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| 3GPP TS 38.101-5 V0.1.0 (2022-03) | |
| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  <NR;  User Equipment (UE) radio transmission and reception;  Part 5: Satellite access Radio Frequency (RF) and performance requirements  (Release 17) | |
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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document establishes the minimum RF and performance requirements for NR User Equipment (UE) supporting satellite access operation.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone".

[3] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[4] 3GPP TS 38.108: "NR; Satellite Node radio transmission and reception"

[5] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[6] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

[7] 3GPP TS 38.213: "NR; Physical layer procedures for control"

[8] 3GPP TS 38.331: “Radio Resource Control (RRC) protocol specification”

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms 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].

**Feeder link:** Wireless link between NTN-Gateway and satellite.

**Geosynchronous Earth Orbit:** Earth-centered orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth’s equator plane.

**Low Earth Orbit:** Orbit around the Earth with an altitude between 300 km, and 1500 km.

**Minimum Elevation angle**: Minimum angle under which the satellite can be seen by a UE.

**Non-Geostationary Satellites:** Satellites (LEO and MEO) orbiting around the Earth with a period that varies approximately between 1.5 hour and 10 hours. It is necessary to have a constellation of several Non-Geostationary satellites associated with handover mechanisms to ensure a service continuity.

**Non-terrestrial networks:** Networks, or segments of networks, using an airborne or space-borne vehicle to embark a transmission equipment relay node or base station.

**NTN-Gateway:** An earth station or gateway is located at the surface of Earth, and providing sufficient RF power and RF sensitivity for accessing to the satellite.

**Satellite:** A space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO), Medium-Earth Orbit (MEO), or Geostationary Earth Orbit (GEO).

**Service link:** Radio link between SAN and NTN satellite UE.

**Transparent payload:** Payload that changes the frequency carrier of the UL/DL RF signal, filters and amplifies it before transmitting it on the DL/UL, respectively.

**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.

**User Throughput:** data rate provided to a terminal.

## 3.2 Symbols

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

ΔFGlobal Granularity of the global frequency raster

BWChannel Channel bandwidth

BWinterferer Bandwidth of the interferer

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*

FInterferer Frequency of the interferer

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

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

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

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

NRB Transmission bandwidth configuration, expressed in units of resource blocks

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

NREF-Offs Offset used for calculating NREF

PInterferer Modulated mean power of the interferer

Puw Power of an unwanted DL signal

[To be added]

## 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

BW Bandwidth

BWP Bandwidth Part

CG Carrier Group

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

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

DM-RS Demodulation Reference Signal

DTX Discontinuous Transmission

EIRP Equivalent Isotropically Radiated Power

EVM Error Vector Magnitude

FR Frequency Range

FRC Fixed Reference Channel

FRF Frequency Reuse Factor

FSS Fixed Satellite Services

FWA Fixed Wireless Access

GEO Geosynchronous Earth Orbit

GW Gateway

GSCN Global Synchronization Channel Number

IBB In-band Blocking

IDFT Inverse Discrete Fourier Transformation

ISL Inter-Satellite Links

ITU‑R Radiocommunication Sector of the International Telecommunication Union

LEO Low Earth Orbiting

Mbps Mega bit per second

MBW Measurement bandwidth defined for the protected band

MCG Master Cell Group

MEO Medium Earth Orbiting

MOP Maximum Output Power

MPR Allowed maximum power reduction

MS Mobile Services

MSD Maximum Sensitivity Degradation

MSS Mobile Satellite Services

NGEO Non-Geostationary Earth Orbiting

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NS Network Signalling

NTN Non-Terrestrial Network

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

RAN Radio Access Network

RE Resource Element

REFSENS Reference Sensitivity

RF Radio Frequency

RMS Root Mean Square (value)

RSRP Reference Signal Receive Power

RSRQ Reference Signal Receive Quality

Rx Receiver

SAN Satellite Access Node

SC Single Carrier

SCG Secondary Cell Group

SCS Subcarrier spacing

SEM Spectrum Emission Mask

SNR Signal-to-Noise Ratio

SRS Sounding Reference Symbol

SS Synchronization Symbol

TAE Time Alignment Error

TAG Timing Advance Group

TN Terrestrial Network

Tx Transmitter

TxD Tx Diversity

UE User Equipment

ULFPTx Uplink Full Power Transmission

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT specification for satellite 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 [2].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-1 [2] 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 [3].

