRP | 1 | 43,44,45 |
| Frequency range | 5815 | - | 5855 | -30 EIRP | 1 | 43,45,46 |
| n48 | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 50, 51, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| n50 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 65, 66, 67, 68 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| n51 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 52, 65, 66, 67, 68, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| n65 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 50, 51, 65, 68, 69, 72, 74, 75, 76,  NR Band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 34 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 1900 | - | 1915 | -15.5 | 5 | 15, 26, 27 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 15, 26, 27 |
| n66, n86 | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 25, 26, 27, 28, 29, 30, 38, 41, 43, 50, 51, 53, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42, 48 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| n70 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| n71 | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 53, 66, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 15 |
| E-UTRA Band 71 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| n74 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 52, 65, 66, 67, 68, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| Frequency range | 1400 | - | 1427 | -32 | 27 | 15, 41 |
| Frequency range | 1475 | - | 1488 | -50 | 1 | 42 |
| Frequency range | 1488 | - | 1518 | -50 | 1 | 15 |
| n77, n78 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| n79 | E-UTRA Band 1, 3, 5, 8, 11, 18, 19, 21, 28, 34, 39, 40, 41, 42, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| n95 | E-UTRA Band 1, 3 , 5, 8, 39, 40, 41,  NR Band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. 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 (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: 15 kHz SCS is assumed when RB is mentioned in the note when channel bandwidth is less than or equal to 50 MHz, lowest SCS is assumed when channel bandwidth is larger than 50 MHz. The transmission bandwidth in terms of RB position and range is not limited to 15 kHz SCS and shall scale with SCS accordingly.  NOTE 4: Void  NOTE 5: For non-synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band  NOTE 6: N/A  NOTE 7: Void  NOTE 8: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz.  NOTE 9: Void  NOTE 10: Void  NOTE 11: Void  NOTE 12: The emissions measurement shall be sufficiently power averaged to ensure a standard deviation < 0.5 dB  NOTE 13: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.  NOTE 14: Void  NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 16: Void  NOTE 17: Void  NOTE 18: Void  NOTE 19: Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 20: Void  NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 22: This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS\_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE P-Max.  NOTE 23: Void  NOTE 24: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 27: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 28: Void  NOTE 29: Void  NOTE 30: This requirement applies when the NR carrier is confined within 2545 – 2575 MHz or 2595 – 2645 MHz and the channel bandwidth is 10 or 20 MHz  NOTE 31: Void  NOTE 32: Void  NOTE 33: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz. For 25 MHz, 30 MHz, and 40 MHz channel bandwidths, NS\_45 shall apply.  NOTE 34: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718-728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart < 48.  NOTE 35: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.  NOTE 36: Void  NOTE 37: Void  NOTE 38: Void  NOTE 39: Void  NOTE 40: Void  NOTE 41: Applicable for cases and when the lower edge of the assigned NR UL channel bandwidth frequency is greater than or equal to 1427 MHz + the channel BW assigned for 5 and 10 MHz bandwidth, and when the lower edge of the assigned NR UL channel bandwidth frequency is greater than or equal to 1440 MHz for 15 and 20 MHz bandwidth.  NOTE 42: Applicable for 5 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1467 MHz assigned for 10 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1463.8 MHz for 15 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1460.8 MHz for 20 MHz bandwidth.  NOTE 43:Applicable when NS\_33 or NS\_34 or NS\_48 is configured by the pre-configured radio parameters.  NOTE 44: 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 45: 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 G.  NOTE 46: 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. | | | | | | | |

NOTE: To simplify Table 6.5.3.2-1, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.

When "NS\_33" or “NS\_34” or “NS\_48” 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 set of conditions.

