**3GPP TSG-RAN4 Meeting #109[R4-2321202](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321202.zip)**

**Chicago, USA, 13th – 17th November 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.106** | **CR** |  | **rev** |  | **Current version:** | **18.2.0** |  |
|  | | | | | | | | |
| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm" \l "_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm" \l "_blank)*** *on using this form: comprehensive instructions can be found at  <http://www.3gpp.org/Change-Requests>.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Big CR to TS 38.106 Introduction of NCR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE Corporation | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_netcon\_repeater-Core | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To the capture the endorsed draft CR for NCR.  [R4-2321040](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321040.zip) CR for TS 38.106, Introduction of Operating band and channel arrangement for NCR  [R4-2321041](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321041.zip) Draft CR to 38.106: NCR conducted TX requirements  [R4-2321042](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321042.zip) Draft CR to TS 38.106: Clause 7 radiated requirement  [R4-2321043](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321043.zip) Draft CR of introduction of NCR into TS 38.106: Clause 1 ~4  [R4-2321044](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321044.zip) Draft CR for TS 38.106 to introduce conducted transmitter requirement for NCR-MT  [R4-2321045](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321045.zip) CR to TS 38.106 with Clause 9: conducted receiver requirement for NCR-MT  [R4-2321046](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321046.zip) Draft CR of introduction of NCR into TS 38.106: Clause 11  [R4-2321047](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321047.zip) Draft CR to TS 38.106: OTA TX requirements for NCR-MT | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | To introduce the NCR RF requirement into 38.106 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete requirement specification for NCR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 4, 5, 6,7 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS/TR 38.115-2 CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# 1 Scope

The present document establishes the minimum RF characteristics of NR Repeater and network controlled repeater. For network controlled repeater (NCR), requirements for NCR-Fwd and NCR-MT apply.

# 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 38.104: “NR; Base Station (BS) radio transmission and reception”.

[3] 3GPP TR 25.942: "RF system scenarios".

[4] Recommendation ITU-R SM.328: "Spectra and bandwidth of emissions".

[5] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".

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

[7] 3GPP TS 38.115-1: “NR; Repeater conformance testing - Part 1: Conducted conformance testing”.

[8] 3GPP TS 38.115-2: “NR; Repeater conformance testing - Part 2: Radiated conformance testing”.

[9] ERC Recommendation 74-01, "Unwanted emissions in the spurious domain".

[10] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.

[11] Void

[12] Void

[13] 3GPP TS 38.101-1: “NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”.

[14] 3GPP TS 38.101-2: “NR User Equipment (UE) radio transmission and reception: Part 2: Range 2 Standalone”.

[15] Void

[16] Void

[17] Void

[18] Void

[19] 3GPP TS 38.213: “NR; Physical layer procedures for control”.

[20] 3GPP TS 36.104: “Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception”

[21] 3GPP TS 38.211: "NR; Physical channels and modulation".

[22] 3GPP TS 38.174: "NR; Integrated Access and Backhaul (IAB) radio transmission and reception".

# 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].

**Antenna connector:** connector at the conducted interface of the *repeater type 1-C*

**Beam:** beam (of the antenna) is the main lobe of the radiation pattern of an *antenna array*

**Beam centre direction:** direction equal to the geometric centre of the half-power contour of the beam

**Beam direction pair:** data set consisting of the *beam centre direction* and the related *beam peak direction*

**Beam peak direction:** direction where the maximum EIRP is found

**Beamwidth:** beam which has a half-power contour that is essentially elliptical, the half-power beamwidths in the two pattern cuts that respectively contain the major and minor axis of the ellipse

**directional requirement:** requirement which is applied in a specific direction within the *OTA coverage range*.

**Equivalent isotropic radiated power:** equivalent power radiated from an isotropic directivity device producing the same field intensity at a point of observation as the field intensity radiated in the direction of the same point of observation by the discussed device

**Fractional bandwidth:** *fractional bandwidth* FBW is defined as

**gap between passbands:** frequency gap between two consecutive passbands that belong to the same *operating band*, where the RF requirements in the gap are based on co-existence for un-coordinated operation

**Inter-passband gap**: The frequency gap between two supported consecutive *passbands* that belong to different operating bands.

**Maximum passband output power:** mean power level measured per *passband* at the *antenna connector*, during the *transmitter ON state* in a specified reference condition

**Maximum passband TRP output power:** mean power level measured perpassband during the *transmitter ON state* in a specified reference condition and corresponding to the declared *rated passband TRP output* power (Prated,p,,TRP)

**Measurement bandwidth**: RF bandwidth in which an emission level is specified

**multi-band connector**: *Antenna Connector* for a *Multi-band repeater*.

**Multi-band repeater:** *Repeater Type 1-C* whose *antenna connector* is associated with a transmitter and/or receiver that is characterized by the ability to process two or more *passband(s)* in common active RF components simultaneously, where at least one *passband* is configured at a different operating band than the other *passband(s)* and where this different operating band is not a sub-band or superseding-band of another supported operating band

**Nominal channel bandwidth:** Bandwidth calculated as min(100MHz, BWpassband) in FR1 or min(400MHz, BWpassband) in FR2. If this bandwidth is not defined for BS channel bandwidth for the operating band, *nominal channel bandwidth* shall be defined as the widest BS channel bandwidth for the operating band which is narrower than BWpassband.

**Non-contiguous spectrum**: spectrum consisting of two or more *passbands* separated by *inter-passband gap*(s).

**Operating band:** frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements

**OTA coverage range**: a common range of directions within which OTA requirements that are neither specified in the *OTA peak directions sets* nor as *TRP requirement* are intended to be met

**OTA peak directions set:** set(s) of *beam peak directions* within which certain OTA requirements are intended to be met, where all *OTA peak directions set(s)* are subsets of the *OTA coverage range*

**Passband:** The frequency range in which the repeater operates in with operational configuration, this frequency range can correspond to one or several consecutive nominal channels, if they are not consecutive each subset of channels shall be considered as an individual *passband*, a repeater can have one or several *passbands*, all channels within the *passband(s)* shall belong to a single operator or collaborating operators.

**passband edge***:* Frequency at the edge of the passband

**Radiated interface boundary**: *operating band* specific radiated requirements reference where the radiated requirements apply

**Rated beam EIRP:** For a declared beam and *beam direction pair*, the *rated beam EIRP* level is the maximum power that the repeater is declared to radiate at the associated *beam peak direction* during the *transmitter ON period*

**Rated passband output power**: mean power level associated with a *passband* the manufacturer has declared to be available at the *antenna connector*, during the *transmitter ON period* in a specified reference condition

**Rated passband TRP output power**: mean power level declared by the manufacturer per passband, that the manufacturer has declared to be available at the RIB during the *transmitter ON state*

**Rated total output power**: mean power level associated with a particular *operating band* the manufacturer has declared to be available at the *antenna connector*, during the *transmitter ON state* in a specified reference condition

**Rated total TRP output power**: mean power level associated with a particular *operating band*, that the manufacturer has declared to be available at the RIB during the *transmitter ON state* in a specified reference condition

**Reference beam direction pair:** Beam direction pair in the reference direction declared by the manufacturer.

**Repeater type 1-C**: Repeater operating at FR1 with a requirement set consisting only of conducted requirements defined at individual *antenna connectors*.

**Repeater type 2-O:** Repeater operating at FR2 with a requirement set consisting only of OTA requirements defined at the RIB

**Requirement set**: one of the NR requirements set as defined for *NR repeater*

**single-band connector:** *Repeater type 1-C* *antenna connector* supporting operation either in a single *operating band* only, or in multiple *operating bands* but does not meet the conditions for a *multi-band connector*.

**Sub-band**: A *sub-band* of an operating band contains a part of the uplink and downlink frequency range of the operating band.

**sub-block:** one contiguous allocated block of spectrum for transmission and reception by the repeater.

**Superseding-band**: A *superseding-band* of an operating band includes the whole of the uplink and downlink frequency range of the operating band.

**Total radiated power:** is the total power radiated by the antenna

NOTE: The *total radiated power* is the power radiating in all direction for two orthogonal polarizations. *Total radiated power* is defined in both the near-field region and the far-field region

**Transmitter OFF state:** Time period during which the repeater downlink or uplink is not allowed to transmit in the corresponding direction.

**Transmitter ON state:** Time period during which the repeater is transmitting downlink or uplink signals in the corresponding direction.

## 3.2 Symbols

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

BWConfig *Transmission bandwidth configuration*, where BWConfig = *N*RB x SCS x 12

BWNominal Nominal channelbandwidth

BWPassband *Passband* bandwidth

Δf Separation between the *passband edge* frequency and the nominal -3 dB point of the measuring filter closest to the carrier frequency

Δfmax f\_offsetmax minus half of the bandwidth of the measuring filter

ΔfOBUE Maximum offset of the *operating band* unwanted emissions mask from the *operating band* edge

FDL,low The lowest frequency of the downlink *operating band*

FDL,high The highest frequency of the downlink *operating band*

FFBWhigh Highest supported frequency within supported operating band, for which *fractional bandwidth* support was declared

FFBWlow Lowest supported frequency within supported operating band, for which *fractional bandwidth* support was declared

Ffilter Filter centre frequency

Foffset,high Frequency offset from FC,high to the upper *passband edge*

Foffset,low Frequency offset from FC,low to the lower *passband edge*

f\_offset Separation between the *passband edge* frequency and the centre of the measuring

f\_offsetmax The offset to the frequency ΔfOBUE outside the *operating band*

Fstep,X Frequency steps for the OTA transmitter spurious emissions (Category B)

FUL,low The lowest frequency of the uplink *operating band*

FUL,high The highest frequency of the uplink *operating band*

PEM,n50/n75,ind Declared emission level for Band n50/n75; ind = a, b

PEM,n54,ind Declared emission level for Band n54; ind = a, b, c, d, e, f

Prated,p,AC Rated passband output power per antenna connector

Prated,t,AC Rated total output power declared per antenna connector

Prated,p,EIRP Rated passband EIRP output power

Prated,p,TRP Rated passband TRP output power declared per RIB

Prated,t,TRP Rated total TRP output power declared per RIB

Pin,p,AC Input power intended to produce the maximum rated output power (Prated,p,AC) at the *antenna connector*

Pin,p,EIRP Input power intended to produce the maximum rated output power (Prated,p,TRP) at the RIB

Prated,out,FBWhigh The rated output EIRPfor the higher supported frequency range within supported *operating band,* for which *fractional bandwidth* support was declared

Prated,out,FBWlow The rated output EIRP for the lower supported frequency range within supported *operating band,* for which *fractional bandwidth* support was declared

Pmax,p,AC *Maximum passband output power* measuredper *antenna connector*

Pmax,p,EIRP *Maximum passband EIRP output power* when repeater is configured at the rated passband TRP output power (Prated,p,TRP)

Pmax,p,TRP *Maximum passband TRP output power* measuredper RIB

Wgap *Inter passband Bandwidth gap* size

## 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

AoA Angle of Arrival

BW Bandwidth

CACLR Cumulative ACLR

CP-OFDM Cyclic Prefix-OFDM

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

DL Downlink

EIRP Effective Isotropic Radiated Power

EVM Error Vector Magnitude

FBW Fractional Bandwidth

FR Frequency Range

ITU‑R Radiocommunication Sector of the International Telecommunication Union

LA Local Area

MR Medium Range

NR New Radio

OBUE Operating Band Unwanted Emissions

OOB Out-of-band

OTA Over-The-Air

QAM Quadrature Amplitude Modulation

RF Radio Frequency

RIB Radiated Interface Boundary

RX Receiver

SCS Sub-Carrier Spacing

TX Transmitter

TRP Total Radiated Power

UL Uplink

WA Wide Area

# 4 General

## 4.1 Relationship between Minimum Requirements and Test Requirements

Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification TS 38.115-1 [7] or TS 38.115-2 [8].

The minimum requirements given in this specification make no allowance for measurement uncertainty. The test specifications TS 38.115-1 [7] and TS 38.115-2 [8] define 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 [6].

## 4.2 Conducted and radiated requirement reference points

### 4.2.1 *Repeater type 1-C*

For *repeater type 1-C*, the requirements are applied at the repeater *antenna connector* (BS-side connector or UE-side connector) for downlink or uplink for the configuration in normal operating conditions.

Downlink

Uplink

UE-side connector

BS-side connector

Figure 4.2.1-1: *Repeater type 1-C* downlink and uplink interface

### 4.2.1A *Network controlled Repeater type 1-C*

For *NCR type 1-C*, the NCR-Fwd RF requirements are applied at the NCR *antenna connector* (BS-side connector or UE-side connector) for downlink or uplink for the configuration in normal operating conditions.

For *NCR type 1-C*, the NCR-MT RF requirements are applied at the NCR *antenna connector* (BS-side connector) for the configuration in normal operating conditions.

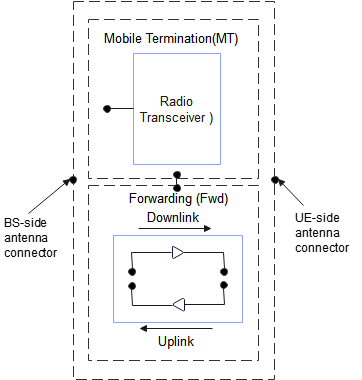


Figure 4.2.1-1A: Network controlled *Repeater type 1-C* downlink and uplink interface

NOTE 1: the NCR-MT and NCR-Fwd may have the same or separate antenna connectors.

### 4.2.1B *Network controlled Repeater type 1-H*

For *NCR type 1-H*, the requirements are defined for two points of reference, signified by radiated requirements and conducted requirements.

For *NCR type 1-H*, the NCR-Fwd conducted RF requirements are applied at the NCR individual or groups of *TAB connectors* at the *transceiver array boundary* (BS-side TAB connector or UE-side TAB connector) for downlink or uplink for the configuration in normal operating conditions.

For *NCR type 1-H,* the NCR-MT conducted RF requirements are applied at the NCR individual or groups of *TAB connectors* at the *transceiver array boundary* (BS-side TAB connector) for the configuration in normal operating conditions.

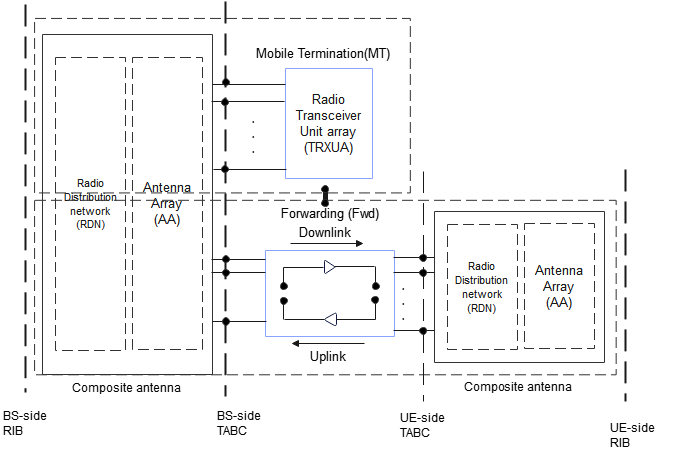


Figure 4.2.1-1B: Network controlled *Repeater type 1-H* downlink and uplink interface

NOTE 1: the NCR-MT and NCR-Fwd may have the same or separate TAB connectors.

### 4.2.2 *Repeater type 2-O*

For *repeater type 2-O*, the radiated characteristics are defined over the air (OTA), where the operating band specific radiated interface is referred to as the Radiated Interface Boundary (RIB). Radiated requirements are also referred to as OTA requirements. The (spatial) characteristics in which the OTA requirements apply are detailed for each requirement.

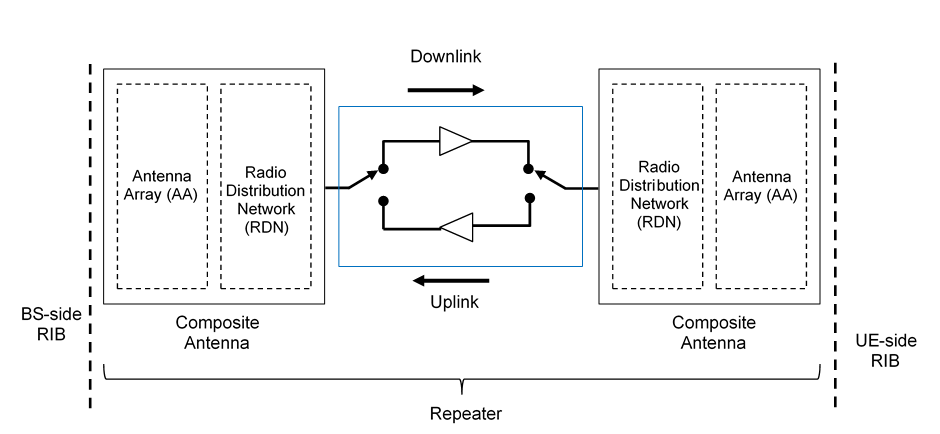


Figure 4.2.2-1: Radiated reference points for *repeater type 2-O*

### 4.2.2A *Network controlled Repeater type 2-O*

For *NCR type 2-O*, the radiated characteristics for NCR-Fwd and NCR-MT are defined over the air (OTA), where the operating band specific radiated interface is referred to as the Radiated Interface Boundary (RIB). Radiated requirements are also referred to as OTA requirements. The (spatial) characteristics in which the OTA requirements apply are detailed for each requirement.

For *NCR type 2-O,* the NCR-MT conducted RF requirements are applied at the BS side RIB for the configuration in normal operating conditions.

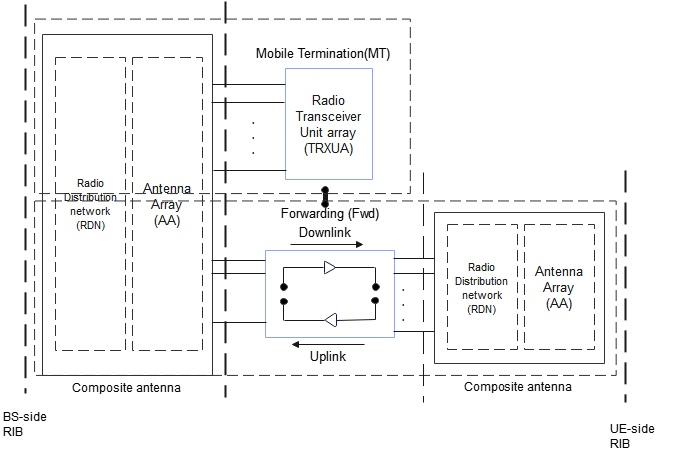


Figure 4.2.2-1A: Radiated reference points for *network controlled* *repeater type 2-O*

NOTE 1: the NCR-MT and NCR-Fwd may have the same or separate RIB

## 4.3 Repeater classes

### 4.3.1 Repeater class for downlink

The requirements in this specification apply to downlink Wide Area repeaters, downlink Medium Range repeaters and downlink Local Area repeaters unless otherwise stated. The associated deployment scenarios for each class are exactly the same for repeater with and without connectors.

For *repeater type 1-C* and *type 2-O*, repeater downlink classes are defined as indicated below:

- Wide Area repeaters are characterised by requirements derived from Macro Cell scenarios with a repeater to UE minimum distance along the ground equal to 35 m.

- Medium Range repeaters are characterised by requirements derived from Micro Cell scenarios with a repeater to UE minimum distance along the ground equal to 5 m.

- Local Area repeaters are characterised by requirements derived from Pico Cell scenarios with a repeater to UE minimum distance along the ground equal to 2 m or from Femto Cell scenarios.

- Note: The requirements in this specification for LA 1-C repeaters apply to 1-C repeaters with declared output power less than or equal to LA rated output power limits as in table 6.2.1-1.

### 4.3.2 Repeater class for uplink

The requirements in this specification apply to uplink Wide Area repeaters and uplink Local Area repeaters unless otherwise stated. The associated deployment scenarios for each class are exactly the same for repeater with and without connectors.

For *repeater type 1-C* and *type 2-O*, repeater uplink classes are defined as indicated below:

- Wide Area repeaters are characterised by requirements derived from Macro Cell and/or Micro Cell scenarios.

- Local Area repeaters are characterised by requirements derived from Pico Cell and/or Micro Cell scenarios.

## 4.3A Network controlled repeater classes

### 4.3A.1 Network controlled repeater class for downlink

The requirements in this specification apply to downlink Wide Area NCR, downlink Medium Range NCR and downlink Local Area NCR unless otherwise stated. The associated deployment scenarios for each class are exactly the same for repeater with and without connectors.

For *NCR type 1-C, type 1-H* and *type 2-O*, NCR downlink classes are defined as indicated below:

- Wide Area NCR are characterised by requirements derived from Macro Cell scenarios with a NCR to UE minimum distance along the ground equal to 35 m.

- Medium Range NCR are characterised by requirements derived from Micro Cell scenarios with a NCR to UE minimum distance along the ground equal to 5 m.

- Local Area NCR are characterised by requirements derived from Pico Cell scenarios with a NCR to UE minimum distance along the ground equal to 2 m or from Femto Cell scenarios.

- Note: The requirements in this specification for LA NCR type 1-C apply to NCR type 1-C with declared output power less than or equal to LA rated output power limits as in table 6.2.1-1.

### 4.3A.2 Network controlled repeater class for uplink

The requirements in this specification apply to uplink Wide Area NCR and uplink Local Area NCR unless otherwise stated. The associated deployment scenarios for each class are exactly the same for NCR with and without connectors.

For *NCR type 1-C, type 1-H* and *type 2-O*, NCR uplink classes are defined as indicated below:

- Wide Area NCR are characterised by requirements derived from Macro Cell and/or Micro Cell scenarios.

- Local Area NCR are characterised by requirements derived from Pico Cell and/or Micro Cell scenarios.

## 4.4 Regional requirements

Some requirements in the present document may only apply in certain regions either as optional requirements, or as mandatory requirements set by local and regional regulation. It is normally not stated in the 3GPP specifications under what exact circumstances the regional requirements apply, since this is defined by local or regional regulation.

Table 4.4-1 lists all requirements in the present specification that may be applied differently in different regions.

Table 4.4-1: List of regional requirements

| Clause number | Requirement | Comments |
| --- | --- | --- |
| 5.2 | *Operating bands* | Some NR *operating bands* may be applied regionally. |
| 6.2 | Repeater output power | For Band n41 and n90 operation in Japan, additional output power limits shall be applied. |
| 6.2.4,  7.3.4 | Repeater output power,  OTA repeater output power:  Additional requirements | These requirements may be applied regionally as additional repeater output power requirements. |
| 6.5.2 | Adjacent Channel Leakage Power Ratio | For Band n41 and n90 operation in Japan, absolute ACLR limits shall be applied to the sum of the absolute ACLR power over all *antenna connectors* for *repeater type 1-C*. |
| 6.5.3.2,  7.5.3.2 | Operating band unwanted emission,  OTA operating band unwanted emissions | Category A or Category B operating band unwanted emissions limits may be applied regionally. |
| 6.5.3.2.5.1 | Operating band unwanted emission | The repeater may have to comply with the additional requirements, when deployed in regions where those limits are applied, and under the conditions declared by the manufacturer. |
| 6.5.3.2.5.2 | Operating band unwanted emission | The repeater operating in Band n20 may have to comply with the additional requirements for protection of DTT, when deployed in certain regions. |
| 6.5.3.2 | Operating band unwanted emissions | For Band n41 and n90 operation in Japan, the operating band unwanted emissions limits shall be applied to the sum of the emission power over all *antenna connectors* for *repeater type 1-C.* |
| 6.5.4.2.1,  7.5.4.2 | Tx spurious emissions,  OTA Tx spurious emissions | Category A or Category B spurious emission limits, as defined in ITU-R Recommendation SM.329 [5], may apply regionally. |
| 6.5.4.2.2,  7.5.4.2.3 | Tx spurious emissions: additional requirements,  OTA Tx spurious emissions: additional requirements | These requirements may be applied for the protection of system operating in frequency ranges other than the repeater *operating band*. |
| 6.5.4.2 | Transmitter spurious emissions | For Band n41 and n90 operation in Japan, the sum of the spurious emissions over all *antenna connectors* for *repeater type 1-C* shall not exceed the *basic limits*. |
| 6.5.5.1 | Receiver spurious emissions | For Band n41 and n90 operation in Japan, the sum of receiver spurious emissions requirements over all *antenna connectors* for *repeater type 1-C* shall not exceed *minimum requirements* defined in clause 6.5.5.2. |
| 6.7.2 | Input intermodulation | Interfering signal positions that are partially or completely outside of any downlink *operating band* of the repeater are not excluded from the requirement in Japan in Band n77, n78, n79. |
| 6.8 | Output intermodulation | For Band n41 and n90 operation in Japan, the repeater may have to comply with the additional requirements, when deployed in certain regions. |

## 4.5 Applicability of requirements

In table 4.5-1, the requirement applicability for each requirement set is defined. For each requirement, the applicable requirement clause in the specification is identified. Requirements not included in a requirement set is marked not applicable (NA).

Table 4.5-1: *Requirement set* applicability

|  |  |  |
| --- | --- | --- |
| Requirement | Requirement set | |
|  | *Repeater type 1-C* | *Repeater type 2-O* |
| Repeater output power | 6.2 |  |
| Frequency stability | 6.3 |  |
| Out of band gain | 6.4 |  |
| Unwanted emissions | 6.5 |  |
| Error Vector Magnitude | 6.6 | NA |
| Input intermodulation | 6.7 |  |
| Output intermodulation | 6.8 |  |
| Adjacent Channel Rejection Ratio (ACRR) | 6.9 |  |
| Transmit ON/OFF power | 6.10 |  |
| Repeater output power |  | 7.2 |
| OTA frequency stability |  | 7.3 |
| OTA out of band gain |  | 7.4 |
| OTA unwanted emissions |  | 7.5 |
| OTA Error Vector Magnitude | NA | 7.6 |
| OTA input intermodulation |  | 7.7 |
|  |  |  |
| OTA Adjacent Channel Rejection Ratio (ACRR) |  | 7.8 |
| OTA transmit ON/OFF power |  | 7.9 |

Table 4.5-1a: *Requirement set* applicability for NCR-Fwd

|  |
| --- |
| Requirement |
|  | *NCR-Fwd type 1-C* | *NCR-Fwd type 1-H* | *NCR-Fwd type 2-O* |
| Repeater output power | 6.2 | 6.2 |  |
| Frequency stability | 6.3 | 6.3 |  |
| Out of band gain | 6.4 | 6.4 |  |
| Unwanted emissions | 6.5 | 6.5 |  |
| Error Vector Magnitude | 6.6 | 6.6 | NA |
| Input intermodulation | 6.7 | 6.7 |  |
| Output intermodulation | 6.8 | 6.8 |  |
| Adjacent Channel Rejection Ratio (ACRR) | 6.9 | 6.9 |  |
| Transmit ON/OFF power | 6.10 | 6.10 |  |
| Repeater output power |  |  | 7.2 |
| OTA frequency stability |  |  | 7.3 |
| OTA out of band gain |  |  | 7.4 |
| OTA unwanted emissions |  |  | 7.5 |
| OTA Error Vector Magnitude | NA | NA | 7.6 |
| OTA input intermodulation |  |  | 7.7 |
| OTA Adjacent Channel Rejection Ratio (ACRR) |  |  | 7.8 |
| OTA transmit ON/OFF power |  |  | 7.9 |

Table 4.5-1b: *Requirement set* applicability for NCR-MT

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | *NCR-MT type 1-C* | *NCR-MT type 1-H* | *NCR-MT type 2-O* |
| Conducted transmitter power | 6.2.3.2 | 6.2.3.2 |  |
| Conducted output power dynamics | 6.11 | 6.11 |  |
| Conducted transmit signal quality | 6.12 | 6.12 |  |
| Conducted output RF spectrum emissions | 6.5 | 6.5 |  |
| Diversity characteristics | 6.13 | 6.13 | NA |
| Conducted reference sensitivity | 6.14 | 6.14 |  |
| Conducted maximum input level | 6.15 | 6.15 |  |
| Conducted adjacent channel selectivity | 6.16 | 6.16 |  |
| Conducted blocking characteristics | 6.17 | 6.17 |  |
| Conducted spurious response | 6.18 | 6.18 |  |
| Conducted intermodulation characteristics | 6.19 | 6.19 |  |
| Conducted spurious emissions | 6.5.5 | 6.5.5 |  |
| Radiated transmitter power |  |  | 7.2 |
| Radiated output power dynamics |  |  | 7.10 |
| Radiated transmit signal quality |  |  | 7.11 |
| Radiated output RF spectrum emissions |  |  | 7.5 |
| Diversity characteristics | NA | NA | 7.12 |
| Radiated reference sensitivity |  |  | 7.13 |
| Radiated maximum input level |  |  | 7.14 |
| Radiated adjacent channel selectivity |  |  | 7.15 |
| Radiated blocking characteristics |  |  | 7.16 |
| Radiated spurious response |  |  | 7.17 |
| Radiated intermodulation characteristics |  |  | 7.18 |
| Radiated spurious emissions |  |  | 7.19 |

## 4.6 Requirements for contiguous and *non-contiguous spectrum*

A spectrum allocation where a repeater operates can either be contiguous or non-contiguous. Unless otherwise stated, the requirements in the present specification apply for repeater configured for both contiguous spectrum operation and non-contiguous spectrum operation.