## 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.

## 4.3 Specification suffix information

Specification suffix information is not defined for the time being in Release-17.

## 4.4 Relationship with other core specifications

The present document establishes the minimum RF and performance requirements for NR User Equipment (UE) operating in a Non-Terrestrial Network. The present document for the single-RAT specification of a satellite NR UE side is used together with the Technical Specification TS 38.108 [4] specifying the Satellite Access Node (SAN).

# 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 NTN satellite 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 |

The present specification covers FR1 operating bands.

## 5.2 Operating bands

### 5.2.1 General

NTN satellite covers FR1 operating bands in the present specification.

### 5.2.2 Operating bands with conducted requirements

NTN satellite is designed to operate in the operating bands defined in Table 5.2.2-1.

Table 5.2.2-1: NTN satellite bands in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| **NTN satellite operating band** | Uplink (UL) operating band Satellite Access Node receive / UE transmit  **FUL,low – FUL,high** | Downlink (DL) operating band Satellite Access Node transmit / UE receive  **FDL,low – FDL,high** | **Duplex mode** |
| n256 | 1980MHz – 2010 MHz | 2170 MHz – 2200 MHz | FDD |
| n255 | 1626.5 MHz – 1660.5 MHz | 1525 MHz – 1559 MHz | FDD |
| NOTE: NTN satellite bands are numbered in descending order from n256. | | | |

### 5.2.3 reserved (for radiated requirements)

[To be updated]

## 5.3 UE channel bandwidth

5.3.1 General

The UE channel bandwidth supports a single RF carrier in the uplink or downlink at the UE. From a SAN perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the SAN.

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 SAN channel bandwidth or how the SAN 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 SAN 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 channel

5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration NRB for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

**Table 5.3.2-1: Maximum transmission bandwidth configuration NRB**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz |
| NRB | NRB | NRB | NRB |
| 15 | 25 | 52 | 79 | 106 |
| 30 | 11 | 24 | 38 | 51 |
| 60 | N/A | 11 | 18 | 24 |

5.3.3 Minimum guardband and transmission bandwidth configuration

The minimum guardband for each UE channel bandwidth and SCS is specified in Table 5.3.3-1,

**Table 5.3.3-1: Minimum guardband for each UE channel bandwidth and SCS (kHz)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz |
| 15 | 242.5 | 312.5 | 382.5 | 452.5 |
| 30 | 505 | 665 | 645 | 805 |
| 60 | N/A | 1010 | 990 | 1330 |

NOTE: The minimum guardbands have been calculated using the following equation: (BWChannel x 1000 (kHz) - NRB x SCS x 12) / 2 - SCS/2, where NRB are from Table 5.3.2-1.

Figure 5.3.3-1: Void

The number of RBs configured in any channel bandwidth shall ensure that the minimum guardband specified in this clause is met.

Minimum guardband

All PRBs falling within UE channel bandwidth not covering the minimum guardband can be used

UE channel BW

f

Figure 5.3.3-2: UE PRB utilization

In the case that multiple numerologies are multiplexed in the same symbol, the minimum guard band on each side of the carrier is the guard band applied at the configured SAN channel bandwidth for the numerology that is transmitted/received immediately adjacent to the guard band.

SAN channel BW

Guardband defined for numerology X when transmitted across full SAN channel BW

Guardband defined for numerology Y when transmitted across full SAN channel BW

Numerology X

Numerology Y

Figure 5.3.3-2: Guard band definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-2 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guard band within the carrier is implementation dependent.

5.3.4 RB alignment

The RB alignment refers to NR RB alignments as specified in TS 38.101-1 [5] clause 5.3.4.