Table 6.5.3.2-2: Requirements for spurious emissions to protect CEN DSRC for NR V2X UE

|  |  |  |
| --- | --- | --- |
|  | Maximum Transmission Power (dBm EIRP) | Emission Limit in Frequency Range 5795-5815 (dBm/MHz EIRP) |
| Condition 1 | 10 | -65 |
| Condition 2 | 10 | -45 |

### *<< Unchanged sections are omitted >>*

### 6.5.4 Transmit intermodulation

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

UE transmit intermodulation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal at each transmitter antenna port with the other antenna port(s) if any terminated. Both the wanted signal power and the intermodulation product power are measured through NR rectangular filter with measurement bandwidth shown in Table 6.5.4-1.

The requirement of transmit intermodulation is specified in Table 6.5.4-1.

Table 6.5.4-1: Transmit Intermodulation

|  |  |  |
| --- | --- | --- |
| Wanted signal  channel bandwidth | BWChannel | |
| Interference signal  frequency offset from channel center | BWChannel | 2\*BWChannel |
| Interference CW signal level | -40 dBc | |
| Intermodulation product | < -29 dBc | < -35 dBc |
| Measurement bandwidth | The maximum transmission bandwidth configuration among the different SCS's for the channel BW as defined in Table 6.5.2.4.1-1 | |
| Measurement offset from channel center | BWChannel and 2\*BWChannel | 2\*BWChannel and 4\*BWChannel |

### *<< Unchanged sections are omitted >>*

## 6.5E Output RF spectrum emissions for NR V2X

### 6.5E.1 Occupied bandwidth for NR V2X

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

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

#### 6.5E.2.1 Spectrum emission mask

For NR V2X UE, the existing NR general spectrum emission mask in subclause 6.5.2.2 applied 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.

#### 6.5E.2.2 Additional Spectrum emission mask

##### 6.5E.2.2.1 Requirements for network signalled 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 G.

##### 6.5E.2.2.2 Requirements for network signalled value "NS\_48"

The additional spectrum mask in Table 6.5E.2.2.2-1 applies for NR V2X UE within 5 765 MHz to 6 005 MHz according to FCC regualtion. 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\_48" 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.2.2.2-1.

Table 6.5E.2.2.2-1: 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 Adjacent channel leakage ratio

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 subclause 6.5.2.4 are applied for NR V2X UE for NR V2X operating bands in 5.2E-1.

### 6.5E.3 Spurious emissions for NR 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 Table 5.2E-1, the general spurious emission requirements in subclause 6.5.3.1 apply for NR V2X sidelink transmission.

#### 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 Table 5.2E-1, the requirements in subclause 6.5.3.2 apply for NR V2X sidelink transmission.

### *<< Unchanged sections are omitted >>*

### 6.5E.4 Transmit intermodulation

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

### *<< Unchanged sections are omitted >>*

Annex G (normative):

## Supported Post Antenna Gain

## G.1 Declared Supported Post Antenna Gain for UE

For NR V2X service at NR band n47, some regional requirements (region 1) are defined per effective isotropic radiated power (EIRP), which is a combination of the transmitted power (or in some cases spectral density) and the effective antenna gain.

Due to large form factor, NR V2X UE can have external antenna placed far away from the chipset unit. In this case, the effective antenna gain is a UE specific condition. This effective antenna gain includes the feeding loss of all components after the chipset unit antenna connector and the peak directional gain of the external antenna and hence will be call the post connector gain Gpost connector.

The 3GPP specifications mandate UE manufacturer declarations of at least one supported value of the post connector gain Gpost connector as a way to accommodate the refered regional requirement without putting requirements on the UE specific condtion.

The possible values of declared supported post connector gains are: 0, 1, 2, 3, 4, 5, 6, 7 dBi. If no value is declared, or if external antenna is not used, the default value of 0dBi will be used.

The regional requirements in PEIRP in Subclauses 6.2.2G, 6.2.5G, 6.6.2.2.4, 6.6.3.2 and 7.9.1 will be converted to conducted requirements by subtracting Gpost connector as.

PConducted = PEIRP - Gpost connector.

## *<< End of changes >>*