For repeater operation in non-contiguous spectrum, some requirements apply at the repeater *passband* edges. For each such requirement, it is stated how the limits apply relative to the repeater *gap between passbands* and the *Inter-passband gap* respectively.

For NCR operation in non-contiguous spectrum, some requirements apply at the NCR-Fwd *passband* edges or NCR-MT carrier edges. For each such requirement, it is stated how the limits apply relative to the NCR *gap between passbands* and the *Inter-passband gap* respectively.

## 4.7 Requirements for repeater capable of multi-band operation

For multi-band connector or multi-band RIB, the RF requirements in clauses 6 and 7 apply separately to each supported operating band unless otherwise stated. For some requirements, it is explicitly stated that specific additions or exclusions to the requirement apply at multi-band connector(s), and multi-band RIB(s) as detailed in the requirement clause. For repeater or NCR capable of multi-band operation, various structures in terms of combinations of different downlink and uplink implementations (multi-band or single band) with mapping to one or more *antenna connectors* for *repeater type 1-C, NCR type 1-C, type 1-H*  in different ways are possible. For multi-band connector(s) the exclusions or provisions for multi-band apply. For single-band connector(s), the following applies:

- Single-band transmitter spurious emissions, *operating band* unwanted emissions, ACLR, output intermodulation, ACRR and receiver spurious emissions requirements apply to this *connector* that is mapped to single-band.

- If the repeater or NCR is configured for single-band operation, single-band requirements shall apply to this *antenna connector* configured for single-band operation and no exclusions or provisions for multi-band capable repeater or NCR are applicable. Single-band requirements are tested separately at the *antenna connector* configured for single-band operation, with all other *antenna connectors* terminated.

# 5 Operating bands

## 5.1 General

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

NOTE: Other *operating bands* 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 the present 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 | FR2-1 | 24250 MHz – 52600 MHz |
| FR2-2 | 52600 MHz – 71000 MHz |

Whenever FR2 is referred, both FR2-1 and FR2-2 frequency sub-ranges shall be applied, unless otherwise stated.

## 5.2 Operating bands

NR repeater is designed to operate in the *operating bands* in FR1 and FR2-1 defined in TS 38.104 [2] except the operating bands n46, n96 and n102.

## 5.3 Channel arrangement

### 5.3.1 Channel raster

#### 5.3.1.1 NR-ARFCN and channel raster

For repeater and NCR-Fwd, the NR-ARFCN and channel raster is the same as specified for BS in TS 38.104 [2], subclause 5.4.2.1.

For NCR-MT, the NR-ARFCN and channel raster is the same as specified for UE in TS 38.101-1 [13] for FR1 in subclause 5.4.2.1 and in TS 38.101-2 [14] for FR2-1 in subclause 5.4.2.1.

#### 5.3.1.2 Channel raster entries for each *operating band*

For repeater and NCR-Fwd, the channel raster entries for NR bands for FR1 and FR2-1 defined in TS 38.104 [2] are the same as specified for BS in TS38.104 [2], clause 5.4.2.3.

For NCR-MT, the channel raster entries for NR bands for FR1 are the same as specified for UE in TS 38.101-1 [13] in subclause 5.4.2.3 and for NR bands for FR2-1 are the same as specified for UE in TS 38.101-2 [14] in subclause 5.4.2.3.

#### 5.3.1.3 Channel raster to resource element mapping

For NCR-MT, the channel raster to resource element mapping is the same as specified for UE in TS 38.101-1 [13] for FR1 in subclause 5.4.2.2 and in TS 38.101-2 [14] for FR2 in subclause 5.4.2.2.

### 5.3.2 Synchronization raster

#### 5.3.2.1 Synchronization raster and numbering

For repeater and NCR-Fwd, the synchronization raster and numbering are the same as specified for BS in TS38.104 [2], clause 5.4.3.1.

For NCR-MT, the synchronization raster and numbering are the same as specified for UE in subclause 5.4.3.1 in TS 38.101-1 [13] for FR1 in subclause 5.4.3.1 and in subclause 5.4.3.1in TS 38.101-2 [14] for FR2-1 in subclause 5.4.3.1.

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

For repeater and NCR-Fwd, the synchronization raster entries for NR bands for FR1 and FR2-1 defined in TS38.104 [2] are the same as specified for BS in TS38.104 [2], clause 5.4.3.3.

For NCR-MT, the synchronization raster entries for NR bands for FR1 in Table 5.2-1 are the same as specified for UE in TS 38.101-1 [13] in subclause 5.4.3.3 and for NR bands for FR2-1 are the same as specified for UE in TS 38.101-2 [14] in subclause 5.4.3.3.

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

For NCR-MT, the synchronization raster to synchronization block resource element mapping is the same as specified for UE in TS 38.101-1 [13] for FR1 in subclause 5.4.3.2 and in TS 38.101-2 [14] for FR2-1 in subclause 5.4.3.2.

### 5.3.3 Channel spacing

For NCR-MT, the channel spacing is the same as specified for UE in TS 38.101-1 [13] for FR1 in subclause 5.4.1 and in TS 38.101-2 [14] for FR2-1 in subclause 5.4.1.

### 5.3.4 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 5.3.4-1.

**Table 5.3.4-1: NCR-MT TX-RX frequency separation**

| **NR Operating Band** | **TX – RX  carrier centre frequency separation** |
| --- | --- |
| n1 | 190 MHz |
| n2 | 80 MHz |
| n3 | 95 MHz |
| n5 | 45 MHz |
| n7 | 120 MHz |
| n8 | 45 MHz |
| n12 | 30 MHz |
| n13 | -31 MHz |
| n14 | -30 MHz |
| n18 | 45 MHz |
| n20 | -41 MHz |
| n24 | -101.5, -120.5 MHz |
| n25 | 80 MHz |
| n26 | 45 MHz |
| n28 | 55 MHz |
| n30 | 45 MHz |
| n65 | 190 MHz |
| n66 | 400 MHz |
| n70 | 300MHz |
| n71 | -46 MHz |
| n74 | 48 MHz |
| n85 | 30 MHz |
| n91 | 570 MHz – 595 MHz  (NOTE 2) |
| n92 | 575 MHz – 680 MHz (*μ* = 0)  580 MHz – 675 MHz (*μ* = 1)  (NOTE 2) |
| n93 | 517 MHz – 547 MHz  (NOTE 2) |
| n94 | 522 MHz – 632 MHz (*μ* = 0)  527 MHz – 627 MHz (*μ* = 1)  (NOTE 2) |
| n100 | 45 MHz |
| n105 | -51 MHz |
| NOTE 1: Void  NOTE 2: The range of TX-RX frequency separation given paired UL and DL channel bandwidths BWUL and BWDL is given by the respective lower and upper limit FDL\_low – FUL\_high + 0.5(BWDL + BWUL) and FDL\_high – FUL\_low – 0.5(BWDL + BWUL). The UL and DL channel bandwidth combinations specified in Clause 5.4 depend on the subcarrier spacing configuration *μ* [21]. | |

## 5.4 NCR-MT channel bandwidth

### 5.4.1 General

The NCR-MT supports a single NR RF carrier in the uplink or downlink in this release. From a BS perspective, different NCR-MT channel bandwidths may be supported within the same spectrum for transmitting to and receiving from NCR-MT connected to the BS. Transmission of multiple carriers to different NCR-MT within the BS channel bandwidth can be supported.

From a NCR-MT perspective, the NCR-MT per passband is configured with one carrier and NCR-MT is configured with one more BWP. The NCR-MT does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different NCR-MT.

The placement of the NCR-MT channel bandwidth for NCR-MT carrier is flexible but can only be completely within the NCR-Fwd passband.

The relationship between the NCR-MT channel bandwidth, the guardband and the transmission bandwidth configuration is shown in Figure 5.4.1-1.



**Figure 5.4.1-1: Definition of channel bandwidth and transmission bandwidth configuration for one NR channel**

5.4.2 Transmission bandwidth configuration

For NCR-MT, the transmission bandwidth configuration is the same as specified for UE in TS 38.101-1 [13] for FR1 in subclause 5.3.2 and in TS 38.101-2 [14] for FR2-1 in subclause 5.3.2.

### 5.4.3 Minimum guardband and transmission bandwidth configuration

For NCR-MT, the minimum guardband and transmission bandwidth configuration is the same as specified for UE in TS38.101-1 [13] for FR1 and in TS 38.101-2 [14] for FR2-1 in subclause 5.3.3.

### 5.4.4 RB alignment

For NCR-MT, the RB alignment is the same as specified for UE in TS38.101-1 [13] for FR1 in subclause 5.3.4 and in TS 38.101-2 [14] for FR2-1 in subclause 5.3.4

### 5.4.5 NCR-MT channel bandwidth per operating band

For NCR-MT, the channel bandwidth for NR bands for FR1 in Table 5.2-1 is the same as specified for UE in TS38.101-1 [13] in subclause 5.3.5 and is the same as specified for UE in TS38.101-2 [14] in subclause 5.3.5.

# 6 Conducted characteristics

## 6.1 General

Unless otherwise stated, the conducted transmitter characteristics are specified at the *antenna connector* for *repeater type 1-C* configuration in normal operating conditions.

Requirements apply in both DL and UL unless otherwise stated or declared.

For the DL the *antenna connector* on the BS side is the input and the *antenna connector* on the UE side is the output.

For the UL the *antenna connector* on the UE side is the input and the *antenna connector* on the BS side is the output.

## 6.2 Repeater output power

### 6.2.1 General

The repeater conducted output power requirement is at the *antenna connector*.

The *rated passband output power* of the *repeater type 1-C* and *NCR-FWD type 1-C* shall be as specified in table 6.2.1-1 and table 6.2.1-2.

Table 6.2.1-1: *Repeater type 1-C* **and *NCR-FWD type 1-C*** DL transmission classes rated output power limits for repeater classes

|  |  |
| --- | --- |
| Repeater class | Prated,p,AC |
| Wide Area repeater | Note 1 |
| Medium Range repeater | ≤ 38 dBm + X, Note 2 |
| Local Area repeater | ≤ 24 dBm + X, Note 2 |
| NOTE 1: There is no upper limit for the Prated,p,AC *rated passband output power* of the Wide Area repeater  NOTE 2: X = 10\*log (ceil (*passband* bandwidth/20MHz)) | |

Table 6.2.1-2: *Repeater type 1-C* **and *NCR-FWD type 1-C*** UL transmission classes rated output power limits for repeater classes

|  |  |
| --- | --- |
| Repeater class | Prated,p,AC |
| Wide Area repeater | Note 1 |
| Local Area repeater | ≤ 24 dBm+ X, Note 2 |
| NOTE 1: There is no upper limit for the Prated,p,AC *rated passband output power* of the Wide Area repeater.  NOTE 2: X = 10\*log (ceil (*passband* bandwidth/20MHz)) | |

The rated passband output power of the *NCR-Fwd 1-H* shall be as specified in table 6.2.1-3 and table 6.2.1-4.

Table 6.2.1-3: *NCR-Fwd 1-H* DL rated output power limits for NCR classes

| Repeater class | Prated,c,sys | Prated,c,TABC |
| --- | --- | --- |
| Wide Area NCR | (Note 1) | (Note 1) |
| Medium Range NCR | ≤ 38 dBm +10log(NTXU,counted) + X (NOTE 2) | ≤ 38 dBm+ X (NOTE 2) |
| Local Area NCR | ≤ 24 dBm +10log(NTXU,counted) + X (NOTE 2) | ≤ 24 dBm+ X (NOTE 2) |
| NOTE 1: There is no upper limit for the Prated,c,sys or Prated,c,TABC of the Wide Area NCR-Fwd.  NOTE 2: X = 10\*log (ceil (*passband* bandwidth/20MHz)) | | |

Table 6.2.1-4: *NCR-Fwd 1-H* UL rated output power limits for NCR classes

| Repeater class | Prated,c,sys | Prated,c,TABC |
| --- | --- | --- |
| Wide Area NCR | (Note 1) | (Note 1) |
| Local Area NCR | ≤ 24 dBm +10log(NTXU,counted) + X (NOTE 2, 3) | ≤ 24 dBm+ X (NOTE 2) |
| NOTE 1: There is no upper limit for the Prated,c,sys or Prated,c,TABC of the Wide Area NCR.  NOTE 2: X = 10\*log (ceil (*passband* bandwidth/20MHz))  NOTE 3: For joint transmission of NCR-FWD and NCR-MT, Prated,c,sys shall apply to the total power of NCR-FWD and NCR-MT. | | |

### 6.2.2 Minimum requirement for RF repeater

The requirements shall apply with NR signals in the *passband* of the repeater at:

The lowest input power (Pin,p,AC) that produces the *rated passband output power* (Prated,p,AC).

Up to:

The lowest input power (Pin,p,AC) that produces the *rated passband output power* (Prated,p,AC), plus 10dB

In normal conditions, the measured output power, Pmax,p,AC shall remain within +2 dB and -2 dB of the *rated passband output power* Prated,p,AC, declared by the manufacturer.

In extreme conditions, the measured output power, Pmax,p,AC shall remain within +2.5 dB and -2.5 dB of the *rated passband output power* Prated,p,AC, declared by the manufacturer.

6.2.3 Minimum requirement for NCR

#### 6.2.3.1 Minimum requirement for NCR-Fwd

##### 6.2.3.1.1 Minimum requirement for NCR-Fwd type 1-C

The requirements shall apply with NR signals in the *passband* of the NCR-Fwd at:

The lowest input power (Pin,p,AC) that produces the *rated passband output power* (Prated,p,AC).

Up to:

The lowest input power (Pin,p,AC) that produces the *rated passband output power* (Prated,p,AC), plus 10dB

In normal conditions, the measured output power, Pmax,p,AC shall remain within +2 dB and -2 dB of the *rated passband output power* Prated,p,AC, declared by the manufacturer.

In extreme conditions, the measured output power, Pmax,p,AC shall remain within +2.5 dB and -2.5 dB of the *rated passband output power* Prated,p,AC, declared by the manufacturer.

##### 6.2.3.1.2 Minimum requirement for NCR-Fwd type 1-H

The requirements shall apply with NR signals in the *passband* of the NCR-Fwd at:

The lowest input power (Pin,p,TABC) that produces the *rated passband output power* (Prated,p,TABC).

Up to:

The lowest input power (Pin,p,TABC) that produces the *rated passband output power* (Prated,p,TABC), plus 10dB

In normal conditions, the measured output power, Pmax,p,TABC shall remain within +2 dB and -2 dB of the *rated passband output power* Prated,p,TABC, declared by the manufacturer.

In extreme conditions, the measured output power, Pmax,p,TABC shall remain within +2.5 dB and -2.5 dB of the *rated passband output power* Prated,p,TABC, declared by the manufacturer.

6.2.3.2 Minimum requirement for NCR-MT

6.2.3.2.1 General

The NCR-MT conducted output power requirement is at *antenna connector* for *NCR-MT type 1-C*, or at *TAB connector* for *NCR-MT* *type 1-H*.

The *rated carrier output power* of the *NCR-MT type 1-C* shall be as specified in table 6.2.3.2.1-1.

**Table 6.2.3.2.1-1: *NCR-MT type 1-C* UL transmission classes rated output power limits**

|  |  |
| --- | --- |
| **Repeater class** | **Prated,c,AC** |
| Wide Area NCR-MT | (Note) |
| Local Area NCR-MT | ≤ 24 dBm |
| NOTE: There is no upper limit for the Prated,c,AC *rated output power* of the Wide Area NCR-MT. | |

The *rated carrier output power* of the *NCR-MT* *type 1-H* shall be as specified in table 6.2.3.2.1-2.

**Table 6.2.3.2.1-2: *NCR-MT type 1-H* UL transmission classes rated output power limits**

| **Repeater class** | **Prated,c,sys** | **Prated,c,TABC** |
| --- | --- | --- |
| Wide Area NCR-MT | (Note 1) | (Note 1) |
| Local Area NCR-MT2,3 | ≤ 24 dBm +10log(NTXU,counted) | ≤ 24 dBm |
| NOTE 1: There is no upper limit for the Prated,c,AC *rated output power* of the Wide Area NCR-MT.  NOTE 2: LA MT cannot exceed highest power class for that band as specified in TS 38.101-1.  NOTE 3: NTXU,counted = min(NTXU,active ,4) | | |

6.2.3.2.2 Minimum requirement for NCR-MT type 1-C and NCR-MT type 1-H

In normal conditions, Pmax,c,AC shall remain within +2 dB and -2 dB of the *rated carrier output power* Prated,c,AC, declared by the manufacturer.

In extreme conditions, Pmax,c,AC shall remain within +2.5 dB and -2.5 dB of the *rated carrier output power* Prated,c,AC, declared by the manufacturer.

## 6.3 Frequency stability

### 6.3.1 General

Frequency stability is the ability to maintain the same frequency on the output signal with respect to the input signal.

### 6.3.2 Minimum requirement for RF repeater

The frequency deviation of the output signal with respect to the input signal shall be no more than ±0,01 PPM.

### 6.3.3 Minimum requirement for NCR

#### 6.3.3.1 Minimum requirement for NCR-Fwd

##### 6.3.3.1.1 Minimum requirement for NCR-Fwd type 1-C

The frequency deviation of the output signal with respect to the input signal shall be no more than ±0,01 PPM.

##### 6.3.3.1.2 Minimum requirement for NCR-Fwd type 1-H

The frequency deviation of the output signal with respect to the input signal between corresponding input/output TAB connectors shall be no more than ±0,01 PPM.

## 6.4 Out of band gain

### 6.4.1 General

Out of band gain refers to the gain of the repeater outside the *passband*.

The intended use of a repeater in a system is to amplify the in-band signals and not to amplify signals outside of the *passband*.

In the intended application of the repeater, the out of band gain is less than lowest expected the coupling loss to the nearest source of emissions.

### 6.4.2 Minimum requirement for RF repeater

The gain outside the *passband* shall not exceed the maximum level specified in table 6.4.2-1 or table 6.4.2-2, where:

- f\_offset\_CW is the offset between the outer channel edge frequency of the outer channel in the *passband* and a CW signal.

Table 6.4.2-1: Out of band gain limits 1 for bands below 2496 MHz

|  |  |
| --- | --- |
| Frequency offset, f\_offset\_CW | Maximum gain |
| 0,2 ≤ f\_offset\_CW < 1,0 MHz | 60 dB |
| 1,0 ≤ f\_offset\_CW < 5,0 MHz | 45 dB |
| 5,0 ≤ f\_offset\_CW < 10,0 MHz | 45 dB |
| 10,0 MHz ≤ f\_offset\_CW | 35 dB |

Table 6.4.2-2: Out of band gain limits 1 for bands above 2496 MHz

|  |  |
| --- | --- |
| Frequency offset, f\_offset\_CW | Maximum gain |
| [0,2] < f\_offset\_CW < 4,0 MHz | 60 dB |
| 4,0 < f\_offset\_CW < 15,0 MHz | 45 dB |
| 15,0 MHz < f\_offset\_CW | 35 dB |

6.4.3 Minimum requirement for NCR

#### 6.4.3.1 Minimum requirement for NCR-Fwd

##### 6.4.3.1.1 Minimum requirement for NCR-Fwd type 1-C

The gain between the input antenna connector and output antenna connector outside the *passband* shall not exceed the maximum level specified in table 6.4.2-1 or table 6.4.2-2

##### 6.4.3.1.2 Minimum requirement for NCR-Fwd type 1-H

The gain defined between corresponding input/output TAB connectors outside the *passband* shall not exceed the maximum level specified in table 6.4.2-1 or table 6.4.2-2.

## 6.5 Unwanted emissions

### 6.5.1 General

Unwanted emissions consist of out-of-band emissions and spurious emissions according to ITU definitions [5]. In ITU terminology, out of band emissions are unwanted emissions immediately outside the channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

The out-of-band emissions requirement for the Repeater transmitter is specified both in terms of Adjacent Channel Leakage power Ratio (ACLR) and *operating band* unwanted emissions (OBUE).

The maximum offset of the *operating band* unwanted emissions mask from the *operating band* edge is ΔfOBUE. The Operating band unwanted emissions define all unwanted emissions in each supported downlink *operating band* of *repeater type 1-C* DL and uplink *operating band* of *repeater type 1-C* UL, plus the frequency ranges ΔfOBUE above and ΔfOBUE below each band. Unwanted emissions outside of this frequency range are limited by a spurious emissions requirement.

The values of ΔfOBUE are defined in tables 6.5.1-1 and 6.5.1-2 for the NR *operating bands*.

Table 6.5.1-1: Maximum offset of OBUE outside the downlink *operating band* of *repeater type 1-C****, NCR-Fwd type 1-C and NCR-Fwd type 1-H*** *DL*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Repeater or NCR type | *Operating band* characteristics | | ΔfOBUE (MHz) | |
| *NCR-Fwd type 1-H* | FDL,high – FDL,low < 100 MHz | | 10 | |
|  | 100 MHz ≤ FDL,high – FDL,low ≤ 900 MHz | | 40 | |
|  |  | |  | |
| *Repeater type 1-C and NCR-Fwd type 1-C* | FDL,high – FDL,low ≤ 200 MHz | | 10 | |
|  | 200 MHz < FDL,high – FDL,low ≤ 900 MHz | | 40 | |

Table 6.5.1-2: Maximum offset of OBUE outside the uplink *operating band* of *repeater 1-C UL*



|  |  |  |
| --- | --- | --- |
| Repeater or NCRtype | *Operating band* characteristics | ΔfOBUE (MHz) |
| *NCR-Fwd type 1-H* | FDL,high – FDL,low < 100 MHz | 10 |
|  | 100 MHz ≤ FDL,high – FDL,low ≤ 900 MHz | 40 |
|  |  |  |
| *Repeater type 1-C and NCR-Fwd type 1-C* | FDL,high – FDL,low ≤ 200 MHz | 10 |
|  | 200 MHz < FDL,high – FDL,low ≤ 900 MHz | 40 |

For *NCR-Fwd type 1-H* the unwanted emission requirements are applied per the *TAB connector TX min cell groups* for all the configurations supported by the repeater. The *basic limits* and corresponding emissions scaling are defined in each relevant clause.

There is no co-location unwanted emission requirement for LA NCR-Fwd type 1-C and repeaters type 1-C deployed in Femto cell scenario.

### 6.5.2 Adjacent Channel Leakage Power Ratio

#### 6.5.2.1 General

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

The requirements shall apply outside the *repeater type 1-C passband* whatever the type of transmitter considered (single carrier or multi-carrier) and for all transmission modes foreseen by the manufacturer’s specification.

For a *repeater* operating in *non-contiguous spectrum*, the ACLR requirement in clause 6.5.2.2 shall apply in *Gaps between passbands* for the frequency ranges defined in table 6.5.2.2-3, while the CACLR requirement in clause 6.5.2.2 shall apply in *gaps between passbands* for the frequency ranges defined in table 6.5.2.2-4.

For a *multi-band connector*, the ACLR requirement in clause 6.5.2.2 shall apply in *inter-passband gaps* for the frequency ranges defined in table 6.5.2.2-3, while the CACLR requirement in clause 6.5.2.2 shall apply in *inter-passband gaps* for the frequency ranges defined in table 6.5.2.2-4.

The requirement shall apply during the *transmitter ON state*.

#### 6.5.2.2 Limits and *basic limits*

The ACLR is defined with a square filter of bandwidth equal to the transmission bandwidth configuration of the transmitted signal (BWConfig) centred on the assigned channel frequency and a filter centred on the adjacent channel frequency according to the tables below.

For DL (all repeater classes), and for UL for WA class, either the ACLR (CACLR) absolute *basic limits* in table 6.5.2.2-2, 6.5.2.2-5 or else the relevant the ACLR (CACLR) *limits* in table 6.5.2.2-1, 6.5.2.2-3 or 6.5.2.2-4, whichever is less stringent, shall apply for each *antenna connector*. For UL for LA class, the ACLR (CACLR) and *basic limits* in table 6.5.2.2-1a, 6.5.2.2-3 or 6.5.2.2-4a shall apply.