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 NTN satellite band**

| NTN satellite band | SCS  kHz | UE Channel bandwidth (MHz) | | | |
| --- | --- | --- | --- | --- | --- |
| 5 | 10 | 15 | 20 |
|  | 15 | 5 | 10 | 15 | 20 |
| n256 | 30 |  | 10 | 15 | 20 |
|  | 60 |  | 10 | 15 | 20 |
|  | 15 | 5 | 10 | 15 | 20 |
| n255 | 30 |  | 10 | 15 | 20 |
|  | 60 |  | 10 | 15 | 20 |

## 5.4 Channel arrangement

5.4.1 Channel spacing

5.4.1.1 Channel spacing for adjacent NTN satellite carriers

The channel spacing for adjacent NTN satellite carriers refers to the NR channel spacing as specified in TS 38.101-1 [5] clause 5.4.1.1.

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 |

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.

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 refers to the NR requirements specified in TS 38.101-1 [5] clause 5.4.2.2.

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

The RF channel positions on the channel raster in each NTN satellite 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 NTN satellite 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>.

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

|  |  |  |  |
| --- | --- | --- | --- |
| **NTN satellite operating band** | **ΔFRaster**  **(kHz)** | **Uplink**  **Range of NREF**  **(First – <Step size> – Last)** | **Downlink**  **Range of NREF**  **(First – <Step size> – Last)** |
| n256 | 100 | 396000 – <20> – 402000 | 434000 – <20> – 440000 |
| n255 | 100 | 325300 – <20> – 332100 | 305000 – <20> – 311800 |
| NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. | | | |

5.4.3 Synchronization raster

#### 5.4.3.1 Synchronization raster and numbering

The synchronization raster indicates the frequency positions of the synchronization block that can be used by the UE for system acquisition when explicit signalling of the synchronization block position is not present.

A global synchronization raster is defined for all frequencies. The frequency position of the SS block is defined as SSREF with corresponding number GSCN. The parameters defining the SSREF and GSCN for all the frequency ranges are in Table 5.4.3.1-1.

The resource element corresponding to the SS block reference frequency SSREF is given in clause 5.4.3.2. The synchronization raster and the subcarrier spacing of the synchronization block is defined separately for each band.

**Table 5.4.3.1-1: GSCN parameters for the global frequency raster**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | **SS Block frequency position SSREF** | **GSCN** | **Range of GSCN** |
| 0 – 3000 MHz | N \* 1200kHz + M \* 50 kHz,  N=1:2499, M ϵ {1,3,5}1 | 3N + (M-3)/2 | 2 – 7498 |
| NOTE 1: The default value for operating bands with which only support SCS spaced channel raster(s) is M=3. | | | |

#### 5.4.3.2 Synchronization raster to synchronization block resource element mapping

The mapping between the synchronization raster and the corresponding resource element of the SS block refers to TS 38.101-1 [5] clause 5.4.3.2.

#### 5.4.3.3 Synchronization raster entries for each operating band

The synchronization raster for each band is give in Table 5.4.3.3-1. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1.

**Table 5.4.3.3-1: Applicable SS raster entries per operating band**

|  |  |  |  |
| --- | --- | --- | --- |
| **NTN satellite operating band** | **SS Block SCS** | **SS Block pattern1** | **Range of GSCN**  **(First – <Step size> – Last)** |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
| 30 kHz | Case B | 3824 – <1> – 3886 |
| NOTE 1: SS Block pattern is defined in clause 4.1 in TS 38.213 [7]. | | | |

### 5.4.4 TX–RX frequency separation

The default TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation for operating bands is specified in Table 5.4.4-1.

Table 5.4.4-1: UE TX-RX frequency separation

| **NTN Satellite Operating Band** | **TX – RX  carrier centre frequency separation** |
| --- | --- |
| n256 | 190 MHz |
| n255 | -101.5 MHz |

# 6 Conducted transmitter characteristics

## 6.1 General

Unless otherwise stated, the transmitter characteristics for satellite access UEs 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. Handheld power class 3 UE is assumed in Rel-17 for satellite access.