Table 6.5.2.2-1: ACLR limit for DL (all repeater classes) and for UL for Wide Area class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) **(NOTE 5)** | *Repeater type 1-C* adjacent channel centre frequency offset below or above the passband edge | **Assumed adjacent channel carrier (informative)** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit** |
| 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | BWNominal/2 | NR of same BW (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 4) |
|  | 1.5 x BWNominal | NR of same BW (Note 2) | Square (BWConfig) | 45 dB  38 dB  (Note 4) |
|  | 2.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | 45 dB (Note 3) |
|  | 7.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | 45 dB (Note 3) |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: The requirements are applicable when the band is also defined for E-UTRA or UTRA.  NOTE 4: For repeater operating in band n104, ACLR requirement 38 dB applies. For repeater operating in other bands, ACLR requirement 45 dB applies.  NOTE 5: For simultaneous NCR-Fwd and NCR-MT transmission, if the NCR-MT carrier is within the NCR-Fwd then the nominal bandwidth shall be the NCR-Fwd passband. If the NCT-MT carrier is adjacent to the NCR-Fwd passband then the nominal bandwidth shall be the combined bandwidth of NCR-Fwd passband and NCR-MT carrier bandwidth. If the NCR-MT carrier is not adjacent to the passband then CACLR shall be applied in the gap between the NCR-Fwd passband and the NCR-MT carrier. | | | | |

Table 6.5.2.2-1a: ACLR limit for UL for Local Area

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) **(NOTE 4)** | *Repeater type 1-C* adjacent channel centre frequency offset below or above the passband edge | Assumed adjacent channel carrier (informative) | Filter on the adjacent channel frequency and corresponding filter bandwidth | ACLR limit |
| 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | BWNominal/2 | NR of same BW (Note 2) | Square (BWConfig) | 31 dB |
|  | 1.5 x BWNominal | NR of same BW (Note 2) | Square (BWConfig) | 31 dB |
|  | 2.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | 31 dB |
|  | 7.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | 31 dB |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: The requirements are applicable when the band is also defined for E-UTRA or UTRA.  NOTE 4: For simultaneous NCR-Fwd and NCR-MT transmission, if the NCR-MT carrier is within the NCR-Fwd then the nominal bandwidth shall be the NCR-Fwd passband. If the NCT-MT carrier is adjacent to the NCR-Fwd passband then the nominal bandwidth shall be the combined bandwidth of NCR-Fwd passband and NCR-MT carrier bandwidth. If the NCR-MT carrier is not adjacent to the passband then CACLR shall be applied in the gap between the NCR-Fwd passband and the NCR-MT carrier. | | | | |

The ACLR absolute *basic limit* is specified in table 6.5.2.2‑2 and is applicable for both contiguous spectrum, non-contiguous spectrum and multiple bands

Table 6.5.2.2-2: ACLR absolute ***basic*** limits for DL and UL for WA class, for DL for MR class and for DL for LA class

|  |  |
| --- | --- |
| Repeater category / class | ACLR absolute basic *limit* |
| Category A Wide Area DL and UL | -13 dBm/MHz |
| Category B Wide Area DL and UL | -15 dBm/MHz |
| Medium Range DL | -25 dBm/MHz |
| Local Area DL | -32 dBm/MHz |

Table 6.5.2.2-3: ACLR limit in non-contiguous spectrum or multiple bands for DL (all repeater classes) and for UL for Wide Area class

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) **(NOTE 6)** | *Gap between passbands* or inter-*passband* *gap* size (Wgap) where the limit applies (MHz) | *Repeater type 1-C* adjacent channel centre frequency offset below or above the passband edge (inside the gap) | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit** |
| 5, 10, 15, 20 | Wgap ≥ 15 (Note 3)  Wgap ≥ 45 (Note 4) | 2.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
|  | Wgap ≥ 20 (Note 3)  Wgap ≥ 50 (Note 4) | 7.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
| 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | Wgap ≥ 60 (Note 4)  Wgap ≥ 30 (Note 3) | 10 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
|  | Wgap ≥ 80 (Note 4)  Wgap ≥ 50 (Note 3) | 30 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable in case the *repeater type 1-C nominal channel bandwidth* at the other edge of the gap is ≤ 20 MHz.  NOTE 4: Applicable in case the *repeater type 1-C nominal channel bandwidth* at the other edge of the gap is > 20 MHz.  NOTE 5: For repeater operating in band n104, ACLR requirement 38 dB applies. For repeater operating in other bands, ACLR requirement 45 dB applies.  NOTE 6: For simultaneous NCR-Fwd and NCR-MT transmission, if the NCR-MT carrier is within the NCR-Fwd then the nominal bandwidth shall be the NCR-Fwd passband. If the NCT-MT carrier is adjacent to the NCR-Fwd passband then the nominal bandwidth shall be the combined bandwidth of NCR-Fwd passband and NCR-MT carrier bandwidth. If the NCR-MT carrier is not adjacent to the passband then CACLR shall be applied in the gap between the NCR-Fwd passband and the NCR-MT carrier. | | | | | |

Table 6.5.2.2-3a: ACLR limit in non-contiguous spectrum or multiple bands for UL for Local Area class

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) **(NOTE 5)** | Sub-block or inter-*passband* *gap* size (Wgap) where the limit applies (MHz) | *Repeater type 1-C* adjacent channel centre frequency offset below or above the passband edge (inside the gap) | Assumed adjacent channel carrier | Filter on the adjacent channel frequency and corresponding filter bandwidth | ACLR limit |
| 5, 10, 15, 20 | Wgap ≥ 15 (Note 3)  Wgap ≥ 45 (Note 4) | 2.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
|  | Wgap ≥ 20 (Note 3)  Wgap ≥ 50 (Note 4) | 7.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
| 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | Wgap ≥ 60 (Note 4)  Wgap ≥ 30 (Note 3) | 10 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
|  | Wgap ≥ 80 (Note 4)  Wgap ≥ 50 (Note 3) | 30 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable in case the *repeater type 1-C nominal channel bandwidth* at the other edge of the gap is ≤ 20 MHz.  NOTE 4: Applicable in case the *repeater type 1-C nominal channel bandwidth* at the other edge of the gap is > 20 MHz.  NOTE 5: For simultaneous NCR-Fwd and NCR-MT transmission, if the NCR-MT carrier is within the NCR-Fwd then the nominal bandwidth shall be the NCR-Fwd passband. If the NCT-MT carrier is adjacent to the NCR-Fwd passband then the nominal bandwidth shall be the combined bandwidth of NCR-Fwd passband and NCR-MT carrier bandwidth. If the NCR-MT carrier is not adjacent to the passband then CACLR shall be applied in the gap between the NCR-Fwd passband and the NCR-MT carrier. | | | | | |

The Cumulative Adjacent Channel Leakage power Ratio (CACLR) in a *gap between passbands* or the *inter-passband gap* is the ratio of:

a) the sum of the filtered mean power centred on the assigned channel frequencies for the two carriers adjacent to each side of the *gap between passbands* or the *inter-passband gap*, and

b) the filtered mean power centred on a frequency channel adjacent to one of the respective *repeater type 1-C passband edges*.

The assumed filter for the adjacent channel frequency is defined in table 6.5.3.2-4 and the filters on the assigned channels are defined in table 6.5.2.2-6.

CACLR shall also be applied in case NCR-Fwd and NCR-MT transmit simultaneously in uplink and the NCR-Fwd passband and NCR-MT carrier are not contiguous. In this case, the gap between the NCR-Fwd passband and the NCR-MT carrier shall be considered in the same manner as a *gap between passbands*.

For operation in *non-contiguous spectrum* or multiple bands, the CACLR for NR carriers located on either side of the *gap between passbands* or the *inter-passband gap* shall be higher than the value specified in table 6.5.2.2-4.

Table 6.5.2.2-4: CACLR limit for DL (all repeater classes) and for UL for Wide Area class

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) | *Gap between passbands* or inter-*passband* *gap* size (Wgap) where the limit applies (MHz) | adjacent channel centre frequency offset below or above the passband edge (inside the gap) | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **CACLR limit** |
| 5, 10, 15, 20 | 5 ≤Wgap< 15 (Note 3)  5 ≤Wgap< 45 (Note 4) | 2.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
|  | 10 < Wgap< 20 (Note 3)  10 ≤Wgap< 50 (Note 4) | 7.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
| 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | 20 ≤Wgap< 60 (Note 4)  20 ≤Wgap< 30 (Note 3) | 10 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
|  | 40 < Wgap< 80 (Note 4)  40 ≤Wgap< 50 (Note 3) | 30 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 45 dB  38 dB (Note 5) |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable in case the *nominal channel bandwidth* at the other edge of the gap is ≤ 20 MHz.  NOTE 4: Applicable in case the *nominal channel bandwidth* at the other edge of the gap is > 20MHz.  NOTE 5: For repeater operating in band n104, ACLR requirement 38 dB applies. For repeater operating in other bands, ACLR requirement 45 dB applies. | | | | | |

The CACLR shall be higher than the value specified in table 6.5.2.2-4a for UL Local Area.

Table 6.5.2.2-4a: *C*ACLR limit for UL for Local Area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| nominal channel bandwidth BWNominal (MHz) | *Gap between passbands* or inter-*passband* *gap* size (Wgap) where the limit applies (MHz) | adjacent channel centre frequency offset below or above the passband edge (inside the gap) | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **CACLR limit** |
| 5, 10, 15, 20 | 5 ≤Wgap< 15 (Note 3)  5 ≤Wgap< 45 (Note 4) | 2.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
|  | 10 < Wgap< 20 (Note 3)  10 ≤Wgap< 50 (Note 4) | 7.5 MHz | 5 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
| 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 | 20 ≤Wgap< 60 (Note 4)  20 ≤Wgap< 30 (Note 3) | 10 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
|  | 40 < Wgap< 80 (Note 4)  40 ≤Wgap< 50 (Note 3) | 30 MHz | 20 MHz NR (Note 2) | Square (BWConfig) | 31 dB |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable in case the *nominal channel bandwidth* at the other edge of the gap is ≤ 20 MHz.  NOTE 4: Applicable in case the *nominal channel bandwidth* at the other edge of the gap is > 20 MHz. | | | | | |

The CACLR absolute *minimum requirement* is specified in table 6.5.2.2‑5.

Table 6.5.2.2-5:CACLR absolute **basic**  *limit* for DL and UL for WA class, for DL for MR class and for DL for LA class

|  |  |
| --- | --- |
| *Repeater* category / class | CACLR absolute basic *limit* |
| Category A Wide Area DL and UL | -13 dBm/MHz |
| Category B Wide Area DL and UL | -15 dBm/MHz |
| Medium Range DL | -25 dBm/MHz |
| Local Area DL | -32 dBm/MHz |

Table 6.5.2.2-6: Filter parameters for the assigned channel

|  |  |
| --- | --- |
| RAT of the carrier adjacent to the *gap between passbands* or *inter-passband gap* | Filter on the assigned channel frequency and corresponding filter bandwidth |
| NR | NR of same BW with SCS that provides largest *transmission bandwidth configuration* |

6.5.2.3 Minimum requirement for *RF repeater*

The ACLR (CACLR) absolute *basic limits* or the ACLR (CACLR) *limits*, whichever is less stringent, shall apply for each *antenna connector*.

For Band n41 and n90 operation in Japan, absolute ACLR limits shall be applied to the sum of the absolute ACLR power over all *antenna connectors* for *repeater type 1-C*.

6.5.2.4 Minimum requirement for *NCR*

##### 6.5.2.4.1 Minimum requirements for NCR-Fwd

6.5.2.4.1.1 Minimum requirements for NCR-Fwd type 1-C

The ACLR (CACLR) absolute *basic limits* or the ACLR (CACLR) *limits*, whichever is less stringent, shall apply for each *antenna connector*.

For Band n41 and n90 operation in Japan, absolute ACLR limits shall be applied to the sum of the absolute ACLR power over all *antenna connectors* for NCR-Fwd *type 1-C*.

6.5.2.4.1.2 Minimum requirement for *NCR-Fwd type 1-H*

The ACLR (CACLR) absolute *basic limits* + X (where X = 10log10(NTXU,countedpercell) for DL and for WA UL and X=0 for LA UL) or the ACLR (CACLR) *limits*, whichever is less stringent, shall apply for each *TAB connector TX min cell group*. For joint transmission of NCR-Fwd and NCR-MT in uplink, the limits shall apply to the sum of emissions from both NCR-Fwd and NCR-MT.

NOTE: Conformance to the *NCR-Fwd type 1-H* ACLR requirement can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The ratio of the sum of the filtered mean power measured on each *TAB connector* in the *TAB connector TX min cell group* at the assigned channel frequency to the sum of the filtered mean power measured on each *TAB connector* in the *TAB connector TX min cell group* at the adjacent channel frequency shall be greater than or equal to the ACLR *basic limit* of the repeater. This shall apply for each *TAB connector TX min cell group*.

Or

2) The ratio of the filtered mean power at the *TAB connector* centred on the assigned channel frequency to the filtered mean power at this *TAB connector* centred on the adjacent channel frequency shall be greater than or equal to the ACLR *basic limit* of the repeater for every *TAB connector* in the *TAB connector TX min cell group*, for each *TAB connector TX min cell group*.

In case the ACLR (CACLR) absolute *basic limit* of *repeater type 1-H* are applied, the conformance can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The sum of the filtered mean power measured on each *TAB connector* in the *TAB connector TX min cell group* at the adjacent channel frequency shall be less than or equal to the ACLR (CACLR) absolute ba*sic limit* + X of the repeater. This shall apply to each *TAB* connector *TX min cell group.*

Or

2) The filtered mean power at each *TAB connector* centred on the adjacent channel frequency shall be less than or equal to the ACLR (CACLR) absolute *basic limit* + X of the repeater scaled by X -10log10(*n*) for every *TAB connector* in the *TAB connector TX min cell group*, for each *TAB connector TX min cell group*, where *n* is the number of *TAB connectors* in the *TAB connector TX min cell group.*

##### 6.5.2.4.2 Minimum requirement for NCR-MT

6.5.2.4.2.1 Minimum requirements for NCR-MT type 1-C

For WA NCR-MT type 1-C, the BS ACLR basic requirements specified in clause 6.6.3 and 6.6.4 in TS 38.104 apply.

For LA NCR-MT type 1-C, the UE ACLR requirements specified in clause 6.5.2.5 in TS 38.101-1 apply.

For simultaneous transmission the limits apply for sum of NCR-MT transmission and NCR-Fwd transmission

6.5.2.4.2.2 Minimum requirements for NCR-MT type 1-H

Limits for NCR-MT type 1-H apply to the sum of emissions across all TAB connectors.

For WA NCR-MT type 1-H, the repeater relative ACLR requirements specified in clause 6.6.3 and 6.6.4 in TS 38.104 apply. For Absolute ACLR requirements, the following scaling factor should be added on on top of NCR-MT type 1-C basic limit requirements.

10log(NTXU,counted), where NTXU,counted = min(NTXU,active ,8)

For LA NCR-MT type 1-H, the UE ACLR requirements specified in clause 6.5.2.5 in TS 38.101-1 apply.

For simultaneous transmission the limits apply for sum of NCR-MT transmission and NCR-Fwd transmission.

### 6.5.3 Operating band unwanted emissions

#### 6.5.3.1 General

Unless otherwise stated, the operating band unwanted emission (OBUE) *basic* limits for DL are defined from ΔfOBUE below the lowest frequency of each supported downlink *operating band* up to ΔfOBUE above the highest frequency of each supported downlink *operating band*. The values of ΔfOBUE are defined in table 6.5.1‑1 for the NR *operating bands*.

Unless otherwise stated, the operating band unwanted emission (OBUE) *basic* limits for UL are defined from ΔfOBUE below the lowest frequency of each supported uplink *operating band* up to ΔfOBUE above the highest frequency of each supported uplink *operating band*. The values of ΔfOBUE are defined in table 6.5.1‑2 for the NR *operating bands*.

The requirements shall apply whatever the type of transmitter considered and for all transmission modes foreseen by the manufacturer’s specification. In addition, for *repeater* operating in *non-contiguous spectrum*, the *basic limits* apply inside any *gap between passbands*. In addition, for a *repeater* operating in multiple bands, the *basic limits* apply inside any *inter-passband* *gap*.

*Basic Limits* are specified in the tables below, where:

- Δf is the separation between the *passband edge* frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency.

- f\_offset is the separation between the *passband edge* frequency and the centre of the measuring filter.

- f\_offsetmax is the offset to the frequency ΔfOBUE outside the downlink *operating band* of *repeater type 1-C* DL and uplink *operating band* of *repeater type 1-C* UL, where ΔfOBUE is defined in tables 6.5.1-1 and 6.5.1-2.

- Δfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter.

For a *multi-band connector* inside any *inter-passband gaps* with Wgap < 2\*ΔfOBUE, a combined *basic limit* shall be applied which is the cumulative sum of the *basic limit* requirement specified at the *repeater type 1-C passband edges* on each side of the *inter-passband gap*. The *basic limit* requirement for *repeater type 1-C Bandwidth edge* is specified in clauses 6.5.3.2.1 to 6.5.3.2.4 below, where in this case:

- Δf is the separation between the *repeater type 1-C passband edge* frequency and the nominal -3 dB point of the measuring filter closest to the *repeater type 1-C passband edge*.

- f\_offset is the separation from the *repeater type 1-C passband edge* frequency to the centre of the measuring filter.

- f\_offsetmax is equal to the *inter-passband gap* minus half of the bandwidth of the measuring filter.

- Δfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter.

For a *multi-band connector* of DL, the operating band unwanted emission basic limits apply also in a supported downlink *operating band* without any carrier transmitted, in the case where there are carrier(s) transmitted in another supported downlink *operating band*. In this case, no cumulative *basic limit* is applied in the *inter-band gap* between a supported downlink *operating band* with carrier(s) transmitted and a supported downlink *operating band* without any carrier transmitted and

- In case the *inter-band gap* between a supported downlink *operating band* with carrier(s) transmitted and a supported downlink *operating band* without any carrier transmitted is less than 2\*ΔfOBUE, f\_offsetmax shall be the offset to the frequency ΔfOBUE MHz outside the outermost edges of the two supported downlink *operating bands* and the operating band unwanted emission minimum requirement of the band where there are carriers transmitted, as defined in the tables of the present clause, shall apply across both downlink bands.

- In other cases, the operating band unwanted emission *basic limit* of the band where there are carriers transmitted, as defined in the tables of the present clause for the largest frequency offset (Δfmax), shall apply from ΔfOBUE MHz below the lowest frequency, up to ΔfOBUE MHz above the highest frequency of the supported downlink *operating band* without any carrier transmitted.

For a *multi-band connector* of UL, the operating band unwanted emission limits apply also in a supported uplink *operating band* without any carrier transmitted, in the case where there are carrier(s) transmitted in another supported uplink *operating band*. In this case, no cumulative *basic limit* is applied in the *inter-band gap* between a supported uplink *operating band* with carrier(s) transmitted and a supported uplink *operating band* without any carrier transmitted and

- In case the inter-band gap between a supported uplink operating band with carrier(s) transmitted and a supported uplink operating band without any carrier transmitted is less than 2\* ΔfOBUE, f\_offsetmax shall be the offset to the frequency ΔfOBUE MHz outside the outermost edges of the two supported uplink operating bands and the operating band unwanted emission *basic limit* of the band where there are carriers transmitted, as defined in the tables of the present clause, shall apply across both uplink bands.

- In other cases, the operating band unwanted emission basic limits of the band where there are carriers transmitted, as defined in the tables of the present clause for the largest frequency offset (Δfmax), shall apply from ΔfOBUE MHz below the lowest frequency, up to ΔfOBUE MHz above the highest frequency of the supported uplink operating band without any carrier transmitted.

In addition, inside any *gap between passbands* for a *single-band connector* operating in *non-contiguous spectrum*, a combined basic limit shall be applied which is the cumulative sum of the basic limitspecified for the adjacent *sub-blocks* on each side of the *gap between passbands*. The basic limit for each *sub-block* is specified in clauses 6.5.3.2.1 to 6.5.3.2.4 below, where in this case:

- Δf is the separation between the *sub-block* edge frequency and the nominal -3 dB point of the measuring filter closest to the *sub-block* edge.

- f\_offset is the separation between the *sub-block* edge frequency and the centre of the measuring filter.

- f\_offsetmax is equal to the *gap between passbands* bandwidth minus half of the bandwidth of the measuring filter.

- Δfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter.

For Wide Area *repeater type 1-C*, the basic limits of either clause 6.5.3.2.1 (Category A limits) or clause 6.5.3.2.2 (Category B limits) shall apply.

For Medium Range *repeater type 1-C*, the basic limits in clause 6.5.3.2.3 shall apply (Category A and B).

For Local Area *repeater type 1-C*, the basic limits of clause 6.5.3.2.4 shall apply (Category A and B).

The application of either Category A or Category B basic limits shall be the same as for Transmitter spurious emissions in clause 6.5.4.

In addition to, for the part of passband where there is no input signal at DL input port, the basic limits in Table 6.5.2.2-2 shall apply. In addition to, for the part of passband where there is no input signal at UL input port, the basic limits in clause 6.5.3.2.6 shall apply.

#### 6.5.3.2 Basic limits

##### 6.5.3.2.1 basic limits for Wide Area repeater type 1-C (Category A)

For repeater operating in Bands n5, n8, n12, n13, n14, n18, n26, n28, n29, n71, n85, basic limits are specified in table 6.5.3.2.1‑1.

Table 6.5.3.2.1-1: Wide Area operating band unwanted emission basic limits (NR bands below 1 GHz) for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | *Basic limits* (Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf <  min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset <  min(10.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax | -13 dBm (Note 3) | 100 kHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission limits within *gaps between passbands* shall be ‑13 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*, where the contribution from the far-end *sub-block* or *passband* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block* or *passband*.  NOTE 3: The basic limit is not applicable when Δfmax < 10 MHz. | | | |

For repeater operating in Bands n1, n2, n3, n7, n24, n25, n30, n34, n38, n39, n40, n41, n48, n50, n54, n65, n66, n70, n74, n75, n77, n78, n79, n90, n92, n94, basic limits are specified in table 6.5.3.2.1-2.

Table 6.5.3.2.1-2: Wide Area *operating band* unwanted emission basic limits (NR bands above 1 GHz) for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | *Basic limit* (Notes 1, 2 | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf <  min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset <  min(10.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.5 MHz ≤ f\_offset < f\_offsetmax | -13 dBm (Note 3) | 1MHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*, where the contribution from the far-end *sub-block* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be ‑13 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*, where the contribution from the far-end *sub-block* or *passband* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block* or *passband*.  NOTE 3: The basic limit is not applicable when Δfmax < 10 MHz. | | | |

##### 6.5.3.2.2 Basic limit for Wide Area *repeater type 1-C* (Category B)

For Category B Operating band unwanted emissions, there are two options for the *basic limits* that may be applied regionally. Either the *basic limits* in clause 6.5.3.2.2.1 or clause 6.5.3.2.2.2 shall be applied.

6.5.3.2.2.1 Category B basic limits (Option 1)

For *repeater* operating in Bands n5, n8, n12, n20, n26, n28, n29, n67, n71, n85, the basic limits are specified in table 6.5.3.2.2.1-1:

Table 6.5.3.2.2.1-1: Wide Area operating band unwanted emission ***basic limits*** (NR bands below 1 GHz) for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limit*** (Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf <  min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset <  min(10.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax | -16 dBm (Note 3) | 100 kHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be ‑15 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 10 MHz. | | | |

For repeater operating in Bands n1, n2, n3, n7, n25, n34, n38, n39, n40, n41, n48, n50, n65, n66, n70, n75, n77, n78, n79, n90, n92, n94, basic limits are specified in table 6.5.3.2.2.1-2.

Table 6.5.3.2.2.1-2: Wide Area *repeater type 1-C* operating band unwanted emission basic limits for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits***(Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf <  min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset <  min(10.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.5 MHz ≤ f\_offset < f\_offsetmax | -15 dBm (Note 3) | 1MHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*, where the contribution from the far-end *sub-block* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be ‑15 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*, where the contribution from the far-end *sub-block* or *passband* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block* or *passband*.  NOTE 3: The basic limit is not applicable when Δfmax < 10 MHz. | | | |

For *repeater type 1-C* operating in Band n104, the *basic* limits are specified in tables 6.5.3.2.2.1-2a:

Table 6.5.3.2.2.1-2a: Wide Area operating band unwanted emission basic limits for band n104 for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits | Measurement bandwidth |
| 0 MHz ≤ Δf < 20 MHz | 0.05 MHz ≤ f\_offset < 20.05 MHz |  | 100 kHz |
| 20 MHz ≤ Δf <  min(40 MHz, Δfmax) | 20.05 MHz ≤ f\_offset <  min(40.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz |
| 40 MHz ≤ Δf ≤ Δfmax | 40.5 MHz ≤ f\_offset < f\_offsetmax | -15 dBm (Note 3) | 1MHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passband*, where the contribution from the far-end *sub-block* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block*. Exception is f ≥ 40MHz from both adjacent *sub-blocks* on each side of the *gap between passband*, where the emission basic limits within *gaps between passbands* shall be ‑15 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*, where the contribution from the far-end *sub-block* or *passband* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block* or *passband*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 40 MHz. | | | |

6.5.3.2.2.2 Category B *basic limits* (Option 2)

The basic limits in this clause are intended for Europe and may be applied regionally for *repeater type 1-C* operating in bands n1, n3, n7, n8, n38, n65.

For a *repeater type 1-C* operating in bands n1, n3, n7, n8, n38 or n65, *basic limits* are specified in Table 6.5.3.2.2.2-1:

Table 6.5.3.2.2.2-1: Regional Wide Area operating band unwanted emission ***basic limits*** for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits*** (Notes 1, 2 | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 0.2 MHz | 0.015 MHz ≤ f\_offset < 0.215 MHz | -14 dBm | 30 kHz |
| 0.2 MHz ≤ Δf < 1 MHz | 0.215 MHz ≤ f\_offset < 1.015 MHz |  | 30 kHz |
| (Note 4) | 1.015 MHz ≤ f\_offset < 1.5 MHz | -26 dBm | 30 kHz |
| 1 MHz ≤ Δf ≤  min(10 MHz, Δfmax) | 1.5 MHz ≤ f\_offset <  min(10.5 MHz, f\_offsetmax) | -13 dBm | 1 MHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.5 MHz ≤ f\_offset < f\_offsetmax | -15 dBm (Note 3) | 1 MHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band*, the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*, where the contribution from the far-end *sub-block* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be ‑15 dBm/1 MHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*, where the contribution from the far-end *sub-block* or *passband* shall be scaled according to the *measurement bandwidth* of the near-end *sub-block* or *passband*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 10 MHz.  NOTE 4: This frequency range ensures that the range of values of f\_offset is continuous. | | | |

##### 6.5.3.2.3 *Basic limits* for Medium Range *repeater type 1-C* (Category A and B) for DL

For Medium Range *repeater* for DL, *basic limits* are specified in table 6.5.3.2.3-1 and table 6.5.3.2.3-2.

For the tables in this clause for *repeater,* Prated,x = Prated,p,AC - 10\*log (ceil (BWPassband/20MHz))

Table 6.5.3.2.3-1: Medium Range *repeater operating band* unwanted emission ***basic limits***, 31< Prated,x ≤ 38 dBm

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits***(Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf < min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset < min(10.05 MHz, f\_offsetmax) | Prated,x - 60dB | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax | Min(Prated,x - 60dB, -25dBm) (Note 3) | 100 kHz |
| NOTE 1: For a *repeater* DL supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be Min(Prated,x -60dB, ‑25dBm)/100kHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 10 MHz. | | | |

For *repeater* operating in Band n104, the limits are specified in Table 6.5.3.2.3-1a and Table 6.5.3.2.3-2a.

Table 6.5.3.2.3-1a. Medium Range *repeater operating band* unwanted emission ***basic*** limits for band n104, 31< Prated,x ≤ 38 dBm

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits***(Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 20 MHz | 0.05 MHz ≤ f\_offset < 20.05 MHz |  | 100 kHz |
| 20 MHz ≤ Δf <  min(40 MHz, Δfmax) | 20.05 MHz ≤ f\_offset <  min(40.05 MHz, f\_offsetmax) | Prated,x - 60dB | 100 kHz |
| 40 MHz ≤ Δf ≤ Δfmax | 40.05 MHz ≤ f\_offset < f\_offsetmax | Min(Prated,x - 60dB, -25dBm) (Note 3) | 100 kHz |
| NOTE 1: For a *repeater* DL supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passband*. Exception is f ≥ 40MHz from both adjacent *sub-blocks* on each side of the *gap between passband*, where the emission basic limits within *gaps between passbands* shall be Min(Prated,x -60dB, ‑25dBm)/100kHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 40 MHz. | | | |

Table 6.5.3.2.3-2: Medium Range *repeater* operating band unwanted emission ***basic limits***, Prated,x ≤ 31 dBm

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits*** (Notes 1, 2 | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf < min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset < min(10.05 MHz, f\_offsetmax) | -29 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax | -29 dBm (Note 3) | 100 kHz |
| NOTE 1: For a *repeater* DL supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be -29dBm/100kHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 10 MHz. | | | |

Table 6.5.3.2.3-2a. Medium Range *repeater* operating band unwanted emission ***basic*** limits for band 104, Prated,x ≤ 31 dBm

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | *basic limits* (Notes 1, 2 | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 20 MHz | 0.05 MHz ≤ f\_offset < 20.05 MHz |  | 100 kHz |
| 20 MHz ≤ Δf <  min(40 MHz, Δfmax) | 20.05 MHz ≤ f\_offset <  min(40.05 MHz, f\_offsetmax) | -29 dBm | 100 kHz |
| 40 MHz ≤ Δf ≤ Δfmax | 40.05 MHz ≤ f\_offset < f\_offsetmax | -29 dBm | 100 kHz |
| NOTE 1: For a *repeater* DL supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passband*. Exception is f ≥ 40MHz from both adjacent *sub-blocks* on each side of the *gap between passband*, where the emission basic limits within *gaps between passbands* shall be -29dBm/100kHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*.  NOTE 3: The *basic limit* is not applicable when Δfmax < 40 MHz. | | | |

##### 6.5.3.2.4 *Basic limits* for Local Area *repeater type 1-C* (Category A and B)

For Local Area, *basic limits* are specified in table 6.5.3.2.4-1.

Table 6.5.3.2.4-1: Local Area *repeater* operating band unwanted emission basic limits

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits***  (Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz |  | 100 kHz |
| 5 MHz ≤ Δf < min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset < min(10.05 MHz, f\_offsetmax) | -37 dBm | 100 kHz |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax | -37 dBm (Note 10) | 100 kHz |
| NOTE 1: For a *repeater* supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. Exception is f ≥ 10MHz from both adjacent *sub-blocks* on each side of the *gap between passbands*, where the emission basic limits within *gaps between passbands* shall be -37dBm/100kHz.  NOTE 2: For a *multi-band connector* with *inter-passband gap* < 2\*ΔfOBUE the emission basic limits within the *inter-passband gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or *passband* on each side of the *inter-passband gap*  NOTE 3: The basic limit is not applicable when Δfmax < 10 MHz. | | | |

For *repeater*  operating in Band n104, *basic limits* are specified in Table 6.5.3.2.4-1a.

Table 6.5.3.2.4-1a. Local Area *repeater* operating band unwanted emission ***basic*** limits for band n104

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | ***Basic limits***(Notes 1, 2) | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 20 MHz | 0.05 MHz ≤ f\_offset < 20.05 MHz |  | 100 kHz |
| 20 MHz ≤ Δf <  min(40 MHz, Δfmax) | 20.05 MHz ≤ f\_offset <  min(40.05 MHz, f\_offsetmax) | -37 dBm | 100 kHz |
| 40 MHz ≤ Δf ≤ Δfmax | 40.05 MHz ≤ f\_offset < f\_offsetmax | -37 dBm | 100 kHz |
| NOTE 1: For a repeater supporting *non-contiguous spectrum* operation within any *operating band* the emission basic limits within *sub-block gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *sub-block gap*. Exception is f ≥ 40MHz from both adjacent *sub-blocks* on each side of the *sub-block gap*, where the emission basic limits within *sub-block gaps* shall be -37dBm/100kHz.  NOTE 2: For a *multi-band connector* with *Inter RF Bandwidth gap* < 2\*ΔfOBUE the emission basic limits within the *Inter RF Bandwidth gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* or RF Bandwidth on each side of the *Inter RF Bandwidth gap*  NOTE 3: The basic limit is not applicable when Δfmax < 40 MHz. | | | |

##### 6.5.3.2.5 Additional *basic limits*

6.5.3.2.5.1 Limits in FCC Title 47

In addition to the basic limits in clauses 6.5.3.2.1, 6.5.3.2.2, 6.5.3.2.3 and 6.5.3.2.4, the *repeater type 1-C* may have to comply with the applicable emission basic limits established by FCC Title 47 [10], when deployed in regions where those limits are applied, and under the conditions declared by the manufacturer.

6.5.3.2.5.2 Protection of DTT

In certain regions the following basic limit may apply for protection of DTT. For *repeater type 1-C* operating in Band n20, the level of emissions in the band 470-790 MHz, measured in an 8 MHz filter bandwidth on centre frequencies Ffilter according to table 6.5.3.2.5.2-1, a basic limitPEM,N is declared by the manufacturer. This basic limit applies in the frequency range 470-790 MHz even though part of the range falls in the spurious domain.

Table 6.5.3.2.5.2-1: Declared emissions *basic limit* for protection of DTT

|  |  |  |
| --- | --- | --- |
| **Filter centre frequency, Ffilter** | ***Measurement bandwidth*** | **Declared emission *basic limit* (dBm)** |
| Ffilter = 8\*N + 306 (MHz);  21 ≤ N ≤ 60 | 8 MHz | PEM,N |

Note: The regional requirement is defined in terms of EIRP (effective isotropic radiated power), which is dependent on both the repeater emissions at the *antenna connector* and the deployment (including antenna gain and feeder loss). The requirement defined above provides the characteristics of the repeater needed to verify compliance with the regional requirement. Compliance with the regional requirement can be determined using the method outlined in TS 36.104 [20], annex F.

##### 6.5.3.2.6 Basic limit inside passband with no UL input signal

The requirement is defined as a function of frequency offset from the edge of some part of passband with non-zero input signal. The requirement is measured as the ratio of the repeater output power in a zero-input basic unit to the repeater output power in a non-zero input basic unit. Basic unit equal to 360KHz.

The average of the basic limits over 10 sub-frames shall not exceed the values specified in Table 6.5.3.2.6-1.

Table 6.5.3.2.6-1: Basic limits inside passband with no UL input signal

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Basic Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any zero-input basic unit (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
|  |  | -25 | Image frequencies when output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
|  |  | -25 | 0 dBm ≤ Output power ≤ 10 dBm |  |
|  |  | -20 | -30 dBm ≤ Output power < 0 dBm |  |
|  |  | -10 | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: requirement is evaluated in each zero-input basic unit. For each such basic unit, the minimum requirement is calculated as the higher of - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. is defined in NOTE 10.  NOTE 2: The measurement bandwidth is one basic unit and the limit is expressed as a ratio of measured power in one zero-input basic unit to the measured average power per non-zero input basic unit, where the averaging is done across all non-zero input parts of the passband.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the non-zero input part of passband, based on symmetry with respect to the carrier leakage frequency, but excluding any non-zero input basic units.  NOTE 4: The measurement bandwidth is 1 basic unit and the limit is expressed as a ratio of measured power in one zero-input basic unit to the measured total power in all non-zero input basic units  NOTE 5: The applicable frequencies are those that are enclosed either in the basic unit containing the carrier leakage frequency, or in the two basic units immediately adjacent to the carrier leakage frequency but excluding any non-zero input basic units.  NOTE 6: *LCRB* is the .  NOTE 7: *NRB* is the .  NOTE 8: *EVM* is the limit specified in Table 6.6.2.2-1 for the modulation format used in the non-zero input basic units..  NOTE 9:  is the starting frequency offset between the end of nearest non-zero input basic unit and the measured zero-input basic unit (e.g. *∆RB*= 1 or *∆RB*= -1 for the first zero-input basic unit outside of the non-zero input part of passband.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of non-zero input basic units, measured in dBm. | | | | |

6.5.3.3 Minimum requirement for NCR

6.5.3.3.1 Minimum requirement for NCR-Fwd

6.5.3.4.1.1 Minimum requirement for NCR-Fwd type 1-C

The operating band unwanted emissions for *NCR-Fwd type 1-C* for each *antenna connector* shall be below the applicable *basic limits* defined in clause 6.5.3.2.

For Band n41 and n90 operation in Japan, the operating band unwanted emissions limits shall be applied to the sum of the emission power over all *antenna connectors* for *NCR-Fwd type 1-C.*

For joint transmission of NCR-Fwd and NCR-MT in the uplink, the operating band unwanted emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

6.5.3.4.1.2 Minimum requirement for *NCR-Fwd type 1-H*

The operating band unwanted emissions requirements for *NCR-Fwd type 1-H* are that for each *TAB connector TX min cell group* and each applicable *basic limit* in clause 6.5.3.2, the power summation emissions at the *TAB connectors* of the *TAB connector TX min cell group* shall not exceed a limit specified as the *basic limit* + X, where X = 10log10(NTXU,countedpercell) for DL and for UL WA and X=0 for UL LA.

For joint transmission of NCR-Fwd and NCR-MT in the uplink, the operating band unwanted emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

NOTE: Conformance to the *repeater type 1-H* spurious emission requirement can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The sum of the emissions power measured on each *TAB connector* in the *TAB connector TX min cell group* shall be less than or equal to the limit as defined in this clause for the respective frequency span.

Or

2) The unwanted emissions power at each *TAB connector* shall be less than or equal to the *repeater type 1-H* limit as defined in this clause for the respective frequency span, scaled by -10log10(n), where n is the number of *TAB connectors* in the *TAB connector TX min cell group*.

6.5.3.3.2 Minimum requirement for NCR-MT

6.5.3.3.2.1 Minimum requirements for NCR-MT type 1-C

For LA NCR-MT type 1-C, regardless of simultaneous transmission with NCR- Fwd is transmiting, the UE spectrum emission mask requirements specified in clause 6.5.2 in TS 38.101-1 applies .

For WA NCR-MT type 1-C, regardless of simultaneous transmission between NCR-MT and NCR-Fwd, the BS requirements specified in clause 6.6.4 in TS 38.104 apply.

For simultaneous transmission the limits apply for sum of NCR-MT transmission and NCR-Fwd transmission.

6.5.3.3.2.2 Minimum requirements for NCR-MT type 1-H

Limits for NCR-MT type 1-H apply to the sum of emissions across all TAB connectors.

For LA NCR-MT type 1-H, regardless of simultaneous transmission with NCR- Fwd is transmiting, the UE spectrum emission mask requirements specified in clause 6.5.2 in TS 38.101-1 applies without scaling factor allowed.

For WA NCR-MT type 1-H, the repeater basic requirements specified in clause 6.6.4 in TS 38.104 relaxed with following scaling factor apply.

10log(NTXU,counted), where NTXU,counted = min(NTXU,active ,8)

For simultaneous transmission the limits apply for sum of NCR-MT transmission and NCR-Fwd transmission.

### 6.5.4 Transmitter spurious emissions

#### 6.5.4.1 General

The transmitter spurious emission limits shall apply from 9 kHz to 12.75 GHz, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink *operating band*, up to ΔfOBUE above the highest frequency of each supported downlink *operating band*, where the ΔfOBUE is defined in table 6.5.1-1. For some *operating bands*, the upper limit is higher than 12.75 GHz in order to comply with the 5th harmonic limit of the downlink *operating band*, as specified in ITU-R recommendation SM.329 [5].

For a *multi-band connector*, for each supported *operating band* together with ΔfOBUE around the band is excluded from the transmitter spurious emissions requirement.

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification.

Unless otherwise stated, all requirements are measured as mean power (RMS).

For Band n41 and n90 operation in Japan, the sum of the spurious emissions over all *antenna connectors* for *Repeater type 1-C* shall not exceed the *minimum requirements* defined in clause 6.5.5.2.

#### 6.5.4.2 *Basic limits*

##### 6.5.4.2.1 General transmitter spurious emissions *basic limits*

The *basic limits* of either table 6.5.4.2.1-1, table 6.5.4.2.1-2 (Category A limits) or table 6.5.4.2.1-3 (Category B limits) shall apply. The application of either Category A or Category B limits shall be the same as for operating band unwanted emissions in clause 6.5.3.

**Table 6.5.4.2.1-1: General transmitter spurious emission *basic limits* for DL in FR1, Category A**

|  |  |  |  |
| --- | --- | --- | --- |
| **Spurious frequency range** | ***Basic limit*** | ***Measurement bandwidth*** | **Notes** |
| 9 kHz – 150 kHz | -13 dBm | 1 kHz | Note 1 |
| 150 kHz – 30 MHz |  | 10 kHz | Note 1 |
| 30 MHz – 1 GHz |  | 100 kHz | Note 1 |
| 1 GHz 12.75 GHz |  | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the DL *operating band* in GHz |  | 1 MHz | Note 1, Note 2, Note 3 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [5], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 3: For DL, this spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the DL *operating band* is reaching beyond 12.75 GHz. | | | |

Table 6.5.4.2.1-2: General transmitter spurious emission ***basic limits*** for UL in FR1, Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Spurious frequency range | ***Basic limits*** | *Measurement bandwidth* | Notes |
| 9 kHz – 150 kHz | -36 dBm | 1 kHz | Note 1 |
| 150 kHz – 30 MHz |  | 10 kHz | Note 1 |
| 30 MHz – 1 GHz |  | 100 kHz | Note 1 |
| 1 GHz – 12.75 GHz | -30 dBm | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the DL *operating band* in GHz |  | 1 MHz | Note 1, Note 2, Note 3 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [5], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 3: For UL, this spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the UL *operating band* is reaching beyond 12.75 GHz. | | | |

Table 6.5.4.2.1-3: General transmitter spurious emission ***basic limits*** in FR1, Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Spurious frequency range | ***basic limits*** | *Measurement bandwidth* | Notes |
| 9 kHz – 150 kHz | -36 dBm | 1 kHz | Note 1 |
| 150 kHz – 30 MHz |  | 10 kHz | Note 1 |
| 30 MHz – 1 GHz |  | 100 kHz | Note 1 |
| 1 GHz – 12.75 GHz | -30 dBm | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the DL *operating band* in GHz |  | 1 MHz | Note 1, Note 2, Note 3 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [5], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 3: For DL, this spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the DL *operating band* is reaching beyond 12.75 GHz. For UL, this spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the UL *operating band* is reaching beyond 12.75 GHz. | | | |

##### 6.5.4.2.2 Additional spurious emissions *basic limits*

These *basic limits* may be applied for the protection of system operating in other frequency ranges. The limits may apply as an optional protection of such systems that are deployed in the same geographical area as the repeater-Node, or they may be set by local or regional regulation as a mandatory requirement for an NR *operating band*. It is in some cases not stated in the present document whether a requirement is mandatory or under what exact circumstances that a limit applies, since this is set by local or regional regulation. An overview of regional requirements in the present document is given in clause 4.5.

Some requirements may apply for the protection of specific equipment (UE, MS and/or BS) or equipment operating in specific systems (GSM, CDMA, UTRA, E-UTRA, NR, etc.) as listed below.

The spurious emission *basic limits* are provided in table 6.5.4.2.2-1 where requirements for co-existence with the system listed in the first column apply for *repeater type 1-C*. For a *multi-band connector*, the exclusions and conditions in the Note column of table 6.5.4.2.2-1 apply for each supported *operating band*.

Table 6.5.4.2.2-1: *Repeater type 1-C* spurious emissions basic limits for co-existence with systems operating in other frequency bands

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **System type to co-exist with** | **Frequency range for co-existence requirement** | ***basic limits*** | ***Measurement bandwidth*** | Note |
| GSM900 | 921 – 960 MHz | -57 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n8 |
|  | 876 – 915 MHz | -61 dBm | 100 kHz | For the frequency range 880-915 MHz, this basic limit does not apply to repeater operating in band n8, since it is already covered by the basic limit in clause 6.5.5.2.2. |
| DCS1800 | 1805 – 1880 MHz | -47 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n3. |
|  | 1710 – 1785 MHz | -61 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n3, since it is already covered by the basic limit in clause 6.5.5.2.2. |
| PCS1900 | 1930 – 1990 MHz | -47 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n2, n25 or band n70. |
|  | 1850 – 1910 MHz | -61 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n2 or n25 since it is already covered by the basic limit in clause 6.6.5.2.2. |
| GSM850 or | 869 – 894 MHz | -57 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n5 or n26. |
| CDMA850 | 824 – 849 MHz | -61 dBm | 100 kHz | This basic limit does not apply to repeater operating in band n5 or n26, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD | 2110 – 2170 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n1 or n65 |
| Band I or  E-UTRA Band 1 or NR Band n1 | 1920 – 1980 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n1 or n65, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD | 1930 – 1990 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n2 or n70. |
| Band II or  E-UTRA Band 2 or NR Band n2 | 1850 – 1910 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n2, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD | 1805 – 1880 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n3. |
| Band III or  E-UTRA Band 3 or NR Band n3 | 1710 – 1785 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n3, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band IV or  E-UTRA Band 4 | 2110 – 2155 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66 |
|  | 1710 – 1755 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band V or  E-UTRA Band 5 or NR Band n5 | 869 – 894 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n5 or n26. |
|  | 824 – 849 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n5 or n26, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD | 860 – 890 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n18. |
| Band VI, XIX or | 815 – 830 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n18, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 6, 18, 19 or NR Band n18 | 830 – 845 MHz | -49 dBm | 1 MHz |  |
| UTRA FDD Band VII or  E-UTRA Band 7 or NR Band n7 | 2620 – 2690 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n7. |
|  | 2500 – 2570 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n7, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band VIII or  E-UTRA Band 8 or NR Band n8 | 925 – 960 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n8. |
|  | 880 – 915 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n8, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band IX or  E-UTRA Band 9 | 1844.9 – 1879.9 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n3. |
|  | 1749.9 – 1784.9 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n3, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band X or  E-UTRA Band 10 | 2110 – 2170 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66 |
|  | 1710 – 1770 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band XI or XXI or  E-UTRA Band 11 or 21 | 1475.9 – 1510.9 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n50, n74, n75, n92 or n94. |
|  | 1427.9 – 1447.9 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n50, n51, n74, n75, n76, n91, n92, n93 or n94. |
|  | 1447.9 – 1462.9 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n50, n74, n75, n92 or n94. |
| UTRA FDD Band XII or  E-UTRA Band 12 or NR Band n12 | 729 – 746 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n12 or n85. |
|  | 699 – 716 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n12 or n85, since it is already covered by the basic limit in clause 6.6.5.2.2.  For NR repeater operating in n29, it applies 1 MHz below the Band n29 downlink operating band (Note 5). |
| UTRA FDD Band XIII or  E-UTRA Band 13 | 746 – 756 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n13. |
|  | 777 – 787 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n13, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band XIV or  E-UTRA Band 14 or NR band n14 | 758 – 768 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n14. |
|  | 788 – 798 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n14, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 17 | 734 – 746 MHz | -52 dBm | 1 MHz |  |
|  | 704 – 716 MHz | -49 dBm | 1 MHz | For NR repeater operating in n29, it applies 1 MHz below the Band n29 downlink operating band (Note 5). |
| UTRA FDD Band XX or E-UTRA Band 20 or NR Band n20 | 791 – 821 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20 or n28. |
|  | 832 – 862 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band XXII or E-UTRA Band 22 | 3510 – 3590 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n48, n77 or n78. |
|  | 3410 – 3490 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n77 or n78. |
| E-UTRA Band 24 | 1525 – 1559 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n24. |
|  | 1626.5 – 1660.5 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n24, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| UTRA FDD Band XXV or  E-UTRA Band 25 or NR band n25 | 1930 – 1995 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n2, n25 or n70. |
|  | 1850 – 1915 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n25 since it is already covered by the basic limit in clause 6.6.5.2.2. For repeater operating in Band n2, it applies for 1910 MHz to 1915 MHz, while the rest is covered in clause 6.6.5.2.2. |
| UTRA FDD Band XXVI or  E-UTRA Band 26 or NR Band n26 | 859 – 894 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n5 or n26. |
|  | 814 – 849 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n26 since it is already covered by the basic limit in clause 6.6.5.2.2. For repeater operating in Band n5, it applies for 814 MHz to 824 MHz, while the rest is covered in clause 6.6.5.2.2. |
| E-UTRA Band 27 | 852 – 869 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n5. |
|  | 807 – 824 MHz | -49 dBm | 1 MHz | This basic limit also applies to repeater operating in Band n28, starting 4 MHz above the Band n28 downlink operating band (Note 5). |
| E-UTRA Band 28 or NR Band n28 | 758 – 803 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20, n67 or n28. |
|  | 703 – 748 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n28, since it is already covered by the basic limit in clause 6.6.5.2.2.  For repeater operating in band n67, it applies for 703 MHz to 736 MHz. |
| E-UTRA Band 29 or NR Band n29 | 717 – 728 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n29 or n85 |
| E-UTRA Band 30 or NR Band n30 | 2350 – 2360 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n30 |
|  | 2305 – 2315 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n30, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 31 | 462.5 – 467.5 MHz | -52 dBm | 1 MHz |  |
|  | 452.5 – 457.5 MHz | -49 dBm | 1 MHz |  |
| UTRA FDD band XXXII or E-UTRA band 32 | 1452 – 1496 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n50, n74, n75, n92 or n94. |
| UTRA TDD Band a) or E-UTRA Band 33 | 1900 – 1920 MHz | -52 dBm | 1 MHz |  |
| UTRA TDD Band a) or E-UTRA Band 34 or NR band n34 | 2010 – 2025 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n34. |
| UTRA TDD Band b) or E-UTRA Band 35 | 1850 – 1910 MHz | -52 dBm | 1 MHz |  |
| UTRA TDD Band b) or E-UTRA Band 36 | 1930 – 1990 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n2 or n25. |
| UTRA TDD Band c) or E-UTRA Band 37 | 1910 – 1930 MHz | -52 dBm | 1 MHz |  |
| UTRA TDD Band d) or E-UTRA Band 38 or NR Band n38 | 2570 – 2620 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n38. |
| UTRA TDD Band f) or E-UTRA Band 39 or NR band n39 | 1880 – 1920MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n39. |
| UTRA TDD Band e) or E-UTRA Band 40 or NR Band n40 | 2300 – 2400MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n30 or n40. |
| E-UTRA Band 41 or NR Band n41, n90 | 2496 – 2690 MHz | -52 dBm | 1 MHz | This is not applicable to repeater operating in Band n41, n53 or [n90]. |
| E-UTRA Band 42 | 3400 – 3600 MHz | -52 dBm | 1 MHz | This is not applicable to repeater operating in Band n48, n77 or n78. |
| E-UTRA Band 43 | 3600 – 3800 MHz | -52 dBm | 1 MHz | This is not applicable to repeater operating in Band n48, n77 or n78. |
| E-UTRA Band 44 | 703 – 803 MHz | -52 dBm | 1 MHz | This is not applicable to repeater operating in Band n28. |
| E-UTRA Band 45 | 1447 – 1467 MHz | -52 dBm | 1 MHz |  |
| E-UTRA Band 46 | 5150 – 5925 MHz | -52 dBm | 1 MHz |  |
| E-UTRA Band 47 | 5855 – 5925 MHz | -52 dBm | 1 MHz |  |
| E-UTRA Band 48 or NR Band n48 | 3550 – 3700 MHz | -52 dBm | 1 MHz | This is not applicable to repeater operating in Band n48, n77 or n78. |
| E-UTRA Band 50 or NR band n50 | 1432 – 1517 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n74, n75, n76, n91, n92, n93 or n94. |
| E-UTRA Band 51 or NR Band n51 | 1427 – 1432 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n75, n76, n91, n92, n93 or n94. |
| E-UTRA Band 53 or NR Band n53 | 2483.5 - 2495 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n41, n53 or n90. |
| E-UTRA Band 54 or NR Band n54 | 1670 – 1675 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n54 |
| E-UTRA Band 65 or NR Band n65 | 2110 – 2200 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n1 or n65. |
|  | 1920 – 2010 MHz | -49 dBm | 1 MHz | For repeater operating in Band n1, it applies for 1980 MHz to 2010 MHz, while the rest is covered in clause 6.6.5.2.2.  This basic limit does not apply to repeater operating in band n65, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 66 or NR Band n66 | 2110 – 2200 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66. |
|  | 1710 – 1780 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 67 | 738 – 758 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n28 or n67. |
| E-UTRA Band 68 | 753 -783 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n28. |
|  | 698-728 MHz | -49 dBm | 1 MHz | For repeater operating in Band n28, this basic limit applies between 698 MHz and 703 MHz, while the rest is covered in clause 6.6.5.2.2. |
| E-UTRA Band 69 | 2570 – 2620 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n38. |
| E-UTRA Band 70 or NR Band n70 | 1995 – 2020 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n2, n25 or n70 |
|  | 1695 – 1710 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n70, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 71 or NR Band n71 | 617 – 652 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n71 or n105 |
|  | 663 – 698 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n71 or n105, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 72 | 461 – 466 MHz | -52 dBm | 1 MHz |  |
|  | 451 – 456 MHz | -49 dBm | 1 MHz |  |
| E-UTRA Band 74 or NR Band n74 | 1475 – 1518 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n50, n74, n75, n92 or n94. |
|  | 1427 – 1470 MHz | -49 dBm | 1MHz | This basic limit does not apply to repeater operating in band n50, n51, n74, n75, n76, n91, n92, n93 or n94. |
| E-UTRA Band 75 or NR Band n75 | 1432 – 1517 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n74, n75, n76, n91, n92, n93 or n94. |
| E-UTRA Band 76 or NR Band n76 | 1427 – 1432 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n75, n76, n91, n92, n93 or n94. |
| NR Band n77 | 3.3 – 4.2 GHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n48, n77 or n78 |
| NR Band n78 | 3.3 – 3.8 GHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n48, n77 or n78 |
| NR Band n79 | 4.4 – 5.0 GHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n79 |
| NR Band n80 | 1710 – 1785 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n3, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n81 | 880 – 915 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n8, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n82 | 832 – 862 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n83 | 703 – 748 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n28, since it is already covered by the basic limit in clause 6.6.5.2.2.  For repeater operating in Band n67, it applies for 703 MHz to 736 MHz. |
| NR Band n84 | 1920 – 1980 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n1, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| E-UTRA Band 85 | 728 – 746 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n12 or n85.  For NR repeater operating in n29, it applies 1 MHz below the Band n29 downlink operating band (Note 5). |
|  | 698 – 716 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n12 or n85, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n86 | 1710 – 1780 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n66, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n89 | 824 – 849 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n5, since it is already covered by the basic limit in clause 6.6.5.2.2. |
| NR Band n91 | 1427 – 1432 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n75 or n76. |
|  | 832 – 862 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20, since it is already covered by the basic limit in clause 6.6.5.5.1.2. |
| NR Band n92 | 1432 – 1517 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n74, n75 or n76. |
|  | 832 – 862 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n20, since it is already covered by the basic limit in clause 6.6.5.5.1.2. |
| NR Band n93 | 1427 – 1432 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n75 or n76. |
|  | 880 – 915 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n8, since it is already covered by the basic limit in clause 6.6.5.5.1.2. |
| NR Band n94 | 1432 – 1517 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n50, n51, n74, n75 or n76. |
|  | 880 – 915 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n8, since it is already covered by the basic limit in clause 6.6.5.5.1.2. |
| NR Band n95 | 2010 – 2025 MHz | -52 dBm | 1 MHz |  |
| NR Band n96 | 5925 – 7125 MHz | -52 dBm | 1 MHz |  |
| NR Band n97 | 2300 – 2400MHz | -52 dBm | 1 MHz |  |
| NR Band n98 | 1880 – 1920MHz | -52 dBm | 1 MHz |  |
| NR Band n99 | 1626.5 – 1660.5 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n24, since it is already covered by the basic limit in clause 6.5.5.2.2. |
| NR band n101 | 1900 – 1910 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n101. |
| NR Band n102 | 5925 – 6425 MHz | -52 dBm | 1 MHz |  |
| E-UTRA Band 103 | 757 – 758 MHz | -52 dBm | 1 MHz |  |
|  | 787 – 788 MHz | -49 dBm | 1 MHz |  |
| NR Band n104 | 6425 – 7125 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in Band n104 |
| NR band n105 | 612 – 652 MHz | -52 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n71 or n105 |
|  | 663 – 703 MHz | -49 dBm | 1 MHz | This basic limit does not apply to repeater operating in band n105, since it is already covered by the basic limit in clause 6.6.5.2.2. |

NOTE 1: As defined in the scope for spurious emissions in this clause, except for the cases where the noted basic limits apply to a repeater operating in Band n28, the co-existence requirements in table 6.5.4.2.3 -1 do not apply for the ΔfOBUE frequency range immediately outside the downlink *operating band* (see table 5.2-1). Emission limits for this excluded frequency range may be covered by local or regional requirements.