## 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

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  | | |

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  | | |

### 6.2.2 UE maximum output power reduction

UE is allowed to reduce the maximum output power due to higher order modulations and transmit bandwidth configurations. For UE power class 3, the allowed maximum power reduction (MPR) is defined as Table 6.2.2-1 in TS 38.101-1[5] clause 6.2.2.

### 6.2.3 UE additional maximum output power reduction

#### 6.2.3.1 General

Additional emission requirements can be signalled by the network. Each additional emission requirement is associated with a unique network signalling (NS) value indicated in RRC signalling by an NR frequency band number of the applicable operating band and an associated value in the field *additionalSpectrumEmission.* Throughout this specification, the notion of indication or signalling of an NS value refers to the corresponding indication of an NR satellite band number of the applicable operating band, the IE field *freqBandIndicatorNR* and an associated value of *additionalSpectrumEmission* in the relevant RRC information elements [6]*.*

To meet the additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in Table 6.2.1-1. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPR is defined in clause 6.2.2. Outer and inner allocation notation used in clause 6.2.3 is defined in TS 38.101-1 [5] clause 6.2.2. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

Table 6.2.3.1-1 specifies the additional requirements with their associated network signalling values and the allowed A-MPR and applicable operating band(s) for each NS value. The mapping of NR satellite band numbers and values of the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2.3.1-1A.

Table 6.2.3.1-1: Additional maximum power reduction (A-MPR)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network signalling label | Requirements (clause) | NR satellite Band | Channel bandwidth (MHz) | Resources blocks (*N*RB) | A-MPR (dB) |
| NS\_01 |  | Table 5.2-1 | 5, 10, 15, 20 | Table 5.3.2-1 in TS 38.101-1 [5] | N/A |
| NS\_24 | 6.5.3.3.13 in TS 38.101-1 [5] | n256 | 5, 10, 15, 20 | Table 6.2.3.15-1 in TS 38.101-1 [5] | Clause 6.2.3.7 in TS 38.101-1 [5] |
| NS\_57 | 6.5.3.3.1 | n255 | 5, 10, 15, 20 |  | TBD |
| NS\_100 | 6.5.2.4.2 in TS 38.101-1 [5] | n2561 |  |  | Table  6.2.3.1-2 in TS 38.101-1 [5] |
| NOTE 1: This NS can be signalled for NR bands that have UTRA services deployed. | | | | | |

[The NS\_01 label with the field *additionalPmax* [8] absent is default for all NR bands.]

Table 6.2.3.1-1A: Mapping of network signalling label

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR satellite band | Value of additionalSpectrumEmission | | | | | | | |
|  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| n256 | NS\_01 | NS\_24 | NS\_100 |  |  |  |  |  |
| n255 | NS\_01 | NS\_57 |  |  |  |  |  |  |
| NOTE: *additionalSpectrumEmission* corresponds to an information element of the same name defined in clause 6.3.2 of TS 38.331 [8]. | | | | | | | | |

### 6.2.4 Configured transmitted power

The requirements for configured transmitted power defined in subclause 6.2.4 of TS 38.101-1 [5] clause 6.2.4 are applied to NTN satellite UE.

## 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 |

### 6.3.2 Transmit OFF power

Transmit OFF power is defined as the mean power in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

The transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1 ms) excluding any transient periods. The transmit OFF power shall not exceed the values specified in Table 6.3.2-1.

Table 6.3.2-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth | (MHz) | 5, 10, 15, 20 |
| REF\_SCS | (kHz) | 15 |
| Transmit OFF power | (dBm) | -50 |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 |

### 6.3.3 Transmit ON/OFF time mask

The requirements for transmit ON/OFF time mask defined in TS 38.101-1 [5] clause 6.3.3 are applied for NTN satellite UE.

### 6.3.4 Power control

The requirements for Power control defined in TS 38.101-1 [5] clause 6.3.4 are applied for NTN satellite UE.

## 6.4 Transmit signal quality

### 6.4.1 Frequency error

The requirements for frequency error defined in TS 38.101-1 [5] clause 6.4.1 are applied for NTN satellite UE.