NOTE 2: Table 6.5.5.2.3 -1 assumes that two *operating bands*, where the frequency ranges in table 5.2-1 would be overlapping, are not deployed in the same geographical area. For such a case of operation with overlapping frequency arrangements in the same geographical area, special co-existence requirements may apply that are not covered by the 3GPP specifications.

NOTE 3: For unsynchronized operation, special co-existence requirements may apply that are not covered by the 3GPP specifications.

NOTE 4: For NR Band n28 repeater, specific solutions may be required to fulfil the spurious emissions limits for repeater for co-existence with E-UTRA Band 27 UL *operating band*.

NOTE 5: For NR Band n29 repeater, specific solutions may be required to fulfil the spurious emissions limits for NR repeater for co-existence with UTRA Band XII, E-UTRA Band 12 or NR Band n12 UL operating band, E-UTRA Band 17 UL operating band or E-UTRA Band 85 UL or NR Band n85 UL operating band.

The following requirement may be applied for the protection of PHS. This requirement is also applicable at specified frequencies falling between ΔfOBUE below the lowest repeater transmitter frequency of the downlink *operating band* and ΔfOBUE above the highest repeater transmitter frequency of the downlink *operating band*. ΔfOBUE is defined in clause 6.5.1.

The spurious emission *basic limit* for this requirement are:

Table 6.5.4.2.3-2: Repeater spurious emissions basic limit for repeater for co-existence with PHS for DL

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | ***basic limit*** | ***Measurement Bandwidth*** | **Note** |
| 1884.5 – 1915.7 MHz | -41 dBm | 300 kHz | Applicable when co-existence with PHS system operating in 1884.5 – 1915.7 MHz |

In certain regions, the following requirement may apply to NR repeater operating in Band n50 and n75 within the 1432 – 1452 MHz, and in Band n51 and Band n76. The *basic limit are* specified in Table 6.5.4.2.3-4. This requirement is also applicable at the frequency range from ΔfOBUE below the lowest frequency of the repeater downlink *operating band* up to ΔfOBUE above the highest frequency of the repeater downlink *operating band*.

Table 6.5.4.2.3-4: Additional operating band unwanted emission basic limit for NR repeater operating in Band n50 and n75 within 1432 – 1452 MHz, and in Band n51 and n76

|  |  |  |
| --- | --- | --- |
| **Filter centre frequency, Ffilter** | ***basic limit*** | ***Measurement Bandwidth*** |
| Ffilter = 1413.5 MHz | -42 dBm | 27 MHz |

In certain regions, the following requirement may apply to repeater operating in NR Band n50 and n75 within 1492-1517 MHz and in Band n74 within 1492-1518 MHz. The maximum level of emissions, measured on centre frequencies Ffilter with filter bandwidth according to Table 6.5.4.2.3-5, shall be defined according to the *basic limits* PEM,n50/n75,a nor PEM,n50/n75,b declared by the manufacturer.

Table 6.5.4.2.3-5: *Operating band* n50, n74 and n75 declared emission above 1518 MHz

|  |  |  |
| --- | --- | --- |
| **Filter centre frequency, Ffilter** | **Declared *basic limits* (dBm)** | ***Measurement bandwidth*** |
| 1518.5 MHz ≤ Ffilter ≤ 1519.5 MHz | PEM, n50/n75,a | 1 MHz |
| 1520.5 MHz ≤ Ffilter ≤ 1558.5 MHz | PEM,n50/n75,b | 1 MHz |

In certain regions, the following requirement shall be applied to repeater operating in Band n13 and n14 to ensure that appropriate interference protection is provided to 700 MHz public safety operations. This requirement is also applicable at the frequency range from 10 MHz below the lowest frequency of the repeater downlink operating band up to 10 MHz above the highest frequency of the repeater downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.5.4.2.3-6: Repeater spurious emissions basic limits for protection of 700 MHz public safety operations

|  |  |  |  |
| --- | --- | --- | --- |
| **Operating Band** | **Frequency range** | ***Basic limit*** | ***Measurement Bandwidth*** |
| n13 | 763 - 775 MHz | -46 dBm | 6.25 kHz |
| n13 | 793 - 805 MHz | -46 dBm | 6.25 kHz |
| n14 | 769 - 775 MHz | -46 dBm | 6.25 kHz |
| n14 | 799 - 805 MHz | -46 dBm | 6.25 kHz |

In certain regions, the following requirement may apply to NR repeater operating in Band n30. This requirement is also applicable at the frequency range from 10 MHz below the lowest frequency of the repeater downlink operating band up to 10 MHz above the highest frequency of the repeater downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.5.4.2.3-7: Additional NR repeater spurious emissions basic limits for Band n30

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | *basic limits* | *Measurement Bandwidth* | Note |
| 2200 – 2345 MHz | -45 dBm | 1 MHz |  |
| 2362.5 – 2365 MHz | -25 dBm | 1 MHz |  |
| 2365 – 2367.5 MHz | -40 dBm | 1 MHz |  |
| 2367.5 – 2370 MHz | -42 dBm | 1 MHz |  |
| 2370 – 2395 MHz | -45 dBm | 1 MHz |  |

The following requirement may apply to repeater operating in Band n48 in certain regions. The power of any spurious emission shall not exceed:

Table 6.5.4.2.3-8: Additional repeater spurious emissions **basic** limits for Band n48

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | ***Basic limits*** | *Measurement Bandwidth* (NOTE) | Note |
| 3530 MHz – 3720 MHz | -25 dBm | 1 MHz | Applicable 10 MHz from the assigned *passband edge* |
| 3100 MHz – 3530 MHz  3720 MHz – 4200 MHz | -40 dBm | 1 MHz |  |

NOTE: 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: The regional requirement, included in [12], is defined in terms of EIRP, which is dependent on both the repeater emissions at the *antenna connector* and the deployment (including antenna gain and feeder loss). The requirement defined above provides the characteristics of the base station needed to verify compliance with the regional requirement. The assessment of the EIRP level is described in Annex F.

The following requirement shall be applied to repeater operating in Band n26 to ensure that appropriate interference protection is provided to 800 MHz public safety operations. This requirement is also applicable at the frequency range from 10 MHz below the lowest frequency of the repeater downlink operating band up to 10 MHz above the highest frequency of the repeater downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.5.4.2.3-9: Repeater spurious emissions **basic** limits for protection of 800 MHz public safety operations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating Band | Frequency range | ***Basic limit*** | Measurement Bandwidth | Note |
| n26 | 851 - 859 MHz | -13 dBm | 100 kHz | Applicable for offsets > 37.5kHz from the *passband* edge |

The following requirement may apply to Repeater for Band n41 and n90 operation in Japan. This requirement is also applicable at the frequency range from ΔfOBUE below the lowest frequency of the Repeater downlink operating band up to ΔfOBUE above the highest frequency of the Repeater downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.5.4.2.3-10: Additional repeater spurious emissions basic limit for Band n41 and n90

|  |  |  |
| --- | --- | --- |
| Frequency range | ***Basic limit*** | *Measurement Bandwidth* |
| 2505 MHz – 2535 MHz | -42 dBm | 1 MHz |
| NOTE: This requirement applies for carriers allocated within 2545-2645 MHz. | | |

The following requirement may apply to repeater operating in 3.45-3.55 GHz in Band n77 in certain regions. Basic limits are specified in table 6.5.4.2.3-11.

Table 6.5.4.2.3-11: Additional repeater spurious emissions **basic** limits for Band n77

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth [MHz] | Frequency range [MHz] | Filter centre frequency, Ffilter [MHz] | ***Basic limit*** [dBm] | *Measurement bandwidth* [MHz] |
| All | 3430 – 3440  3560 – 3570 | 3430.5 ≤ Ffilter < 3439.5  3560.5 ≤ Ffilter < 3569.5 | -25 | 1 |
| All | ≤ 3430  > 3570 | Ffilter < 3429.5  3570.5 ≤ Ffilter | -40 | 1 |

NOTE: 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.

The following requirement may also apply to repeater operating in Band n54 in certain regions. The level of emissions in the 1541 – 1650 MHz band, measured in measurement bandwidth according to Table 6.5.4.2.3-12 shall not exceed the maximum emission levels PEM,n54,a, PEM,n54,b, PEM,n54,c, PEM,n54,d, PEM,n54,e and PEM,n54,f declared by the manufacturer.

Table 6.5.4.2.3-12: Declared Band n54 emissions **basic limits** for protection of the 1541-1650 MHz band

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating Band | Frequency range | Declared emission level (dBW)  (Measurement bandwidth = 1 MHz) | Declared emission level (dBW) of discrete emissions of less than 700 Hz bandwidth  (Measurement bandwidth = 1 kHz) | Declared emission level (dBW) of discrete emissions of less than 2 kHz bandwidth  (Measurement bandwidth = 1 kHz) |
| n54 | 1541 - 1559 MHz | PEM,n54,a |  | PEM,n54,f |
|  | 1559 - 1610 MHz | PEM,n54,b | PEM,n54,d |  |
|  | 1610 - 1650 MHz | PEM,n54,c | PEM,n54,e |  |

Note: The regional requirements specified in attachment to the FCC reference document, 0007135419 are defined in terms of EIRP (effective isotropic radiated power), which is dependent on both the repeater emissions at the antenna connector and the deployment (including antenna gain and feeder loss). The EIRP level is calculated using: PEIRP = PE + Gant where PE denotes the repeater unwanted emission level at the antenna connector, Gant equals the repeater antenna gain minus feeder loss. The requirement defined above provides the characteristics of the base station needed to verify compliance with the regional requirement.

##### 6.5.4.2.3 Co-location with base stations and repeater Nodes

These requirements may be applied for the protection of other BS, IAB-DU, IAB-MT and repeater receivers when GSM900, DCS1800, PCS1900, GSM850, CDMA850, UTRA FDD, UTRA TDD, E-UTRA, NR BS, IAB-DU, IAB-MT, or repeater are co-located.

The requirements assume a 30 dB coupling loss between transmitter and receiver and are based on co-location with same class.

The *basic limits* are in table 6.5.4.2.3-1. Requirements for co-location with a system listed in the first column apply, depending on the declared class. For a *multi-band connector*, the exclusions and conditions in the Note column of table 6.5.4.2.3-1 shall apply for each supported *operating band*.

Table 6.5.4.2.3-1: Spurious emissions minimum requirements for co-location with BS, IAB-Node or repeater-Node

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Type of co-located BS | Frequency range for | ***Basic limits*** | | | Measurement | Note |
|  | co-location requirement | WA repeater | MR repeater | LA repeater | bandwidth |  |
| GSM900 | 876 – 915 MHz | -98 dBm | -91 dBm | -70 dBm | 100 kHz |  |
| DCS1800 | 1710 – 1785 MHz | -98 dBm | -91 dBm | -80 dBm | 100 kHz |  |
| PCS1900 | 1850 – 1910 MHz | -98 dBm | -91 dBm | -80 dBm | 100 kHz |  |
| GSM850 or CDMA850 | 824 – 849 MHz | -98 dBm | -91 dBm | -70 dBm | 100 kHz |  |
| UTRA FDD Band I or E-UTRA Band 1 or NR Band n1 | 1920 – 1980 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band II or E-UTRA Band 2 or NR Band n2 | 1850 – 1910 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band III or E-UTRA Band 3 or NR Band n3 | 1710 – 1785 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band IV or E-UTRA Band 4 | 1710 – 1755 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band V or E-UTRA Band 5 or NR Band n5 | 824 – 849 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band VI, XIX or E-UTRA Band 6, 19 | 830 – 845 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band VII or E-UTRA Band 7 or NR Band n7 | 2500 – 2570 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band VIII or E-UTRA Band 8 or NR Band n8 | 880 – 915 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band IX or E-UTRA Band 9 | 1749.9 – 1784.9 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band X or E-UTRA Band 10 | 1710 – 1770 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XI or E-UTRA Band 11 | 1427.9 –1447.9 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n50, n75, n91, n92, n93 or n94 |
| UTRA FDD Band XII or  E-UTRA Band 12 or NR Band n12 | 699 – 716 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XIII or  E-UTRA Band 13 or NR Band n13 | 777 – 787 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XIV or  E-UTRA Band 14 or NR Band n14 | 788 – 798 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 17 | 704 – 716 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 18 or NR Band n18 | 815 – 830 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XX or E-UTRA Band 20 or NR Band n20 | 832 – 862 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XXI or E-UTRA Band 21 | 1447.9 – 1462.9 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n50, n75, n92 or n94 |
| UTRA FDD Band XXII or E-UTRA Band 22 | 3410 – 3490 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| E-UTRA Band 24 or NR Band n24 | 1626.5 – 1660.5 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XXV or  E-UTRA Band 25 or NR Band n25 | 1850 – 1915 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA FDD Band XXVI or  E-UTRA Band 26 or NR Band n26 | 814 – 849 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 27 | 807 – 824 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 28 or NR Band n28 | 703 – 748 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 30 or NR Band n30 | 2305 – 2315 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 31 | 452.5 – 457.5 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA TDD Band a) or E-UTRA Band 33 | 1900 – 1920 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA TDD Band a) or E-UTRA Band 34 or NR band n34 | 2010 – 2025 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n34 |
| UTRA TDD Band b) or E-UTRA Band 35 | 1850 – 1910 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA TDD Band b) or E-UTRA Band 36 | 1930 – 1990 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n2 or band n25 |
| UTRA TDD Band c) or E-UTRA Band 37 | 1910 – 1930 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| UTRA TDD Band d) or E-UTRA Band 38 or NR Band n38 | 2570 – 2620 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n38. |
| UTRA TDD Band f) or E-UTRA Band 39 or NR band n39 | 1880 – 1920MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n39 |
| UTRA TDD Band e) or E-UTRA Band 40 or NR Band n40 | 2300 – 2400MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n30 or n40. |
| E-UTRA Band 41 or NR Band n41, n90 | 2496 – 2690 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n41, n53 or [n90] |
| E-UTRA Band 42 | 3400 – 3600 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| E-UTRA Band 43 | 3600 – 3800 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| E-UTRA Band 44 | 703 – 803 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n28 |
| E-UTRA Band 45 | 1447 – 1467 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 46 or NR Band n46 | 5150 – 5925 MHz | N/A | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 48 or NR Band n48 | 3550 – 3700 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| E-UTRA Band 50 or NR Band n50 | 1432 – 1517 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n51, n74, n75, n91, n92, n93 or n94 |
| E-UTRA Band 51 or NR Band n51 | 1427 – 1432 MHz | N/A | N/A | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n50, n74, n75, n76, n91, n92, n93 or n94 |
| E-UTRA Band 53 or NR Band n53 | 2483.5 – 2495 MHz | N/A | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n41, n53 or n90 |
| E-UTRA Band 54 or NR Band n54 | 1670 – 1675 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n54 |
| E-UTRA Band 65 or NR Band n65 | 1920 – 2010 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 66 or NR Band n66 | 1710 – 1780 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 68 | 698 – 728 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 70 or NR Band n70 | 1695 – 1710 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 71 or NR Band n71 | 663 – 698 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 72 | 451 – 456 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 74 or NR Band n74 | 1427 – 1470 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n50, n51, n91, n92, n93 or n94 |
| NR Band n77 | 3.3 – 4.2 GHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| NR Band n78 | 3.3 – 3.8 GHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz | This is not applicable to repeater operating in Band n48, n77 or n78 |
| NR Band n79 | 4.4 – 5.0 GHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n80 | 1710 – 1785 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n81 | 880 – 915 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n82 | 832 – 862 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n83 | 703 – 748 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n84 | 1920 – 1980 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| E-UTRA Band 85 or NR Band 85 | 698 – 716 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n86 | 1710 – 1780 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n89 | 824 – 849 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n91 | 832 – 862 MHz | N/A | N/A | -88 dBm | 100 kHz |  |
| NR Band n92 | 832 – 862 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n93 | 880 – 915 MHz | N/A | N/A | -88 dBm | 100 kHz |  |
| NR Band n94 | 880 – 915 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n95 | 2010 – 2025 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n96 | 5925 – 7125 MHz | N/A | -90 dBm | -87 dBm | 100 kHz |  |
| NR Band n97 | 2300 – 2400MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n98 | 1880 – 1920MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n99 | 1626.5 – 1660.5 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n101 | 1900 – 1910 MHz | -96 dBm | NA | NA | 100 kHz |  |
| NR Band n102 | 5925 – 6425 MHz | N/A | -90 dBm | -87 dBm | 100 kHz |  |
| E-UTRA Band 103 | 787 – 788 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |
| NR Band n104 | 6425 – 7125 MHz | -95 dBm | -90 dBm | -87 dBm | 100 kHz | This requirement does not apply to repeater operating in Band n104. |
| NR Band n105 | 663 – 703 MHz | -96 dBm | -91 dBm | -88 dBm | 100 kHz |  |

NOTE 1: As defined in the scope for spurious emissions in this clause, the co-location requirements in table 6.5.4.2.4-1 do not apply for the frequency range extending ΔfOBUE immediately outside the transmit frequency range. The current state-of-the-art technology does not allow a single generic solution for co-location with other system on adjacent frequencies for 30dB antenna to antenna minimum coupling loss. However, there are certain site-engineering solutions that can be used. These techniques are addressed in TR 25.942 [3].

NOTE 2: Table 6.5.4.2.3-1 assumes that two *operating bands*, where the corresponding transmit and receive frequency ranges in table 5.2-1 would be overlapping, are not deployed in the same geographical area. For such a case of operation with overlapping frequency arrangements in the same geographical area, special co-location requirements may apply that are not covered by the 3GPP specifications.

#### 6.5.4.3 Minimum requirement for *RF repeater*

The Tx spurious emissions for *repeater type 1-C* for each *antenna connector* shall not exceed the *basic limits* specified in clause 6.5.4.2.

For Band n41 and n90 operation in Japan, the sum of the spurious emissions over all *antenna connectors* for *repeater type 1-C* shall not exceed the *basic limits* defined in clause 6.6.4.2.

6.5.4.4 Minimum requirement for *NCR*

##### 6.5.4.4.1 Minimum requirement for NCR-Fwd

6.5.4.4.1.1 Minimum requirement for NCR-Fwd type 1-C

The Tx spurious emissions for *NCR-Fwd type 1-C* for each *antenna connector* shall not exceed the *basic limits* specified in clause 6.5.4.2.

For Band n41 and n90 operation in Japan, the sum of the spurious emissions over all *antenna connectors* for *NCR-Fwd type 1-C* shall not exceed the *basic limits* defined in clause 6.6.5.2.

For joint transmission of NCR-Fwd and NCR-MT in the uplink, the spurious emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

6.5.4.4.1.2 Minimum requirement for NCR-Fwd type 1-H

The Tx spurious emissions requirements for *NCR-Fwd type 1-H* are that for each *TAB connector TX min cell group* and each applicable *basic limit* in clause 6.5.4.2, the power summation emissions at the *TAB connectors* of the *TAB connectors* of the *TAB connector TX min cell group* shall not exceed a limit specified as the *basic limit* + X, where X = 10log10(NTXU,countedpercell) for DL and for WA UL and X=0 for LA UL, unless stated differently in regional regulation.

NOTE: Conformance to the *NCR-Fwd type 1-H* spurious emission requirement can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The sum of the emissions power measured on each *TAB connector* in the *TAB connector TX min cell group* shall be less than or equal to the limit as defined in this clause for the respective frequency span.

Or

2) The unwanted emissions power at each *TAB connector* shall be less than or equal to the *NCR-Fwd type 1-H* limit as defined in this clause for the respective frequency span, scaled by -10log10(n), where n is the number of *TAB connectors* in the *TAB connector TX min cell group*.

For joint transmission of NCR-Fwd and NCR-MT in the uplink, the spurious emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

##### 6.5.4.4.2 Minimum requirement for NCR-MT

6.5.4.4.2.1 Minimum requirements for NCR-MT type 1-C

When NCR-MT and NCR-Fwd are not transmting simultaneously, the requirements in clause 6.6.4 of TS 38.104 applies for WA NCR-MT type 1-C and the requirements in clause 6.5.3 in TS 38.101-1 applies for LA NCR-MT type 1-C.

When NCR-MT and NCR-Fwd are transmting simultaneously, the requirements in clause 6.5.3 in TS 38.101-1 applies for LA NCR-MT type 1-C for sum of NCR-MT transmission and NCR-Fwd transmission.

6.5.4.4.2.2 Minimum requirements for NCR-MT type 1-H

Limits for NCR-MT type 1-H apply to the sum of emissions across all TAB connectors.

When WA NCR-MT and NCR-Fwd are not transmting simultaneously, the requirements in clause 6.6.4 of TS 38.104 relaxed with the following scaling factor applies for WA NCR-MT type 1-H.

10log(NTXU,counted), where NTXU,counted = min(NTXU,active ,8)

When WA NCR-MT and NCR-Fwd are transmting simultaneously, the requirements in clause 6.6.4 of TS 38.104 relaxed with the following scaling factor applies for the sum of NCR-MT transmission and NCR-Fwd transmission.

When LA NCR-MT and NCR-Fwd are not transmting simultaneously, the requirements in clause 6.5.3 in TS 38.101-1 applies for LA NCR-MT type 1-H without scaling factor allowed for the sum of the spurious emissions.

When NCR-MT and NCR-Fwd are transmting simultaneously, the requirements in clause 6.5.3 in TS 38.101-1 applies for sum of NCR-MT transmission and NCR-Fwd transmission.

### 6.5.5 Receiver spurious emissions

#### 6.5.5.1 General

The receiver spurious emissions power is the power of emissions generated or amplified in a receiver unit that appear at the *antenna connector*. The requirements only apply to *repeater type 1-C* for TDD operation.

For each a*ntenna connectors* on BS-side and UE-side supporting both RX and TX in TDD, the requirements apply during the *transmitter OFF state*. For *antenna connectors* both BS-side and UE-side in FDD, the RX spurious emissions requirements are superseded by the TX spurious emissions requirements, as specified in clause 6.5.4.

For *multi-band* *connectors* that both transmit and receive in *operating band* supporting TDD, RX spurious emissions requirements are applicable during the *TX OFF state*, and are subject to exclusion zones in each supported *operating band*.

For Band n41 and n90 operation in Japan, the sum of receiver spurious emissions requirements over all *antenna connectors* for *repeater type 1-C* shall not exceed *minimum requirements* defined in clause 6.5.5.2.

#### 6.5.5.2 Basic limits

The receiver spurious emissions requirements*,basic limits* are provided in table 6.5.5.2-1.

Table 6.5.5.2-1: *Repeater* receiver spurious emissions ***basic limits***

| Spurious frequency range | ***Basic limits*** | *Measurement bandwidth* | Note |
| --- | --- | --- | --- |
| 30 MHz – 1 GHz | -57 dBm | 100 kHz | Note 1 |
| 1 GHz – 12.75 GHz | -47 dBm | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the UL *operating band* in GHz | -47 dBm | 1 MHz | Note 1, Note 2, Note 3, Note 5 |
| 12.75 GHz ‑ 26 GHz | -47 dBm | 1 MHz | Note 1, Note 2, Note 6 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [5], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 3: This spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the UL *operating band* is reaching beyond 12.75 GHz.  NOTE 4: The frequency range from ΔfOBUE below the lowest frequency of the repeater transmitter *operating band* to ΔfOBUE above the highest frequency of the repeater transmitter *operating band* may be excluded from the requirement. ΔfOBUE is defined in clause 6.5.1. For *multi-band* *connectors*, the exclusion applies for all supported *operating bands*.  NOTE 5: Does not apply for band n104.  NOTE 6: Applies only for band n104. | | | |

6.5.5.3 Minimum requirement for *RF repeater*

The RX spurious emissions requirements for *repeater type 1-C* are that for each *antenna connector,* the power of emissions shall not exceed *basic limits* specified in table 6.5.5.2-1.

For Band n41 and n90 operation in Japan, the sum of RX spurious emissions requirements over all *antenna connectors* for *repeater type 1-C* shall not exceed *basic limits* specified in table 6.5.5.2-1.

6.5.5.4 Minimum requirement for *NCR*

##### 6.5.5.4.1 Minimum requirement for NCR-Fwd

6.5.5.4.1.1 Minimum requirement for NCR-Fwd type 1-C

The RX spurious emissions requirements for *NCR-Fwd type 1-C* are that for each *antenna connector,* the power of emissions shall not exceed *basic limits* specified in table 6.5.5.2-1.

For Band n41 and n90 operation in Japan, the sum of RX spurious emissions requirements over all *antenna connectors* for *NCR-Fwd type 1-C* shall not exceed *basic limits* specified in table 6.5.5.2-1.

For joint reception of NCR-Fwd and NCR-MT in the uplink, the receiver spurious emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

6.5.5.4.1.2 Minimum requirement for *NCR-Fwd type 1-H*

The RX spurious emissions requirements for *NCR-Fwd type 1-H* are that for each applicable *basic limit* specified in table 7.6.2-1 for each *TAB connector RX min cell group,* the power sum of emissions at respective *TAB connectors* shall not exceed the limits specified as the *basic limit*s + X, where X = 10log10(NRXU,countedpercell) for DL and for WA UL and X=0 for LA UL, unless stated differently in regional regulation.

The RX spurious emission requirements are applied per the *TAB connector RX min cell group* for all the configurations supported by the repeater.

NOTE: Conformance to the repeater receiver spurious emissions requirement can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The sum of the spurious emissions power measured on each *TAB connector* in the *TAB connector RX min cell group* shall be less than or equal to the limit above for the respective frequency span.

Or

2) The spurious emissions power at each *TAB connector* shall be less than or equal to the limit as defined above for the respective frequency span, scaled by -10log10(*n*), where *n* is the number of *TAB connectors* in the *TAB connector RX min cell group*.

For joint reception of NCR-Fwd and NCR-MT in the uplink, the receiver spurious emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

## 6.6 Repeater Error Vector Magnitude

### 6.6.1 Downlink repeater error vector magnitude

#### 6.6.1.1 General

The Repeater Error Vector Magnitude (EVM) is a measure of the difference between the symbols provided at the input of repeater and the measured signal symbols at the output of the repeater after the equalization by the measurement equipment. This difference is called the error vector. Details about how the repeater EVM is determined are the same as specified in TS 38.104 [2] Annex B for FR1. The repeater EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed in percent.

The repeater EVM requirement is applicable for a repeater operating at an input power in the range from what is required to reach the maximum output power to the minimum power level in table 6.6.1.1-1.

Table 6.6.1.1-1: Minimum input power for repeater EVM

|  |  |  |
| --- | --- | --- |
| Repeater DL class | Minimum input power spectral density (dBm/MHz) | |
| QPSK, 16 QAM, 64QAM | 256QAM1 |
| WA | -82 | -75 |
| MR | -77 | -70 |
| LA | -74 | -67 |
| Note 1: support of 256QAM is based on the declaration | | |

#### 6.6.1.2 Minimum requirement for *RF repeater*

The repeater EVM levels for different modulation schemes outlined in table 6.6.1.2-1 shall be met using the frame structure described in clause 6.6.1.3.

Table 6.6.1.2-1: Repeater EVM requirements

|  |  |
| --- | --- |
| **Parameter** | **Required repeater EVM** |
| QPSK, 16QAM, 64QAM | 8 % |
| 256QAM | 3.5 % 1 |
| Note 1: support of 256QAM is based on the declaration. | |

6.6.1.2A Minimum requirement for *NCR*

##### 6.6.1.2A.1 Minimum requirement for NCR-Fwd

6.6.1.2A.1.1 Minimum requirement for NCR-Fwd type 1-C

The NCR-Fwd EVM levels for different modulation schemes outlined in table 6.6.1.2-1 shall be met using the frame structure described in clause 6.6.1.3.

6.6.1.2A.1.2 Minimum requirement for *NCR-Fwd type 1-H*

The NCR-Fwd EVM levels for different modulation schemes outlined in table 6.6.1.2-1 shall be met using the frame structure described in clause 6.6.1.3 between corresponding input/output TAB connectors.

#### 6.6.1.3 Repeater EVM frame structure for measurement

The input signals for the repeater EVM requirement shall have the same frame structure as defined for the BS is TS 38.104 [2].

### 6.6.2 Uplink repeater error vector magnitude

#### 6.6.2.1 General

The Repeater Error Vector Magnitude is a measure of the difference between the reference waveform provided at the input of repeater and the measured waveform at the output of the repeater. This difference is called the error vector. Details about how the repeater EVM is determined are the same as specified in TS 38.101-1 [13] Annex F for FR1. Before calculating the repeater EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the repeater EVM.

The measured waveform is further equalised using the channel estimates subjected to the repeater EVM equaliser spectrum flatness requirement specified in TS 38.101-1 [13] clause 6.4.2.4. For DFT-s-OFDM waveforms, the repeater EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the repeater EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic repeater EVM measurement interval in one slot in the time domain. The repeater EVM measurement interval is reduced by any symbols that contains an allowable power transient in the measurement interval, as defined in TS 38.101-1 [13] clause 6.3.3 for EVM for UE.

The repeater EVM requirement is applicable for a repeater operating at an input power in the range from what is required to reach the maximum output power to the minimum power level in table 6.6.2.1-1.

Table 6.6.2.1-1: Minimum input power for repeater EVM

|  |  |  |
| --- | --- | --- |
| Repeater UL class | Minimum input power spectral density (dBm/MHz) | |
| QPSK, 16 QAM, 64QAM | 256QAM1 |
| WA | -82 | -75 |
| LA | -74 | -67 |
| Note 1: support of 256QAM is based on the declaration | | |

#### 6.6.2.2 Minimum requirement for *RF repeater*

The RMS average of the basic repeater EVM measurements over 10 subframes for the average repeater EVM case for the different modulation schemes shall not exceed the values specified in Table 6.6.2.2-1.

Table 6.6.2.2-1: Requirements for Repeater Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Average Repeater EVM Level** |
| QPSK, 16 QAM, 64QAM | % | 8 |
| 256 QAM | % | 3.5 1 |
| Note 1: support of 256QAM is based on the declaration. | | |

6.6.2.3 Minimum requirement for *NCR*

##### 6.6.2.3.1 Minimum requirement for NCR-Fwd

6.6.2.3.1.1 Minimum requirement for NCR-Fwd type 1-C

The RMS average of the basic NCR-Fwd EVM measurements over 10 subframes for the average NCR-Fwd EVM case for the different modulation schemes shall not exceed the values specified in Table 6.6.2.2-1.

6.6.2.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

The RMS average of the basic NCR-Fwd EVM measurements over 10 subframes for the average NCR-Fwd EVM case for the different modulation schemes shall not exceed the values specified in Table 6.6.2.2-1 between corresponding input/output TAB connectors.

## 6.7 Input intermodulation

### 6.7.1 General requirement

#### 6.7.1.1 General

The input intermodulation is a measure of the capability of the repeater to inhibit the generation of interference in the *passband*, in the presence of interfering signals on frequencies other than the *passband*.

The following requirement applies for interfering signals depending on the repeaters *passband*.

This requirement applies to the uplink and downlink of the repeater during the *transmitter ON state*.

There is no co-location input intermodulation requirement for LA 1-C repeaters deployed in Femto cell scenario.

#### 6.7.1.2 Minimum requirement for *RF repeater*

For the parameters specified in table 6.7.1.2-1, the power in the *passband* shall not increase with more than 10 dB at the output of the repeater as measured with 1 MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

Table 6.7.1.2-1 specifies the parameters for two interfering signals, where:

- f1 offset is the offset from the channel edge frequency of the first or last channel in the *passband* of the closer carrier.

Table 6.7.1.2-1: Input intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| f1 offset | Interfering Signal Levels | Type of signals | Measurement bandwidth |
| 1 MHz | -40 dBm | 2 CW carriers | 1 MHz |

6.7.1.3 Minimum requirement for *NCR*

##### 6.7.1.3.1 Minimum requirement for NCR-Fwd

6.7.1.3.1.1 Minimum requirement for NCR-Fwd type 1-C

For the parameters specified in table 6.7.1.1-1, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1 MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

Table 6.7.1.2-1 specifies the parameters for two interfering signals.

6.7.1.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

For the parameters specified in table 6.7.1.1-1, considering corresponding input/output TAB connectors, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1 MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

Table 6.7.1.2-1 specifies the parameters for two interfering signals.

### 6.7.2 Co-location with BS/repeater in other systems

#### 6.7.2.1 General

This additional input intermodulation requirement may be applied for the protection of NR repeater receivers when GSM, CDMA, UTRA, E-UTRA, NR BS or repeater operating in a different frequency band are co-located with a NR repeater.

The following requirement applies for interfering signals depending on the repeaters *passband*.

This requirement applies to the uplink and downlink of the repeater. If the BS side is declared to meet co-location requirements, then it should meet input intermodulation co-location requirements for the downlink. If the UE side is declared to meet co-location requirements, then it should meet input intermodulation co-location requirements for the uplink.

#### 6.7.2.2 Minimum requirement for *RF repeater*

For the parameters specified in table 6.7.2.2-1 for DL and 6.7.2.2-2 for UL, the power in the *passband* shall not increase with more than 10 dB at the output of the repeater as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

Table 6.7.2.2-1: input intermodulation requirement for NR repeater DL when co-located with BS/repeater in other frequency bands.

| Frequency range of interfering signal | Interfering signal mean power for repeater with WA UE side (dBm) | Interfering signal mean power for repeater with MR UE side(dBm) | Interfering signal mean power for repeater with LA UE side(dBm) | Type of interfering signals |
| --- | --- | --- | --- | --- |
| Frequency range of co-located BS’s downlink operating band or located repeater’s *passband* | +16 | +8 | x (Note 1) | 2 CW carriers |
| NOTE 1: x = -7 dBm for NR repeater co-located with Pico GSM850 or Pico CDMA850  x = -4 dBm for NR repeater co-located with Pico DCS1800 or Pico PCS1900  x = -6 dBm for NR repeater co-located with UTRA bands or E-UTRA bands or NR bands  NOTE 2: The requirement does not apply when the interfering signal falls within the *passband*.  NOTE 3: For unsynchronized base stations (except in band n46, n96, and n102) or repeaters, special co-location requirements may apply that are not covered by the 3GPP specifications. | | | | |

Table 6.7.2.2-2: input intermodulation requirement for NR repeater UL when co-located with BS/repeater in other frequency bands.

| Frequency range of interfering signal | Interfering signal mean power for repeater with WA BS side(dBm) | Interfering signal mean power for repeater with LA BS side(dBm) | Type of interfering signals |
| --- | --- | --- | --- |
| Frequency range of co-located BS’s downlink operating band or located repeater’s *passband* | +16 | Prated,p,AC -30 | 2 CW carriers |
| NOTE 1: The requirement does not apply when the interfering signal falls within the *passband*.  NOTE 2: For unsynchronized base stations (except in band n46, n96, and n102) or repeaters, special co-location requirements may apply that are not covered by the 3GPP specifications. | | | |

6.7.2.3 Minimum requirement for *NCR*

##### 6.7.2.3.1 Minimum requirement for NCR-Fwd

6.7.2.3.1.1 Minimum requirement for NCR-Fwd type 1-C

For the parameters specified in table 6.7.2.2-1 for DL and 6.7.2.2-2 for UL, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

6.7.2.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

For the parameters specified in table 6.7.2.2-1 for DL and 6.7.2.2-2 for UL, considering corresponding input/output TAB connectors, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

### 6.7.3 Co-existence with other systems

#### 6.7.3.1 General

This input intermodulation existence requirement may be applied for the protection of NR repeater receivers when GSM, CDMA, UTRA, E-UTRA, NR BS or repeater operating in another frequency band co-exist with a NR repeater.

#### 6.7.3.2 Minimum requirement for *RF repeater*

For the parameters specified in table 6.7.3.2-1, the power in the *passband* shall not increase with more than 10 dB at the output of the repeater as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

Table 6.7.3.2-1: input intermodulation requirement for NR repeater when co-exist with BS/repeater in other non-overlapping frequency bands

| Frequency range of interfering signal | Interfering signal mean power (dBm) | Type of interfering signals | Measurement bandwidth |
| --- | --- | --- | --- |
| Frequency range of co-existence system operating band | -15 | 2 CW carriers | 1MHz |
| NOTE 1: All the interfering signals should be limited into the frequency ranges that are either X MHz higher than FUL,high or X MHz lower than FUL,low, where X equals to 20MHz when FUL,high - FUL,low is not larger than 200MHz, otherwise X equals to 60MHz | | | |

6.7.3.3 Minimum requirement for *NCR*

##### 6.7.3.3.1 Minimum requirement for NCR-Fwd

6.7.3.3.1.1 Minimum requirement for NCR-Fwd type 1-C

For the parameters specified in table 6.7.3.2-1, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

6.7.3.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

For the parameters specified in table 6.7.3.2-1, considering corresponding input/output TAB connectors, the power in the *passband* shall not increase with more than 10 dB at the output of the NCR-Fwd as measured with 1MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the *passband*.

## 6.8 Output intermodulation

6.8.1 General

The output intermodulation requirement is a measure of the capability of the repeater to inhibit the generation of signals in its non-linear elements caused by presence of the wanted signal and an interfering signal reaching the repeater via the output port. The requirement shall apply during the *transmitter ON period* and the *transmitter transient period*.

The requirement shall apply to the uplink and downlink of the Repeater.

The output intermodulation level is the power of the intermodulation products when an interfering signal is injected into the *antenna connector*.

6.8.2 Minimum requirements for *RF repeater*

6.8.2.1 Minimum requirements

The output intermodulation level is the power of the intermodulation products when an interfering signal is injected into the output port. The wanted signal *passband* shall be the maximum bandwidth supported by the repeater.

For *repeater type 1-C*, the wanted signal and interfering signal centre frequency is specified in table 6.8.2.1‑1, where interfering signal level is *rated total output power* (Prated,t,AC) at *antenna connector* in the *passband* – 30 dB.

The unwanted emission with output intermodulation applied shall not exceed the corresponding uplink and downlink unwanted emission limits in clause 6.5 in the presence of an interfering signal according to table 6.8.2.1-1. The measurement may be limited to frequencies on which third and fifth order intermodulation products appear, considering the width of these products.

Table 6.8.2.1-1: Interfering and wanted signals for the output intermodulation requirement

| Parameter | Value |
| --- | --- |
| Wanted signal type | NR signal, filling all supported *passbands* in the operating band and with sufficient carriers to fill each *passband*. Minimum defined SCS for the operating band |
| Interfering signal type | NR signal, with the minimum SCS and channel bandwidth defined in the operating band in [2] |
| Interfering signal level | *Rated total output power* (Prated,t,AC) in the *passband* – 30 dB |
| Interfering signal centre frequency offset from the lower/upper edge of the wanted signal or edge of *sub-block* inside a *sub-block gap* | , for n=1, 2 and 3 |
| NOTE 1: Interfering signal positions that are partially or completely outside of any downlink operating band of the repeater are excluded from the requirement, unless the interfering signal positions fall within the frequency range of adjacent downlink operating bands in the same geographical area. In case that none of the interfering signal positions fall completely within the frequency range of the downlink operating band, TS 38.115-1 [7] provides further guidance regarding appropriate test requirements.  NOTE 2: In Japan, NOTE 1 is not applied in Band n77, n78, n79. | |

6.8.2.2 Additional requirements

For repeater supporting Band n41 and n90 operation in Japan, the sum of output intermodulation level over all *antenna connectors* shall not exceed the unwanted emission limits in clauses 6.5 in the presence of an NR interfering signal according to table 6.8.2.2-1.

Table 6.8.2.2-1 Interfering and wanted signals for the additional output intermodulation requirement for Band n41 and n90

|  |  |
| --- | --- |
| Parameter | Value |
| Wanted signal | NR single (NOTE) |
| Interfering signal type | NR signal of 10 MHz *passband bandwidth* |
| Interfering signal level | *Rated total output power* (Prated,t,AC) in the *passband* – 30 dB |
| Interfering signal centre frequency offset from the lower/upper *passband* centre frequency of the wanted signal | ± 5 MHz  ± 15 MHz  ± 25 MHz |
| NOTE: This requirement applies for *passband* allocated within 2545-2645 MHz. | |

6.8.3 Minimum requirements for *NCR*

6.8.3.1 Minimum requirements for NCR-Fwd

##### 6.8.3.1.1 Minimum requirements for NCR-Fwd type 1-C

The output intermodulation level is the power of the intermodulation products when an interfering signal is injected into the output port. The wanted signal *passband* shall be the maximum bandwidth supported by the NCR-Fwd.

For *NCR-Fwd type 1-C*, the wanted signal and interfering signal centre frequency is specified in table 6.8.2.1‑1, where interfering signal level is *rated total output power* (Prated,t,AC) at *antenna connector* in the *passband* – 30 dB.

The unwanted emission with output intermodulation applied shall not exceed the corresponding uplink and downlink unwanted emission limits in clause 6.5 in the presence of an interfering signal according to table 6.8.2.1-1. The measurement may be limited to frequencies on which third and fifth order intermodulation products appear, considering the width of these products.

##### 6.8.3.1.2 Additional requirements for NCR-Fwd type 1-C

For NCR supporting Band n41 and n90 operation in Japan, the sum of output intermodulation level over all *antenna connectors* shall not exceed the unwanted emission limits in clauses 6.5 in the presence of an NR interfering signal according to table 6.8.2.2-1.

##### 6.8.3.1.3 Minimum requirements for *NCR-Fwd type 1-H*

The output intermodulation level is the power of the intermodulation products when an interfering signal is injected into the output port. The wanted signal *passband* shall be the maximum bandwidth supported by the NCR-Fwd.

For *NCR-Fwd type 1-H*, the wanted signal and interfering signal centre frequency is specified in table 6.8.2.1‑1, where interfering signal level is *rated total output power* (Prated,t,TABC) at *TAB connector* in the *passband* – 30 dB.

The unwanted emission with output intermodulation applied shall not exceed the corresponding uplink and downlink unwanted emission limits in clause 6.5 in the presence of an interfering signal according to table 6.8.2.1-1. The measurement may be limited to frequencies on which third and fifth order intermodulation products appear, considering the width of these products.

##### 6.8.3.1.4 Additional requirements for NCR-Fwd type 1-H

For NCR supporting Band n41 and n90 operation in Japan, the sum of output intermodulation level over all *TAB connectors* shall not exceed the unwanted emission limits in clauses 6.5 in the presence of an NR interfering signal according to table 6.8.2.2-1.

## 6.9 Adjacent Channel Rejection Ratio (ACRR)

### 6.9.1 General

Adjacent Channel Rejection Ratio (ACRR) is the ratio of the average gain over a carrier of the repeater in the *passband* to the average gain of the repeater over an adjacent channel outside the repeater *passband*. The carrier in the *passband* and in the adjacent channel shall be of the same type (reference carrier) with bandwidths as defined by *nominal channel bandwidth*.

The requirement shall apply to the uplink and downlink of the Repeater, where the donor link is maintained via antennas (wireless Repeater).

The requirement is differentiated between uplink and downlink.

The requirement shall apply during the *transmitter ON state*.

### 6.9.2 Minimum Requirements for *RF repeater*

For a repeater operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-1 shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 6.9.2-1.

Table 6.9.2-1: Repeater Downlink ACRR below 2496MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit |
| UTRA, E-UTRA, NR | Wide Area repeater | BWNominal/2 | 45 |
| Medium Range repeater | BWNominal/2 | 45 |
| Local Area repeater | BWNominal/2 | 33  (Note 1) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*. | | | |

For a repeater operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-1a shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 6.9.2-1a.

Table 6.9.2-1a: Repeater Downlink ACRR above 2496 MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit |
| UTRA, E-UTRA, NR | Wide Area repeater | BWNominal/2 | 33dB |
| Medium Range repeater | BWNominal/2 | 33dB |
| Local Area repeater | BWNominal/2 | 33dB  (Note 1) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*. | | | |

For a repeater operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-2 shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 6.9.2-2.

Table 6.9.2-2: Repeater Uplink ACRR below 2496 MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit |
| UTRA, E-UTRA, NR | Wide Area repeater | BWNominal/2 | 33dB |
| Local Area repeater | BWNominal/2 | 33dB  (Note 1) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*. | | | |

For a repeater operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-2a shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 6.9.2-2a.

Table 6.9.2-2a: Repeater Uplink ACRR above 2496 MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit |
| UTRA, E-UTRA, NR | Wide Area repeater | BWNominal/2 | 33dB |
| Local Area repeater | 5MHz | 20dBc (Note 1, Note 2) |
| BWNominal/2 | 33dBc (Note 1) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*.  NOTE 2: In this case, the channel within the *passband* and the adjacent channel are assumed to have a bandwidth of 10 MHz | | | |

6.9.3 Minimum Requirements for *NCR*

#### 6.9.3.1 Minimum requirements for NCR-Fwd

##### 6.9.3.1.1 Minimum requirements for NCR-Fwd type 1-C

For a NCR-Fwd operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.3-1 shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 6.9.2-1.

For a NCR-Fwd operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-1a shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 6.9.2-1a.

For a NCR-Fwd operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-2 shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 6.9.2-2.

For a NCR-Fwd operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-2a shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 6.9.2-2a.

##### 6.9.3.1.2 Minimum Requirements for *NCR-Fwd type 1-H*

For a NCR-Fwd operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-1 shall apply in downlink. In normal conditions the ACRR for downlink between corresponding input/output TAB connectors shall be higher than the value specified in the Table 6.9.2-1.

For a NCR-Fwd operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-1a shall apply in downlink. In normal conditions the ACRR for downlink between corresponding input/output TAB connectors shall be higher than the value specified in the Table 6.9.2-1a.

For a NCR-Fwd operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-2 shall apply in uplink. In normal conditions the ACRR for uplink between corresponding input/output TAB connectors shall be higher than the value specified in the Table 6.9.2-2.

For a NCR-Fwd operating at *passband* above 2496 MHz, the ACRR requirements in table 6.9.2-2a shall apply in uplink. In normal conditions the ACRR for uplink between corresponding input/output TAB connectors shall be higher than the value specified in the Table 6.9.2-2a.

## 6.10 Transmit ON/OFF power

### 6.10.1 Transmitter OFF power

#### 6.10.1.1 General

Transmit OFF power requirements apply only to TDD operation of the repeater. The requirement applies to both downlink and uplink of the repeater.

Transmitter OFF power is defined as the mean power measured over 70/N us filtered with a square filter of bandwidth equal to the *passband bandwidth* of the repeater (BWpassband) centred on the assigned channel frequency during the *transmitter OFF state*. N = SCS/15, where SCS is Sub Carrier Spacing in kHz of the input signal.

For *multi-band connectors* and for *single band connectors* supporting transmission in multiple *operating bands*, the requirement is only applicable during the *transmitter OFF state* in all supported *operating bands*.

#### 6.10.1.2 Minimum requirement for *RF repeater*

For *repeater type 1-C downlink*, the requirements for transmitter OFF power spectral density shall be less than -85 dBm/MHz per *antenna connector*.

For *repeater type 1-C uplink*, the requirements for transmitter OFF power spectral density shall be less than -50dBm / (SCS\*(12\*NRB+1)/1000) MHz per *antenna connector,* where SCS is Sub Carrier Spacing in kHz.

6.10.1.3 Minimum requirement for *NCR*

##### 6.10.1.3.1 Minimum requirement for NCR Fwd

6.10.1.3.1.1 Minimum requirement for NCR-Fwd type 1-C

For *NCR-Fwd type 1-C downlink*, the requirements for transmitter OFF power spectral density shall be less than -85 dBm/MHz per *antenna connector*.

For *NCR-Fwd type 1-C uplink*, the requirements for transmitter OFF power spectral density shall be less than -50dBm / (SCS\*(12\*NRB+1)/1000) MHz per *antenna connector,* where SCS is Sub Carrier Spacing in kHz.

6.10.1.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

For *NCR-Fwd type 1-H downlink*, the requirements for transmitter OFF power spectral density shall be less than -85 dBm/MHz per *TAB connector*.

For *NCR-Fwd type 1-H uplink*, the requirements for transmitter OFF power spectral density shall be less than -50dBm / (SCS\*(12\*NRB+1)/1000) MHz per *TAB connector,* where SCS is Sub Carrier Spacing in kHz.

### 6.10.2 Transmitter transient period

#### 6.10.2.1 General

*Transmitter transient period* requirements apply only to TDD operation of the repeater. The requirement applies to both downlink and uplink of the repeater.

The *transmitter transient state* is the time period during which the transmitter is changing from the *transmitter OFF state* to the *transmitter ON state* or vice versa. The *transmitter transient period* is illustrated in figure 6.10.2.1-1.



Figure 6.10.2.1-1: Example of relations between transmitter ON period, transmitter OFF period and *transmitter transient period*

For *repeater type 1-C* this requirement shall be applied at the *antenna connector* supporting transmission in the *operating band*. The beginning and end point of downlink and uplink bursts are referenced to the slot timing at the input.

#### 6.10.2.2 Minimum requirement for *RF repeater*

For *repeater type 1-C*, the *transmitter transient period* shall be shorter than the values listed in the minimum requirement table 6.10.2.2-1.

Table 6.10.2.2-1: Minimum requirement for the *transmitter transient period* for *repeater type 1-C*

|  |  |
| --- | --- |
| Transition | Transient period length (µs) |
| OFF to ON | 10 |
| ON to OFF | 10 |

6.10.2.3 Minimum requirement for *NCR*

##### 6.10.2.3.1 Minimum requirement for NCR-Fwd

6.10.2.3.1.1 Minimum requirement for NCR-Fwd type 1-C

For *NCR-Fwd type 1-C* this requirement shall be applied at the *antenna connector* supporting transmission in the *operating band*. The beginning and end point of downlink and uplink bursts are referenced to the slot timing at the input.

For *NCR-Fwd type 1-C*, the *transmitter transient period* shall be shorter than the values listed in the minimum requirement table 6.10.2.2-1.

6.10.2.3.1.2 Minimum requirement for *NCR-Fwd type 1-H*

For *NCR-Fwd type 1-H* this requirement shall be applied at the *TAB connector* supporting transmission in the *operating band*. The beginning and end point of downlink and uplink bursts are referenced to the slot timing at the input.

For *NCR-Fwd type 1-H*, the *transmitter transient period* shall be shorter than the values listed in the minimum requirement table 6.10.2.2-1.

## **<<next Change>>**

6.11 Output power dynamics

### 6.11.1 General

Output power dynamics is specified in terms of: OFF power, ON/OFF time mask and power control requirements.

6.11.2 Transmit OFF power for NCR-MT

For WA NCR-MT type 1-C and NCR-MT type 1-H, the BS requirements specified in clause 6.4.1.2 in TS 38.104 applies.

For LA NCR-MT type 1-C and NCR-MT type 1-H , the UE requirement specified in clause 6.3.2 in TS 38.101-1 applies.

6.11.3 Transmit ON/OFF time mask for NCR-MT

For WA NCR-MT type 1-C and NCR-MT type 1-H, the BS requirements specified in clause 6.4.2.2 in TS 38.104 applies .

For LA NCR-MT type 1-C and NCR-MT type 1-H, the UE requirements specified in clause 6.3.3 in TS 38.101-1 applies.

6.11.4 Power control for NCR-MT

For WA NCR-MT, The IAB-MT requirements specified in clause 6.3.2 output dynamic range requirement, 6.3.3.1 relative power tolerance and 6.3.3.2 aggregated power tolerance requirements in TS 38.174 applies.

For LA NCR-MT, The UE requirements specified in clause 6.3.4.3 of relative power tolerance and clause 6.3.4.4 of aggregate power tolerance in TS 38.101-1 applies.

## 6.12 Transmit signal quality

### 6.12.1 General

Transmit signal quality is specified in terms of: frequency error and transmit modulation quality requirements.

### 6.12.2 Frequency error requirements for NCR-MT

The IAB-MT requirements specified in clause 6.5.1.2 in TS 38.174 apply to both NCR-MT type 1-C and NCR-MT type 1-H.

### 6.12.3 Transmit modulation quality

The IAB-MT requirements specified in clause 6.5.2.2 in TS 38.174 apply to both NCR-MT type 1-C and NCR-MT type 1-H.

## 6.13 Transmit intermodulation

### 6.13.1 General

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.

NCR-MT 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 signal is added at a level below the wanted signal at each transmitter antenna port with the other antenna port(s) if any terminated.

### 6.13.2 Minimum requirements for NCR-MT

The Tx IMD requirement for IAB-MT specified in clause 6.7 of Rel-16 TS 38.174 apply for WA and LA NCR-MT. The IM interference level is based on NCR-Fwd link.

## 6.14 General

Conducted receiver characteristics are specified at *antenna connector* for *NCR type 1-C* and TAB connector for *NCR type 1-H*, with full complement of transceivers for the configuration in normal operating condition.