### 6.4.2 Transmit modulation quality

The requirements for transmit modulation quality defined in TS 38.101-1 [5] clause 6.4.1 are applied for NTN satellite UE except for the requirements for Pi/2 BPSK modulation.

## 6.5 Output RF spectrum emissions

### 6.5.1 Occupied bandwidth

[To be updated]

### 6.5.2 Out of band emission

[To be updated]

### 6.5.3 Spurious emission

#### 6.5.3.1 “reserved”

[To be updated]

#### 6.5.3.2 “reserved”

[To be updated]

#### 6.5.3.3 Additional spurious emissions

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

##### 6.5.3.3.1 Requirement for network signalling value "NS\_57"

When "NS 57" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.1-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.

Table 6.5.3.3.1-1: Additional requirements for "NS\_57"

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency band  (MHz) | Channel bandwidth / Spectrum emission limit1 (dBW) | Measurement bandwidth | NOTE |
| 5 MHz, 10 MHz, 15 MHz, 20 MHz |
| 1559≤ f ≤ 1605 | -80 | 700 Hz | Averaged over any 2 millisecond active transmission interval |
| 1605≤ f ≤ 1610 | -80 + 24/5 (f-1605) | 700Hz |  |
| 1559 ≤ f ≤ 1605 | -70 | 1MHz | Averaged over any 2 millisecond active transmission interval |
| 1605≤ f ≤ 1610 | -70 + 24/5 (f-1605) | 1MHz |  |
| NOTE 1: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna. | | | |

### 6.5.4 Transmit intermodulation

[To be updated]

# 7 Conducted receiver characteristics

## 7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna. For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective clauses below.

With the exception of clause 7.3, the requirements shall be verified with the network signalling value NS\_01 configured in Table 6.2.3.1-1.

All the parameters in clause 7 are defined using the UL reference measurement channels specified in TS 38.101-1 [5] Annex A.2.2, the DL reference measurement channels specified in TS 38.101-1[5] Annex A.3.2 and using the set-up specified in TS 38.101-1 [5] Annex C.3.1.

## 7.2 Diversity characteristics

The UE is required to be equipped with a minimum of two Rx antenna ports in all operating bands.

The UE shall be verified with two Rx antenna ports in all supported frequency bands.

The above rules apply for all clauses with the exception of clause 7.9.

## 7.3 Reference sensitivity

### 7.3.1 General

[To be updated]

### 7.3.2 Reference sensitivity power level

[To be updated]

## 7.4 Maximum input level

Maximum input level is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel. The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in TS 38.101-1 [5] Annexs A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in TS 38.101-1 [5] Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4-1.

Table 7.4-1: Maximum input level

|  |  |  |
| --- | --- | --- |
| **Rx Parameter** | **Units** | **Channel bandwidth (MHz)** |
| **5, 10, 15, 20** |
| Power in Transmission Bandwidth Configuration3 | dBm | -402 |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum uplink configuration specified in Table 7.3.2-3 with PCMAX\_L,f,c as defined in clause 6.2.4.  NOTE 2: Reference measurement channel is A.3.2.3 or A.3.3.3 for 64 QAM.  NOTE 3: Power in transmission bandwidth configuration value is rounded to the nearest 0.5dB value. | | |

## 7.5 Adjacent channel selectivity

Adjacent channel selectivity (ACS) is a measure of a receiver's ability to receive an NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

In release 17, only frequency bands below 2.7GHz are considered. The NR satellite UE shall fulfil the minimum requirements specified in Table 7.5-1 for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz. These requirements apply for all values of an adjacent channel interferer in case 1 and for any SCS specified for the channel bandwidth of the wanted signal. The lower and upper range of test parameters are chosen as in Table 7.5-2 and Table 7.5-3 for verification of the requirements specified in Table 7.5-1. For these test parameters, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in TS 38.101-1 [5] Annexes A.2.2, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in TS 38.101-1 [5] Annex A.5.1.1/A.5.2.1).

Table 7.5-1: ACS for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) | | |
| 5, 10 | 15 | 20 |
| ACS | dB | 33 | 30 | 27 |

Table 7.5-2: Test parameters for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz, case 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) | | |
| 5, 10 | 15 | 20 |
| Power in transmission bandwidth configuration | dBm | REFSENS + 14 dB | | |
| Pinterferer4 | dBm | REFSENS + 45.5 dB | REFSENS + 42.5 dB | REFSENS + 39.5 |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset)2 | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.  NOTE 3: The interferer consists of the NR interferer RMC specified in TS 38.101-1 [5] Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in TS 38.101-1 [5] Annex A.5.1.1/A.5.2.1.  NOTE 4: Pinterferer shall be rounded to the next higher 0.5dB value. | | | | |

Table 7.5-3: Test parameters for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz, case 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) | | |
| 5, 10 | 15 | 20 |
| Power in transmission bandwidth configuration | dBm | -71.5 | -68.5 | -65.5 |
| Pinterferer | dBm | -40 | | |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset) | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 24 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.  NOTE 3: The interferer consists of the NR interferer RMC specified in TS 38.101-1 [5] Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in TS 38.101-1 [5] Annex A.5.1.1/A.5.2.1.  NOTE 4: Pinterferer shall be rounded to the next higher 0.5dB value. | | | | |

## 7.6 Blocking characteristics

### 7.6.1 General

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

In release 17, channel bandwidth less than 25MHz are applicable.

### 7.6.2 In-band blocking

unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band.

The throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in TS 38.101-1 [5] Annexes A.2.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.2-1 and Table 7.6.2-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

**Table 7.6.2-1: In-band blocking parameters for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration3 | dBm | REFSENS + 6 dB | REFSENS + 7 dB | REFSENS + 9 dB |
| BWinterferer | MHz | 5 | | |
| FIoffset, case 1 | MHz | 7.5 | | |
| FIoffset, case 2 | MHz | 12.5 | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The interferer consists of the RMC specified in TS 38.101-1 [5] Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and 15 kHz SCS.  NOTE 3: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value. | | | | |

Table 7.6.2-2: In-band blocking for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Parameter | Unit | Case 1 | Case 2 |
|  | Pinterferer | dBm | -56 | -44 |
|  | Finterferer (offset) | MHz | -BWChannel/2 –  FIoffset, case 1  and  BWChannel/2 +  FIoffset, case 1 | ≤ -BWChannel/2 –  FIoffset, case 2  and  ≥ BWChannel/2 +  FIoffset, case 2 |
| n255,  n256 | Finterferer | MHz | NOTE 2 | FDL\_low – 15  to  FDL\_high + 15 |
| NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.  NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -BWChannel/2 – FIoffset, case 1; b: BWChannel/2 + FIoffset, case 1 | | | | |

### 7.6.3 Out-of-band blocking

For NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band.

The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in TS 38.101-1 [5] Annexes A.2.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3-1 and Table 7.6.3-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

**Table 7.6.3-1: Out-of-band blocking parameters for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration2 | dBm | REFSENS + 6 dB | REFSENS + 7 dB | REFSENS + 9 dB |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value. | | | | |

Table 7.6.3-2: Out of-band blocking for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | Range 1 | Range 2 | Range 3 |
|  | Pinterferer | dBm | -44 | -30 | -15 |
| n255,  n256 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15  or  15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60  or  60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85  or  FDL\_high + 85 ≤ f  ≤ 12750 |
| NOTE 1: For band n256 in Range 2 requirement, the applicable lower frequency range should be modified as -[145] < f – FDL\_low ≤ -60.  NOTE 2: For band n256 in Range 3 requirement, the applicable lower frequency range should be modified as 1 ≤ f ≤ FDL\_low – [145]  NOTE 3: For band n256 in Range 2 requirement, the Pinterferer should be modified as [-30]  NOTE 4: For band n256 in Range 3 requirement, the Pinterferer should be modified as [-15] | | | | | |

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-1, a maximum of



exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of MHz withthe number of resource blocks in the downlink transmission bandwidth configuration, BWChannelthe bandwidth of the frequency channel in MHz and *n* = 1, 2, 3 for SCS = 15, 30, 60 kHz, respectively. For these exceptions, the requirements in clause 7.7 apply.