Unless otherwise stated, the following arrangements apply for conducted receiver characteristics requirements in clause 9:

- Requirements apply during the receive period.

- Requirements shall be met for any transmitter setting.

- Throughput requirements defined for the conducted receiver characteristics do not assume HARQ retransmissions.

- For ACS, blocking and intermodulation characteristics, the negative offsets of the interfering signal apply relative to the lower *passband* edge or *inter-passband gap*, and the positive offsets of the interfering signal apply relative to the upper *passband* edge or *inter-passband gap*.

NOTE 1: In normal operating condition the NCR-MT in TDD operation is configured to TX OFF power during *receive period*.

## 6.15 Diversity characteristics

The Local Area NCR-MT is required to be equipped with a minimum of two Rx antenna ports in all operating bands except for the bands n7, n38, n41, n48, n77, n78, n79, n104 where the NCR-MT is required to be equipped with a minimum of four Rx antenna ports. This requirement applies when the band is used as a standalone band or as part of a band combination.

For the single carrier REFSENS requirements in Clause 6.16, the Local Area NCR-MT shall be verified with two Rx antenna ports in all supported frequency bands, additional requirements for four Rx ports shall be verified in operating bands where the NCR-MT is equipped with four Rx antenna ports.

For Rx requirements other than single carrier REFSENS in Clause 6.16, the NCR-MT shall be verified with four Rx antenna ports and skip two Rx antenna ports requirements in operating bands where the NCR-MT is equipped with four Rx antenna ports, otherwise, the NCR-MT shall be verified with two Rx antenna ports.

6.16 Conducted reference sensitivity

6.16.1 NCR-MT reference sensitivity level

6.16.1.1 General

The reference sensitivity power level PREFSENS is the minimum mean power received at the antenna connector for *NCR-MT type 1-C* or *TAB connector* for *NCR-MT type 1-H* at which a throughput requirement shall be met for a specified reference measurement channel.

6.16.1.2 Minimum requirements for *NCR-MT type 1-C and 1-H*

The Wide Area NCR-MT reference sensitivity level is specified the same as the Wide Area IAB-MT reference sensitivity level requirement for *IAB-MT type 1-H* in TS 38.174 [22], clause 7.2.2, where references to *nominal channel bandwidth* apply to NCR-MT *passband*.

The Local Area NCR-MT reference sensitivity level is specified the same as specified in TS 38.101-1 [13] clause 7.3.

Referenced requirements applying to NB IoT are not applicable to the NCR-MT.

6.17 Conducted maximum input level

Maximum input level is defined as the maximum mean power received at the Local Area NCR-MT antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel. For Local Area NCR-MT, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in 38.101-1 [13] Annex A.3.2 and Annex A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in TS 38.101-1 [13] in Table 7.4-1.

6.18 Conducted adjacent channel selectivity

6.18.1 Adjacent Channel Selectivity (ACS)

6.18.1.1 General

Adjacent channel selectivity (ACS) is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency at the antenna connector for *NCR-MT type 1-C or TAB connector for NCR-MT type 1-H* in the presence of an adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system.

6.18.1.2 Minimum requirement for *NCR-MT type 1-C*

For Wide Area *NCR-MT type 1-C*, minimum requirement is the same as specified for BS type 1-C in TS 38.104 [2], clause 7.4.1.2.

For Local Area *NCR-MT type 1-C*, minimum requirement is the same as specified in TS 38.101-1 [13], clause 7.3.2.

6.18.1.3 Minimum requirement for *NCR-MT type 1-H*

For Wide Area *NCR-MT type 1-H,* minimum requirement is the same as specified for *IAB-MT type 1-H* in TS 38.174 [22], clause 7.4.1.3.

For Local Area *NCR-MT type 1-H*, minimum requirement is the same as specified in TS 38.101-1 [13], clause 7.3.2.

6.19 Conducted blocking characteristics

6.19.1 General

The in-band blocking characteristics is a measure of the receiver's ability to receive a wanted signal at its assigned channel at the *TAB connector* for *NCR-MT type 1-C* and *NCR-MT type 1-H* in the presence of an unwanted interferer, which is an NR signal for general blocking or an NR signal with one resource block for narrowband blocking.

6.19.2 Minimum requirement for NCR-MT type 1-C

For Wide Area *NCR-MT type 1-C*, minimum requirement is the same as specified for BS type 1-C in TS 38.104 [2], clause 7.4.2.2.

For Local Area *NCR-MT type 1-C*, minimum requirement is the same as specified in TS 38.101-1 [13] clause 7.6.2.

6.19.3 Minimum requirement for NCR-MT type 1-H

For Wide Area *NCR-MT type 1-H*, minimum requirement at TAB connector is the same as specified for IAB-MT in TS 38.174 [22], clause 7.4.2.3.

For Local Area *NCR-MT type 1-H*, minimum requirement at TAB connector is the same as specified in TS 38.101-1 [13], clause 7.6.2.

6.20 Conducted spurious response

6.20.1 General

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency at the *antenna connector* for *NCR-MT type 1-C* or *TAB connector* for *NCR-MT type 1-H* in the presence of two interfering signals which have a specific frequency relationship to the wanted signal.

6.20.2 Minimum requirements for NCR-MT type 1-C and NCR-MT type 1-H

For Local Area *NCR-MT type 1-C* and *NCR-MT type 1-H*, minimum requirements are the same as specified in TS 38.101-1 [13], clause 7.7.

6.21 Conducted intermodulation characteristics

6.21.1 General

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency at the antenna connector for *NCR-MT type 1-C* or TAB connector for *NCR-MT type 1-H* in the presence of two interfering signals which have a specific frequency relationship to the wanted signal.

6.21.2 Minimum requirement for NCR type 1-C

For Wide Area *NCR-MT type 1-C*, minimum requirement at antenna connector is the same as specified for *BS type 1-C* in TS 38.104 [2], clause 7.7.2.

For Local Area *NCR-MT type 1-C*, minimum requirement at antenna connector is the same as specified in TS 38.101-1 [13], clause 7.8.2.

6.21.3 Minimum requirement for NCR type 1-H

For Wide Area *NCR-MT type 1-H*, minimum requirement at TAB connector is the same as specified for *IAB-MT type 1-H* in TS 38.174 [22], clause 7.7.3.

For Local Area *NCR-MT type 1-H*, minimum requirement at TAB connector is the same as specified in TS 38.101-1 [13], clause 7.8.2.

6.22 Conducted spurious emissions

6.22.1 General

The receiver spurious emissions power is the power of emissions generated or amplified in a receiver unit that appear at the *antenna connector for NCR-MT type 1-C* and at *the TAB connector for NCR-MT type 1-H*. The requirements apply to all NCR-MT with separate RX and TX *TAB connectors*.

For *TAB connectors* supporting both RX and TX in TDD, the requirements apply during the *transmitter OFF period*.

For RX-only *multi-band* *connectors*, the spurious emissions requirements are subject to exclusion zones in each supported *operating band*. For *multi-band* *connectors* that both transmit and receive in *operating band* supporting TDD, RX spurious emissions requirements are applicable during the *TX OFF period*, and are subject to exclusion zones in each supported *operating band*.

For *NCR-MT type 1-H* manufacturer shall declare *TAB connector RX min cell groups*. Every *TAB connector* of *-NCR-MT type 1-H* supporting reception in an *operating band* shall map to one *TAB connector RX min cell group*, where mapping of *TAB connectors* to cells/beams is implementation dependent.

The number of active receiver units that are considered when calculating the conducted RX spurious emission limits (NRXU,counted) for Wide Area *NCR-MT type 1-H* is calculated as follows:

NRXU,counted = *min(NRXU,active , 8* *)*

NOTE: NRXU,active is the number of actually active receiver units .

6.22.2 Minimum requirements for *NCR-MT type 1-C* and *type 1-H*

The receiver spurious emissions requirements for *NCR-MT type 1-C at the antenna connector* and *NCR-MT type 1-H* are that for each *TAB connector,* the power of emissions shall not exceed the value specified in table 6.22.2-1.

**Table 6.22.2-1: *NCR-MT type 1-C* and *type 1-H* receiver spurious emissions minimum requirements**

| **Spurious frequency range** | ***Basic requirements*** | ***Measurement bandwidth*** | **Note** |
| --- | --- | --- | --- |
| 30 MHz – 1 GHz | -57 dBm | 100 kHz | Note 1 |
| 1 GHz – 12.75 GHz | -47 dBm | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the UL *operating band* in GHz | -47 dBm | 1 MHz | Note 1, Note 2, Note 3, Note 5 |
| 12.75 GHz ‑ 26 GHz | -47 dBm | 1 MHz | Note 1, Note 2, Note 6 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [5], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 3: This spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the UL *operating band* is reaching beyond 12.75 GHz.  NOTE 4: The frequency range from ΔfOBUE below the lowest frequency of the repeater transmitter *operating band* to ΔfOBUE above the highest frequency of the repeater transmitter *operating band* may be excluded from the requirement. ΔfOBUE is defined in clause 6.5.1. For *multi-band* *connectors*, the exclusion applies for all supported *operating bands*.  NOTE 5: Does not apply for band n104.  NOTE 6: Applies only for band n104. | | | |

# 7 Radiated characteristics

## 7.1 General

Radiated characteristics are specified at RIB for *repeater type 2-O*, *NCR-Fwd type 2-O*. Requirements apply in both DL and UL unless otherwise stated or declared.

## 7.2 OTA output power

### 7.2.1 General

*Repeater type 2-O*, *NCR-Fwd type 2-O* are declared to support one or more beams, as per manufacturer's declarations specified in TS 38.115-2 [8]. Radiated transmit power is defined as the EIRP level for a declared beam at a specific *beam peak direction*.

For each beam, the requirement is based on declaration of a beam identity, *reference beam direction pair*, beamwidth, *rated beam EIRP*, *OTA peak directions set*, the *beam direction pairs* at the maximum steering directions and their associated *rated beam EIRP* and beamwidth(s).

For a declared beam and *beam direction pair*, the *rated beam EIRP* level is the maximum power that the repeater is declared to radiate at the associated *beam peak direction*.

For each *beam peak direction* associated with a *beam direction pair* within the *OTA peak directions set*, a specific *rated beam EIRP* level may be claimed. Any claimed value shall be met within the accuracy requirement as described below. *Rated beam EIRP* is only required to be declared for the *beam direction pairs* subject to conformance testing as detailed in TS 38.115-2 [8].

NOTE 1: *OTA peak directions set* is set of *beam peak directions* for which the EIRP accuracy requirement is intended to be met. The *beam peak directions* are related to a corresponding contiguous range or discrete list of *beam centre directions* by the *beam direction pairs* included in the set.

NOTE 2: A *beam direction pair* is data set consisting of the *beam centre direction* and the related *beam peak direction.*

NOTE 3: A declared EIRP value is a value provided by the manufacturer for verification according to the conformance specification declaration requirements, whereas a claimed EIRP value is provided by the manufacturer to the equipment user for normal operation of the equipment and is not subject to formal conformance testing.

For *pass bands* where the supported *fractional bandwidth* (FBW) is larger than 6%, two rated beam EIRP may be declared by manufacturer:

- Prated,out,FBWlow for lower supported frequency range, and

- Prated,out,FBWhigh for higher supported frequency range.

For frequencies in between FFBWlow and FFBWhigh the rated beam EIRP is:

- Prated,out,FBWlow, for the output whose frequency is within frequency range FFBWlow ≤ f < (FFBWlow +FFBWhigh) / 2,

- Prated,out,FBWhigh, for the output whose frequency is within frequency range (FFBWlow +FFBWhigh) / 2 ≤ f ≤FFBWhigh.

For *repeater type 2-O*, *NCR-Fwd type 2-O*, OTA repeater output power is also declared as a TRP radiated requirement, with the output power accuracy requirement defined at the RIB. TRP does not change with beamforming settings as long as the *beam peak direction* is within the *OTA peak directions set*. Thus, the TRP accuracy requirement shall be met for any beamforming setting for which the *beam peak direction* is within the *OTA peak directions set*.

There is no upper limit for the *rated TRP output power* and the *rated beam EIRP output power* of *repeater type 2-O* DL transmission.

The *repeater rated TRP output power* and the *rated beam EIRP output power* for *repeater type 2-O* UL transmissionshall be within limits as specified in table 7.2.1-1.

Table 7.2.1-1: Repeater *rated TRP output power* limits and *rated EIRP output power* limits for *repeater type 2-O* UL transmission

|  |  |  |
| --- | --- | --- |
| Repeater class | Prated,p,TRP | Prated,p,EIRP |
| Wide Area | (note 1) | (note 1) |
| Local Area | ≤ + 35 + X dBm (Note 2) | ≤ + 55 + X dBm (Note 2) |
| NOTE1: There is no upper limit for the Prated,p,TRP or Prated,p,EIRP of the *repeater type 2-O* UL transmission.  NOTE2: X = 10\*log (ceil (*passband* bandwidth/100MHz)) | | |

There is no upper limit for the *rated TRP output power* and the *rated beam EIRP output power* of *NCR-Fwd type 2-O* DL transmission.

The *repeater rated TRP output power* and the *rated beam EIRP output power* for *NCR-Fwd type 2-O* UL transmissionshall be within limits as specified in table 7.2.1-2.

Table 7.2.1-2: *Rated TRP output power* limits and *rated beam EIRP output power* limits for *NCR-Fwd type 2-O* UL transmission

|  |  |  |
| --- | --- | --- |
| NCR-Fwd class | Prated,p,TRP | Prated,p,EIRP |
| Wide Area | (note 1) | (note 1) |
| Local Area | ≤ + 35 + X dBm (Note 2) | ≤ + 55 + X dBm (Note 2) |
| NOTE1: There is no upper limit for the Prated,p,TRP or Prated,p,EIRP of the *NCR type 2-O* UL transmission.  NOTE2: X = 10\*log (ceil (*passband* bandwidth/100MHz)) | | |

### 7.2.2 Minimum requirement for NR repeater

The AoA of the input signal shall be the same as the reference direction for the *OTA peak directions set* when operating in the opposite DL/UL direction.

The requirements shall apply with NR signals in the *passband* of the repeater at:

The lowest input power (Pp,in,EIRP) that produces the *rated passband TRP output power* (Prated,p,TRP)

Up to:

The lowest input power (Pp,in,EIRP) that produces the *rated passband TRP output power* (Prated,p,TRP), plus 10dB

In normal conditions, the measured output power, Pmax,p,EIRP shall remain within +3.4 dB and -3.4 dB of the *rated beam EIRP output power* Prated,p,EIRP, declared by the manufacturer.

In extreme conditions, the measured output power, Pmax,p,,EIRP shall remain within +4.5 dB and -4.5 dB of the *rated beam EIRP output power* Prated,p,EIRP, declared by the manufacturer.

In normal conditions, the *repeater type 2-O* *maximum passband TRP output power*, Pmax,p,TRP measured at the RIB shall remain within ±3 dB of the *rated passband TRP output power* Prated,p,TRP, as declared by the manufacturer.

### 7.2.3 Minimum requirement for NCR

#### 7.2.3.1 Minimum requirement for NCR-MT

#### 7.2.3.1.1 Minimum requirement for NCR-MT type 1-H

For NCR-MT type 1-H, the IAB requirement specified in clause 9.2.2 in TS 38.174 apply.

#### 7.2.3.1.2 Minimum requirement for NCR-MT type 2-O

For NCR-MT type 2-O, the IAB requirement specified in clause 9.2.3 in TS 38.174 apply.

#### 7.2.3.2 Minimum requirement for NCR-Fwd

##### 7.2.3.2.1 Minimum requirement for NCR-Fwd type 2-O

The AoA of the input signal shall be within the *Gain REFSENS RoAoA*.

The requirements shall apply with NR signals in the *passband* of the NCR-Fwd at:

The lowest input power (Pp,in,EIRP) that produces the *rated passband TRP output power* (Prated,p,TRP)

Up to:

The lowest input power (Pp,in,EIRP) that produces the *rated passband TRP output power* (Prated,p,TRP), plus 10dB

In normal conditions, the measured output power, Pmax,p,EIRP shall remain within +3.4 dB and -3.4 dB of the *rated beam EIRP output power* Prated,p,EIRP, declared by the manufacturer.

In extreme conditions, the measured output power, Pmax,p,,EIRP shall remain within +4.5 dB and -4.5 dB of the *rated beam EIRP output power* Prated,p,EIRP, declared by the manufacturer.

In normal conditions, the *repeater type 2-O* *maximum passband TRP output power*, Pmax,p,TRP measured at the RIB shall remain within ±3 dB of the *rated passband TRP output power* Prated,p,TRP, as declared by the manufacturer.

## 7.3 OTA frequency stability

### 7.3.1 General

Frequency stability is the ability to maintain the same frequency on the output signal with respect to the input signal.

OTA frequency stability requirement is defined as a *directional requirement* at the RIB and shall be met within the *OTA coverage range*.

### 7.3.2 Minimum requirement for NR repeater

The frequency deviation of the output signal with respect to the input signal shall be no more than ±0,01 PPM.

### 7.3.3 Minimum requirement for NCR

#### 7.3.3.1 Minimum requirement for NCR-Fwd

##### 7.3.3.1.1 Minimum requirement for NCR-Fwd type 2-O

The frequency deviation of the output signal with respect to the input signal shall be no more than ±0,01 PPM.

## 7.4 OTA out of band gain

### 7.4.1 General

Out of band gain refers to the gain of the repeater outside the *passband*.

The requirement is based on the ratio of TRP output power to directional input power.

The intended use of a repeater in a system is to amplify the in-band signals and not to amplify signals outside of the *passband*.

In the intended application of the repeater, the out of band gain is less than lowest expected the coupling loss to the nearest source of emissions.

### 7.4.2 Minimum requirement for NR repeater

The gain outside the *passband* shall not exceed the maximum level specified in table 7.4.2-1, where:

- f\_offset\_CW is the offset between the outer channel edge frequency of the outer channel in the *passband* and a CW signal.

Table 7.4.2-1: Out of band gain limits 1

|  |  |
| --- | --- |
| Frequency offset, f\_offset\_CW | Maximum gain |
| 0.1\*Minimum {400MHz, *passband* BW}  f\_offset\_CW < 150 MHz | 68 dB |
| 150 MHz  f\_offset\_CW < 400 MHz | 55 dB |
| 400 MHz  f\_offset\_CW < f\_offset\_max | 35 dB |

### 7.4.3 Minimum requirement for NCR

#### 7.4.3.1 Minimum requirement for NCR-Fwd

##### 7.4.3.1.1 Minimum requirement for NCR-Fwd type 2-O

The gain outside the *passband* shall not exceed the maximum level specified in Table 7.4.2-1.

## 7.5 OTA unwanted emissions

### 7.5.1 General

Unwanted emissions consist of so-called out-of-band emissions and spurious emissions according to ITU definitions ITU-R SM.329 [5]. In ITU terminology, out of band emissions are unwanted emissions immediately outside the *passband* resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

The OTA out-of-band emissions requirement for the *repeater type 2-O* transmitter is specified both in terms of Adjacent Channel Leakage power Ratio (ACLR) and operating band unwanted emissions (OBUE). OTA Unwanted emissions outside of this frequency range are limited by an OTA spurious emissions requirement.

The maximum offset of the operating band unwanted emissions mask from the *operating band* edge is ΔfOBUE. The value of ΔfOBUE are defined in table 7.5.1-1and 7.5.1-2 for *repeater type 2-O* for NR *operating bands*.

Table 7.5.1-1: Maximum offset ΔfOBUE outside the downlink *operating band* for *repeater type 2-O and NCR-Fwd type 2-O DL*

|  |  |  |
| --- | --- | --- |
| **Repeater type** | ***Operating band* characteristics** | **ΔfOBUE (MHz)** |
| *Repeater type 2-O*  *NCR-Fwd type 2-O* | FDL,high – FDL,low ≤ 4000 MHz | 1500 |

Table 7.5.1-2: Maximum offset ΔfOBUE outside the downlink *operating band* for *repeater type 2-O and NCR-Fwd type 2-O UL*

|  |  |  |
| --- | --- | --- |
| **Repeater type** | ***Operating band* characteristics** | **ΔfOBUE (MHz)** |
| *Repeater type 2-O, NCR-Fwd type 2-O* | FUL,high – FUL,low ≤ 4000 MHz | 1500 |

The unwanted emission requirements are applied per cell for all the configurations. Requirements for OTA unwanted emissions are captured using TRP, *directional requirements* or co-location requirements as described per requirement.

If the NCR supports simultaneous NCR-MT and NCR-Fwd transmission, then the unwanted emissions requirements should be defined on the total emissions from NCR-MT and NCR-Fwd.

### 7.5.2 OTA Adjacent Channel Leakage Power Ratio (ACLR)

#### 7.5.2.1 General

OTA 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. The measured power is TRP.

The requirement shall be applied per RIB during the *transmitter ON state*.

#### 7.5.2.2 Minimum requirement for *NR Repeater*

The OTA ACLR limit is specified in table 7.5.2.2-1 for DL and UL for Wide Area class and DL for Local Area class.

The OTA ACLR limit is specified in table 7.5.2.2-1a for UL for Local Area class.

The OTA ACLR absolute limit is specified in table 7.5.2.2-2.

Either the OTA ACLR (CACLR) absolute limit in table 7.5.2.2-2 or 7.5.2.2-5 or the relevant ACLR (CACLR) limit in table 7.5.2.2-1, 7.5.2.2-1a, 7.5.2.2-3, 7.5.5.2-3a, 7.5.2.2-4 or 7.5.2.2-4a, whichever is less stringent, shall apply.

For a RIB operating in *non-contiguous spectrum*, the OTA ACLR requirement in table 7.5.2.2-3 shall apply in *gaps between passbands* for the frequency ranges defined in the table, while the OTA CACLR requirement in table 7.5.2.2-4 shall apply in *gaps between passbands* for the frequency ranges defined in the table.

The CACLR in a *gap between passbands* is the ratio of:

a) the sum of the filtered mean power centred on the assigned channel frequencies for the two carriers adjacent to each side of the *gap between passbands*, and

b) the filtered mean power centred on a frequency channel adjacent to one of the respective *passband* edges.

The assumed filter for the adjacent channel frequency is defined in table 7.5.2.2-4 and the filters on the assigned channels are defined in table 7.5.2.2-6.

For operation in *non-contiguous spectrum*, the CACLR for NR carriers located on either side of the *gap between passbands* shall be higher than the value specified in table 7.5.2.2-4.

Table 7.5.2.2-1: *Repeater type 2-O* ACLR limit for DL and UL for WA class and DL for LA class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit**  **(dB)** |
| 50, 100, 200, 400 | BWNominal/2 | NR of same BW (Note 2) | Square (BWConfig) | 28 (Note 3)  26 (Note 4) |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | | |

Table 7.5.2.2-1a: *Repeater type 2-O* ACLR limit for UL LA class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit**  **(dB)** |
| 50, 100, 200, 400 | BWNominal/2 | NR of same BW (Note 2) | Square (BWConfig) | 17 (Note 3)  16 (Note 4) |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | | |

**Table 7.5.2.2-2: *Repeater type 2-O* ACLR absolute limit**

|  |  |
| --- | --- |
| **Repeater class** | **ACLR absolute limit** |
| Wide area DL and UL | -13 dBm/MHz |
| Medium range DL | -20 dBm/MHz |
| Local area DL | -20 dBm/MHz |

Table 7.5.2.2-3: *Repeater type 2-O* ACLR limit in non-contiguous spectrum for DL and UL for WA class and DL for LA class

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal (MHz) | Gap between passbands size (Wgap) where the limit applies (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge (inside the gap) | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit** |
| 50, 100, 200, 400 | Wgap≥ 100 (Note 5)  Wgap≥ 250 (Note 6) | 25 MHz | 50 MHz NR (Note 2) | Square (BWConfig) | 28 (Note 3)  26 (Note 4) |
| 50, 100, 200, 400 | Wgap≥ 400 (Note 6)  Wgap≥ 250 (Note 5) | 100 MHz | 200 MHz NR (Note 2) | Square (BWConfig) | 28 (Note 3)  26 (Note 4) |
| NOTE 1: BWNominal is the *nominal channel bandwidth.*BWConfigis the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz.  NOTE 5: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is ≤ 100 MHz.  NOTE 6: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is > 100 MHz. | | | | | |

Table 7.5.2.2-3a: *Repeater type 2-O* ACLR limit in non-contiguous spectrum for UL for LA class

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal  (MHz) | Gap between passbands size (Wgap) where the limit applies (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge (inside the gap) | Assumed adjacent channel carrier | Filter on the adjacent channel frequency and corresponding filter bandwidth | ACLR limit |
| 50, 100, 200, 400 | Wgap≥ 100 (Note 5)  Wgap≥ 250 (Note 6) | 25 MHz | 50 MHz NR (Note 2) | Square (BWConfig) | 17 (Note 3)  16 (Note 4) |
| 50, 100, 200, 400 | Wgap≥ 400 (Note 6)  Wgap≥ 250 (Note 5) | 100 MHz | 200 MHz NR (Note 2) | Square (BWConfig) | 17 (Note 3)  16 (Note 4) |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz.  NOTE 5: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is ≤ 100 MHz.  NOTE 6: Applicable in case the *repeater* *type 2-O nominal channel bandwidth* at the other edge of the gap is > 100 MHz. | | | | | |

Table 7.5.2.2-4: *Repeater type 2-O* CACLR limit in non-contiguous spectrum for DL and UL for WA class and DL for LA class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal (MHz) | | Gap between passbands size (Wgap) where the limit applies (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge (inside the gap) | **Assumed adjacent channel carrier** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **CACLR limit** |
| 50, 100, 200, 400 | | 50 ≤Wgap< 100 (Note 5)  50 ≤Wgap< 250 (Note 6) | 25 MHz | 50 MHz NR (Note 2) | Square (BWConfig) | 28 (Note 3)  26 (Note 4) |
| 50, 100, 200, 400 | | 200 ≤Wgap< 400 (Note 6)  200 ≤Wgap< 250 (Note 5) | 100 MHz | 200 MHz NR (Note 2) | Square (BWConfig) | 28 (Note 3)  26 (Note 4) |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz.  NOTE 5: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is ≤ 100 MHz.  NOTE 6: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is > 100 MHz. | | | | | | |

Table 7.5.2.2-4a: *Repeater type 2-O* CACLR limit in non-contiguous spectrum for UL for LA class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Repeater nominal channel bandwidth BWNominal  (MHz) | | Gap between passbands size (Wgap) where the limit applies (MHz) | Repeater adjacent channel centre frequency offset below or above the passband edge (inside the gap) | Assumed adjacent channel carrier | Filter on the adjacent channel frequency and corresponding filter bandwidth | CACLR limit |
| 50, 100, 200, 400 | | 50 ≤Wgap< 100 (Note 5)  50 ≤Wgap< 250 (Note 6) | 25 MHz | 50 MHz NR (Note 2) | Square (BWConfig) | 17 (Note 3)  16 (Note 4) |
| 50, 100, 200, 400 | | 200 ≤Wgap< 400 (Note 6)  200 ≤Wgap< 250 (Note 5) | 100 MHz | 200 MHz NR (Note 2) | Square (BWConfig) | 17 (Note 3)  16 (Note 4) |
| NOTE 1: BWConfig is the *transmission bandwidth configuration* assumed for the adjacent channel.  NOTE 2: With SCS that provides the largest *transmission bandwidth configuration* (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz.  NOTE 5: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is ≤ 100 MHz.  NOTE 6: Applicable in case the *repeater type 2-O nominal channel bandwidth* at the other edge of the gap is > 100 MHz. | | | | | | |

Table 7.5.2.2-5: *Repeater type 2-O* CACLR absolute limit

|  |  |
| --- | --- |
| **Repeater class** | **CACLR absolute limit** |
| Wide area DL and UL | -13 dBm/MHz |
| Medium range DL | -20 dBm/MHz |
| Local area DL | -20 dBm/MHz |

Table 7.5.2.2-6: Filter parameters for the assigned channel

|  |  |
| --- | --- |
| **RAT of the carrier adjacent to the *gap between passbands*** | **Filter on the assigned channel frequency and corresponding filter bandwidth** |
| NR | NR of same BW with SCS that provides largest *transmission bandwidth configuration* |

#### 7.5.2.3 Minimum requirement for NCR

##### 7.5.2.3.1 Minimum requirement for NCR-Fwd

###### 7.5.2.3.1.1 Minimum requirement for NCR-Fwd *type 2-O*

The requirements in clause 7.5.2.2 apply for NCR-Fwd type 2-O. The limits apply to the sum of emissions from NCR-MT and NCR-FWD when transmitting simultaneously.