### 7.6.4 Narrow band blocking

This requirement is measure of a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing. The relative throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in TS 38.101-1 [5] Annexes A.2.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.4-1.

Table 7.6.4-1: Narrow Band Blocking

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | Channel Bandwidth (MHz) | | | |
|  |  |  | 5 | 10 | 15 | 20 |
| n255,  n256 | Pw | dBm | PREFSENS + channel-bandwidth specific value below | | | |
|  |  | 16 | 13 | 14 | 16 |
| Puw (CW) | dBm | -55 | | | |
| Fuw (offset SCS= 15 kHz) 4 | MHz |  | | | |
| Fuw (offset SCS= 30 kHz)4 | MHz | NA | | | |
| NOTE 1: The transmitter shall be set a 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4  NOTE 2: The PREFSENS power level is specified in clause 7.3.2.  NOTE 3: Fuw shall be rounded to half of SCS. | | | | | | |

## 7.7 Spurious response

Spurious response is a measure of the ability of the receiver to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency for which a response is obtained, i.e. for which the out-of-band blocking limit as specified in clause 7.6.3 is not met.

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters for the wanted signal as specified in Table 7.7-1 for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz for the interferer as specified in Table 7.7-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.7-1: Spurious response parameters for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration2 | dBm | REFSENS + 6 dB | REFSENS +  7 dB | REFSENS + 9 dB |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2-3 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: Power in transmission bandwidth configuration value is rounded to the next higher 0.5dB value. | | | | |

Table 7.7-2: Spurious response

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer (CW) | dBm | -44 |
| FInterferer | MHz | Spurious response frequencies |

## 7.8 Intermodulation characteristics

The definition and requirements for intermodulation characteristics specified in TS 38.101-1 [5] clause 7.8 are applied for NTN satellite UE.

## 7.9 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9-1

Table 7.9-1: General receiver spurious emission requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Measurement  bandwidth | Maximum level | NOTE |
| 30 MHz ≤ f < 1 GHz | 100 kHz | -57 dBm |  |
| 1 GHz ≤ f ≤ 12.75 GHz | 1 MHz | -47 dBm |  |
| NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH as defined in TS 38.101-1 [5] Annex C.3.1. | | | |

# 8 Conducted performance requirements

## 8.1 General

## 8.2 Demodulation performance requirements

## 8.3 CSI reporting requirements

Annex <A> (normative):  
<Normative annex for a Technical Specification>

Start each annex on a new page.

Annexes are labelled A, B, C, etc. and designated either "normative" or "informative" depending on their content.

Normative annexes only to appear in Technical Specifications. Use style "Heading 8".

Annex <B> (informative):  
<Informative annex for a Technical Specification>

Informative annexes may appear in both Technical Specifications and Technical Reports. Use style "Heading 8" for use in TSs.

Informative annexes shall not contain requirements for the implementation of the Technical Specification.

Annex <X> (informative):  
Change history

This is the last annex for TS/TSs which details the change history using the following table.  
This table is to be used for recording progress during the WG drafting process till TSG approval of this TS/TR.  
For TRs under change control, use one line per approved Change Request  
Date: use format YYYY-MM  
CR: four digits, leading zeros as necessary  
Rev: blank, or number (max two digits)  
Cat: use one of the letters A, B, C, D, F  
Subject/Comment: for TSs under change control, include full text of the subject field of the Change Request cover  
New vers: use format [n]n.[n]n.[n]n

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2022-01 | RAN4#101-bis-e | R4-2203086 |  |  |  | Draft skeleton approved | 0.0.1 |
| 2022-03 | RAN4#102-e | R4-2207514 |  |  |  | Added approved TPs in RAN4#102-e including:  R4-2207332, R4-2207334, R4-2207343, R4-2207344, R4-2207391, R4-2207393, R4-2207394, R4-2207396, R4-2207400, R4-2207404, R4-2207405, R4-2207410, R4-2207411, R4-2207413, R4-2207415 | 0.1.0 |