##### 7.5.2.3.2 Minimum requirement for NCR-MT

###### 7.5.2.3.2.1 Minimum requirement for NCR-MT type 2-O

For WA NCR-MT type 2-O, the BS ACLR requirements specified in clause 9.7.3.3 in TS 38.104 apply.

For LA NCR-MT type 2-O, the UE ACLR requirements specified in clause 6.5.2.3 in TS 38.101-2 apply.

For simultaneous transmission the limits apply for sum of NCR-MT transmission and NCR-Fwd transmission

### 7.5.3 OTA operating band unwanted emissions

#### 7.5.3.1 General

The OTA limits for operating band unwanted emissions are specified as TRP per RIB unless otherwise stated.

In addition to, for the part of passband where there is no input signal, -13dBm/MHz shall apply for all classes DL and UL.

#### 7.5.3.2 Minimum requirement for NR repeater

##### 7.5.3.2.1 General

The requirements of either clause 7.5.3.2.2 (Category A limits) or clause 7.5.3.2.3 (Category B limits) shall apply. The application of either Category A or Category B limits shall be the same as for General OTA transmitter spurious emissions requirements (*repeater type 2-O*) in clause 7.5.3.3.2. In addition, the limits in clause 7.5.3.2.4 may also apply.

Out-of-band emissions in FR2 are limited by OTA operating band unwanted emission limits.

For *repeater type 2-O*, unless otherwise stated, the OTA operating band unwanted emission limits in FR2 are defined from ΔfOBUE below the lowest frequency of each supported downlink *operating band* up to ΔfOBUE above the highest frequency of each supported downlink *operating band*.

The values of ΔfOBUE are defined in table 7.5.1-1 and 7.5.1-2 for the NR *operating bands*.

The requirements shall apply whatever the type of transmitter considered and for all transmission modes foreseen by the manufacturer's specification. For a *RIB* operating in contiguous CA, the requirements apply to the frequencies (ΔfOBUE) starting from the edge of the *passband.* In addition, for a *RIB* operating in *non-contiguous spectrum*, the requirements apply inside any *gap between passbands*.

Emissions shall not exceed the maximum levels specified in the tables below, where:

- Δf is the separation between the *passband* edge frequency and the nominal -3dB point of the measuring filter closest to the *passband* edge.

- f\_offset is the separation between the *passband* edge frequency and the centre of the measuring filter.

- f\_offsetmax is the offset to the frequency ΔfOBUE outside thedownlink *operating band*, where ΔfOBUE is defined in table 7.5.1-1 and 7.5.1-2..

- Δfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter.

In addition, inside any *gap between passbands* for a *RIB* operating in *non-contiguous spectrum*, emissions shall not exceed the cumulative sum of the limits specified for the adjacent *sub-blocks* on each side of the *gap between passbands*. The limit for each *sub-block* is specified in clauses 7.5.3.2.2 and 7.5.3.2.3 below, where in this case:

- Δf is the separation between the *sub-block* edge frequency and the nominal -3 dB point of the measuring filter closest to the *sub-block* edge.

- f\_offset is the separation between the *sub-block* edge frequency and the centre of the measuring filter.

- f\_offsetmax is equal to the *gap between passbands* bandwidth minus half of the bandwidth of the measuring filter.

- Δfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter.

##### 7.5.3.2.2 OTA operating band unwanted emission limits (Category A)

*Repeater type 2-O* unwanted emissions shall not exceed the maximum levels specified in tables 7.5.3.2.2‑1 and 7.5.3.2.2-2.

Table 7.5.3.2.2-1: OBUE limits applicable in the frequency range 24.25 – 33.4 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency offset of measurement filter -3B point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Limit** | ***Measurement bandwidth*** |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-5 dBm, Max(Prated,t,TRP – 35 dB, -12 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – 43 dB, -20 dBm)) | 1 MHz |
| NOTE 1: For *non-contiguous spectrum* operation within any *operating band* the limitwithin *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. | | | |

Table 7.5.3.2.2-2: OBUE limits applicable in the frequency range 37 – 52.6 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency offset of measurement filter -3B point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Limit** | ***Measurement bandwidth*** |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-5 dBm, Max(Prated,t,TRP – 33 dB, -12 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| NOTE 1: For *non-contiguous spectrum* operation within any *operating band* the limitwithin *gaps between passbands* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *gap between passbands*. | | | |

##### 7.5.3.2.3 OTA operating band unwanted emission limits (Category B)

*Repeater type 2-O* unwanted emissions shall not exceed the maximum levels specified in table 7.5.3.2.3‑1 or 7.5.3.2.3-2.

Table 7.5.3.2.3-1: OBUE limits applicable in the frequency range 24.25 – 33.4 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency offset of measurement filter -3 dB point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Limit** | ***Measurement bandwidth*** |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-5 dBm, Max(Prated,t,TRP – 35 dB, -12 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – 43 dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – 33 dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin gaps between *passbands* is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the gap between *passbands*.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

Table 7.5.3.2.3-2: OBUE limits applicable in the frequency range 37 – 52.6 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency offset of measurement filter -3 dB point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Limit** | ***Measurement bandwidth*** |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-5 dBm, Max(Prated,t,TRP – 33 dB, -12 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – 31 dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin gaps between *passbands* is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the gap between *passbands*.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

##### 7.5.3.2.4 Additional OTA operating band unwanted emission requirements

7.5.3.2.4.1 Protection of Earth Exploration Satellite Service

For repeater operating in the frequency range 24.25 – 27.5 GHz, the power of unwanted emission shall not exceed the limits in table 7.5.3.2.4.1-1 for DL and in table7.5.3.2.4.1-2.

Table 7.5.3.2.4.1-1: OBUE limits for protection of Earth Exploration Satellite Service for DL

|  |  |  |
| --- | --- | --- |
| **Frequency range** | **Limit** | ***Measurement Bandwidth*** |
| 23.6 – 24 GHz | -3 dBm (Note 1) | 200 MHz |
| 23.6 – 24 GHz | -9 dBm (Note 2) | 200 MHz |
| NOTE 1: This limit applies to repeater brought into use on or before 1 September 2027.  NOTE 2: This limit applies to repeater brought into use after 1 September 2027. | | |

Table 7.5.3.2.4.1-2: OBUE limits for protection of Earth Exploration Satellite Service for UL

|  |  |  |
| --- | --- | --- |
| **Frequency range** | **Limit** | ***Measurement Bandwidth*** |
| 23.6 – 24 GHz | 1 dBm | 200 MHz |

7.5.3.3 Minimum requirement for NCR

7.5.3.3.1 Minimum requirement for NCR-Fwd

###### 7.5.3.3.1.1 Minimum requirement for NCR-Fwd *type 2-O*

The requirements in clause 7.5.3.2 apply for NCR-Fwd type 2-O. The limits apply to the sum of emissions from NCR-MT and NCR-FWD when transmitting simultaneously.

7.5.3.3.2 Minimum requirement for NCR-MT

##### 7.5.3.3.2 Minimum requirement for NCR-MT

###### 7.5.3.3.2.1 Minimum requirement for NCR-MT type 2-O

For Wide Area *NCR-MT type 2-O*, the BS OBUE requirements specified in clause 9.7.4.3 in TS 38.104 apply.

For Local Area *NCR-MT type 2-O*, the UE SEM requirements specified in clause 6.5.2.1 in TS 38.101-2 apply.

### 7.5.4 OTA transmitter spurious emissions

#### 7.5.4.1 General

Unless otherwise stated, all requirements are measured as mean power.

The OTA spurious emissions limits are specified as TRP per RIB unless otherwise stated.

#### 7.5.4.2 Minimum requirement for *NR repeater*

##### 7.5.4.2.1 General

For *repeater type 2-O*, the OTA transmitter spurious emission limits apply from 30 MHz to 2nd harmonic of the upper frequency edge of the downlink *operating band*, excluding the frequency range from ΔfOBUE below the lowest frequency of the downlink *operating band*, up to ΔfOBUE above the highest frequency of the downlink *operating band*, where the ΔfOBUE is defined in table 7.5.1-1 and 7.5.1-2..

##### 7.5.4.2.2 General OTA transmitter spurious emissions requirements

7.5.4.2.2.1 General

The requirements of either clause 7.5.4.2.2.2 (Category A limits) or clause 7.5.4.2.2.3 (Category B limits) shall apply. The application of either Category A or Category B limits shall be the same as for Operating band unwanted emissions in clause 7.5.3.

7.5.4.2.2.2 OTA transmitter spurious emissions (Category A)

The power of any spurious emission shall not exceed the limits in table 7.5.4.2.2.2-1

Table 7.5.4.2.2.2-1: Repeater radiated Tx spurious emission limits in FR2

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | **Limit** | ***Measurement Bandwidth*** | **Note** |
| 30 MHz – 1 GHz | -13 dBm | 100 kHz | Note 1 |
| 1 GHz – 2nd harmonic of the upper frequency edge of the *passband* |  | 1 MHz | Note 1, Note 2 |
| NOTE 1: Bandwidth as in ITU-R SM.329 [5], s4.1  NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1. | | | |

7.5.4.2.2.3 OTA transmitter spurious emissions (Category B)

The power of any spurious emission shall not exceed the limits in table 7.5.4.2.2.3-1.

Table 7.5.4.2.2.3-1: Repeater radiated Tx spurious emission limits in FR2 (Category B)

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range  (Note 4)** | **Limit** | ***Measurement Bandwidth*** | **Note** |
| 30 MHz ↔ 1 GHz | -36 dBm | 100 kHz | Note 1 |
| 1 GHz ↔ 18 GHz | -30 dBm | 1 MHz | Note 1 |
| 18 GHz ↔ Fstep,1 | -20 dBm | 10 MHz | Note 2 |
| Fstep,1  ↔ Fstep,2 | -15 dBm | 10 MHz | Note 2 |
| Fstep,2 ↔ Fstep,3 | -10 dBm | 10 MHz | Note 2 |
| Fstep,4  ↔ Fstep,5 | -10 dBm | 10 MHz | Note 2 |
| Fstep,5  ↔ Fstep,6 | -15 dBm | 10 MHz | Note 2 |
| Fstep,6 ↔ 2nd harmonic of the upper frequency edge of the *passband* | -20 dBm | 10 MHz | Note 2, Note 3 |
| NOTE 1: Bandwidth as in ITU-R SM.329 [5], s4.1  NOTE 2: Limit and bandwidth as in ERC Recommendation 74-01 [9], Annex 2.  NOTE 3: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 4: The step frequencies Fstep,X are defined in Table 7.5.4.2.2.3-2. | | | |

Table 7.5.4.2.2.3-2: Step frequencies for defining the Repeater radiated Tx spurious emission limits in FR2 (Category B)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Operating band** | **Fstep,1 (GHz)** | **Fstep,2 (GHz)** | **Fstep,3 (GHz) (Note 2)** | **Fstep,4 (GHz) (Note 2)** | **Fstep,5 (GHz)** | **Fstep,6 (GHz)** |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| NOTE 1: Fstep,X are based on ERC Recommendation 74-01 [9], Annex 2.  NOTE 2: Fstep,3 and Fstep,4 are aligned with the values for ΔfOBUE in Table 7.5.1-1 and 7.5.1-2.. | | | | | | |

##### 7.5.4.2.3 Additional OTA transmitter spurious emissions requirements

These requirements may be applied for the protection of systems operating in frequency ranges other than the repeater-Node. The limits may apply as an optional protection of such systems that are deployed in the same geographical area as the repeater-Node, or they may be set by local or regional regulation as a mandatory requirement for an NR *operating band*. It is in some cases not stated in the present document whether a requirement is mandatory or under what exact circumstances that a limit applies, since this is set by local or regional regulation. An overview of regional requirements in the present document is given in clause 4.4.

7.5.4.2.3.1 Limits for protection of Earth Exploration Satellite Service

For repeater operating in the frequency range 24.25 – 27.5 GHz, the power of any spurious emissions shall not exceed the limits in Table 7.5.4.2.3.1-1 and Table 7.5.4.2.3.1-2.

Table 7.5.4.2.3.1-1: Limits for protection of Earth Exploration Satellite Service for DL

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | **Limit** | ***Measurement Bandwidth*** | **Note** |
| 23.6 – 24 GHz | -3 dBm | 200 MHz | Note 1 |
| 23.6 – 24 GHz | -9 dBm | 200 MHz | Note 2 |
| NOTE 1: This limit applies to Repeater brought into use on or before 1 September 2027.  NOTE 2: This limit applies to Repeater brought into use after 1 September 2027. | | | |

Table 7.5.4.2.3.1-2: OBUE limits for protection of Earth Exploration Satellite Service for UL

|  |  |  |
| --- | --- | --- |
| **Frequency range** | **Limit** | ***Measurement Bandwidth*** |
| 23.6 – 24 GHz | 1 dBm | 200 MHz |

#### 7.5.4.3 Minimum requirement for *NCR*

##### 7.5.4.3.1 Minimum requirement for NCR-Fwd

###### 7.5.4.3.1.1 Minimum requirement for *NCR-Fwd type 2-O*

The requirements in clause 7.5.4.2 apply. The limits apply to the sum of emissions from NCR-MT and NCR-FWD when transmitting simultaneously.

##### 7.5.4.3.2 Minimum requirement for NCR-MT

###### 7.5.4.3.2.1 Minimum requirement for NCR-MT Type 2-O

For Wide Area *NCR-MT type 2-O*, the OTA TX spurious emission requirements are as defined in clause 7.5.4.2.

For Local Area *NCR-MT type 2-O*, the OTA TX spurious emission requirements defined for NR UE in clause 6.5.3 in TS 38.101-2 apply.

### 7.5.5 OTA receiver spurious emissions

#### 7.5.5.1 General

The OTA RX spurious emission is the power of the emissions radiated from the antenna array from a receiver unit.

The metric used to capture OTA receiver spurious emissions is *total radiated power* (TRP), with the requirement defined at the RIB.

For a RIB operating in FDD, OTA RX spurious emissions requirement do not apply as they are superseded by the OTA TX spurious emissions requirement. This is due to the fact that TX and RX spurious emissions cannot be distinguished in OTA domain.

For a RIB operating in TDD, the OTA RX spurious emissions requirement shall apply during the *transmitter OFF state* only.

For *multi-band RIB*, the OTA RX spurious emissions requirements are subject to exclusion zones in each supported *operating band*.

7.5.5.2 Minimum requirement for *NR repeater*

For the *Repeater type 2-O*, the power of any RX spurious emission shall not exceed the limits in table 7.5.5.2-1.

7.5.5.2-1: OTA receiver spurious emission limits for *Repeater type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| Spurious  frequency range  (Note 4) | Limit (Note 5) | Measurement Bandwidth | Note |
| 30 MHz ↔ 1 GHz | -36 dBm | 100 kHz | Note 1 |
| 1 GHz ↔ 18 GHz | -30 dBm | 1 MHz | Note 1 |
| 18 GHz ↔ Fstep,1 | -20 dBm | 10 MHz | Note 2 |
| Fstep,1  ↔ Fstep,2 | -15 dBm | 10 MHz | Note 2 |
| Fstep,2 ↔ Fstep,3 | -10 dBm | 10 MHz | Note 2 |
| Fstep,4  ↔ Fstep,5 | -10 dBm | 10 MHz | Note 2 |
| Fstep,5  ↔ Fstep,6 | -15 dBm | 10 MHz | Note 2 |
| Fstep,6 ↔ 2nd harmonic of the upper frequency edge of the UL *operating band* | -20 dBm | 10 MHz | Note 2, Note 3 |
| NOTE 1: Bandwidth as in ITU-R SM.329 [5], s4.1.  NOTE 2: Limit and bandwidth as in ERC Recommendation 74-01 [9], Annex 2.  NOTE 3: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.  NOTE 4: The step frequencies Fstep,X are defined in table 7.5.5.3-2.  NOTE 5: Additional limits may apply regionally. | | | |

Table 7.5.5.2-2: Step frequencies for defining the OTA receiver spurious emission limits for *Repeater type 2-O*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating band | Fstep,1 (GHz) | Fstep,2 (GHz) | Fstep,3 (GHz) | Fstep,4 (GHz) | Fstep,5 (GHz) | Fstep,6 (GHz) |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| n260 | 25 | 34 | 35.5 | 41.5 | 43 | 52 |
| n261 | 18 | 25.5 | 26.0 | 29.85 | 30.35 | 38.35 |
| n262 | 37.2 | 45.2 | 45.7 | 49.7 | 50.2 | 58.2 |
| n263 | 18 | 43 | 53.5 | 74.5 | 85 | 127 |

In addition to the requirements in Table 7.5.5.2-1, the requirement for protection of EESS for *NR repeater* operating in frequency range 24.25 – 27.5 GHz in clause 7.5.4.2.3.1 may be applied.

7.5.5.3 Minimum requirement for *NCR*

##### 7.5.5.3.1 Minimum requirement for NCR-Fwd

7.5.5.3.1.1 Minimum requirement for *NCR-Fwd type 2-O*

The requirements in clause 7.5.5.2 apply.

The receiver spurious emissions limits shall apply to the total emissions from both the NCR-Fwd and NCR-MT.

## 7.6 OTA Repeater Error Vector Magnitude

### 7.6.1 Downlink repeater error vector magnitude

#### 7.6.1.1 General

The Repeater Error Vector Magnitude (EVM) is a measure of the difference between the symbols provided at the input of the repeater and the measured signal symbols at the output of the repeater after the equalization by the measurement equipment. This difference is called the error vector. Details about how the repeater EVM is determined are same as specified in TS 38.104 [2] Annex C for FR2. The repeater EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed in percent.

For repeater type 2-O, OTA modulation quality requirement is defined as a *directional requirement* at the RIB and shall be met within the *OTA coverage range* on the transmit side and the AoA of the incident wave of the received signal is in the reference direction at the receive side.

For NCR-Fwd type 2-O, OTA modulation quality requirement is defined as a directional requirement at the RIB and shall be met within the OTA coverage range on the transmit side and the AoA of the incident wave of the received signal is within the OTA REFSENS RoAoA at the receive side.

The repeater EVM requirement is applicable when the repeater is operating with an input power level within the range from what is required to reach the rated beam EIRP output power (Prated,p,EIRP) to the minimum power levels in table 7.6.1.1-1.

Table 7.6.1.1-1: Minimum input power for repeater EVM for repeater type 2-O and NCR-Fwd type 2-O

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Repeater class | Minimum input power (dBm/MHz) | | | | | |
| 24.25 – 33.4 GHz | | | 37 – 52.6 GHz | | |
| Up to 16 QAM | 64QAM 1 | 256QAM 2 | Up to 16 QAM | 64QAM 1 | 256QAM 2 |
| WA, MR, LA | -77- GRX\_ANT | -73- GRX\_ANT | -66- GRX\_ANT | -75- GRX\_ANT | -71- GRX\_ANT | -64- GRX\_ANT |
| Note 1: support of 64QAM is based on the declaration  Note 2: support of 256QAM is based on the declaration | | | | | | |

Where GRX\_ANT is the gain of the receive side antennas and is estimated based on the 3dB gain RoAoA and a formula, GRX\_ANT = 44.1 - 10\*log10(BeWθ,REFSENS\*BeWφ,REFSENS) dB.

#### 7.6.1.2 Minimum requirement for NR repeater

The repeater EVM levels for different modulation schemes outlined in table 7.6.1.2-1 shall be met using the frame structure described in clause 7.6.1.3.

**Table 7.6.1.2-1: Repeater EVM requirements**

|  |  |
| --- | --- |
| Parameter | Required repeater EVM |
| Up to 16QAM | 12.5% |
| 64QAM | 8 % 1 |
| 256QAM | 3.5 % 2 |
| Note 1: support of 64QAM is based on the declaration  Note 2: support of 256QAM is based on the declaration. | |

#### 7.6.1.2A Minimum requirement for NCR

##### 7.6.1.2A.1 Minimum requirement for NCR-Fwd

###### 7.6.1.2A.1.1 Minimum requirement for NCR-Fwd type 2-O

The requirements in clause 7.6.1.2 apply for NCR-Fwd type 2-O.

#### 7.6.1.3 Repeater EVM frame structure for measurement

The input signals for the repeater EVM requirement shall have the same frame structure as defined for the BS is TS 38.104 [2].

### 7.6.2 Uplink repeater error vector magnitude

#### 7.6.2.1 General

The Repeater Error Vector Magnitude is a measure of the difference between the reference waveform provided at the input of repeater and the measured waveform at the output of the repeater. This difference is called the error vector. Details about how the repeater EVM is determined are the same as specified in TS 38.101-2 [14] Annex F for FR2. Before calculating the repeater EVM, the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the repeater EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in TS 38.101-2 [14] clauses 6.4.2.4 and 6.4.2.5. For DFT-s-OFDM waveforms, the repeater EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the repeater EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic repeater EVM measurement interval is one slot in the time domain. The repeater EVM measurement interval is reduced by any symbols that contains an allowable power transient in the measurement interval as defined in TS 38.101-2 [14] clause 6.3.3.

All the parameters defined in clause 7.6.2 are defined using the measurement methodology specified in TS 38.101-2 [14] Annex F.

For *repeater type 2-O*, OTA modulation quality requirement is defined as a *directional requirement* at the RIB and shall be met within the *OTA coverage range* on the transmit side and the AoA of the incident wave of the received signal is in the reference direction at the receive side.

For *NCR-Fwd type 2-O*, OTA modulation quality requirement is defined as a directional requirement at the RIB and shall be met within the OTA coverage range on the transmit side and the AoA of the incident wave of the received signal is within the OTA REFSENS RoAoA at the receive side.

The repeater EVM requirement is applicable when the repeater is operating with an input power level within the range from what is required to reach the rated beam EIRP output power (Prated,p,EIRP) to the minimum input power levels in table 7.6.2.1-1.

Table 7.6.2.1-1: Minimum input power for repeater EVM for repeater type 2-O and NCR-Fwd type 2-O

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Repeater class | Minimum input power (dBm/MHz) | | | |
| 24.25 – 33.4 GHz | | 37 – 52.6 GHz | |
| Up to 16 QAM | 64QAM 1 | Up to 16 QAM | 64QAM1 |
| WA, LA | -77- GRX\_ANT | -73- GRX\_ANT | -75- GRX\_ANT | -71- GRX\_ANT |
| Note 1: support of 64QAM is based on the declaration | | | | |

Where GRX\_ANT is the gain of the receive side antennas and is estimated based on the 3dB gain RoAoA and a formula, GRX\_ANT = 44.1 - 10\*log10(BeWθ,REFSENS\*BeWφ,REFSENS) dB.

#### 7.6.2.2 Minimum requirement for NR repeater

The RMS average of the basic repeater EVM measurements over 10 subframes for the average repeater EVM case, for the different modulation schemes shall not exceed the values specified in Table 7.6.2.2-1.

**Table 7.6.2.2-1: Minimum requirements for repeater error vector magnitude**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Average repeater EVM level** |
| Up to 16 QAM | % | 12.5 |
| 64 QAM | % | 8 1 |
| Note 1: support of 64QAM is based on the declaration | | |

#### 7.6.2.3 Minimum requirement for NCR

##### 7.6.2.3.1 Minimum requirement for NCR-Fwd

###### 7.6.2.3.1.1 Minimum requirement for *NCR-Fwd type 2-O*

The requirements in clause 7.6.2.2 apply for *NCR-Fwd type 2-O*.

## 7.7 OTA input intermodulation

### 7.7.1 General

The input intermodulation is a measure of the capability of the repeater to inhibit the generation of interference in the *passband*, in the presence of interfering signals on frequencies other than the *passband*. The requirement is defined as a directional requirement.

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction:

The interfering signals apply to each supported polarization, under the assumption of polarization match.

The following requirement applies for interfering signals depending on the repeaters *passband*.

This requirement applies to the uplink and downlink of the repeater during the *transmitter ON state*.

When GSM, CDMA, UTRA, E-UTRA, NR BS or repeater operating in a different frequency band are co-located with a NCR, additional input intermodulation co-location requirement may be applied for the protection of NR repeater or NCR receivers. This requirement applies to the uplink and downlink of the repeater. If the BS side is declared to meet co-location requirements, then it should meet input intermodulation co-location requirements for the downlink. If the UE side is declared to meet co-location requirements, then it should meet input intermodulation co-location requirements for the uplink.

When GSM, CDMA, UTRA, E-UTRA, NR BS or repeater operating in another frequency band co-exist with a NCR, additional input intermodulation co-existence requirement may be applied for the protection of NR repeater or NCR receivers.

### 7.7.2 Minimum requirement for NR repeater

For the parameters specified in table 7.7.2-1, the power in the *passband* shall not increase with more than 10 dB at the output of the repeater as measured with 1 MHz measurement bandwidth, compared to the level obtained without interfering signals applied.

The core requirement is applicable for all frequency separation possibilities between the two interfering signals that cause the 3rd order intermodulation product to fall into the whole *passband*.

Table 7.7.2-1 specifies the parameters for two interfering signals, where:

- f1 offset is the offset from the channel edge frequency of the first or last channel in the *passband* of the closer carrier.

- GRX\_ANT is the gain of the receive side antennas and is calculated from EIRP and TRP declaration.

Table 7.7.2-1: Input intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| f1 offset | Interfering Signal Levels | Type of signals | Measurement bandwidth |
| 1 MHz | -53dBm – G\_RX\_ANT | 2 CW carriers | 1 MHz |

### 7.7.3 Minimum requirement for NCR

#### 7.7.3.1 Minimum requirement for NCR-Fwd

##### 7.7.3.1.1 Minimum requirement for NCR-Fwd type 2-O

The requirements in clause 7.7.2 apply for NCR-Fwd type 2-O.

## 7.8 OTA Adjacent Channel Rejection Ratio (ACRR)

### 7.8.1 General

OTA Adjacent Channel Rejection Ratio (ACRR) is the ratio of the average gain over a carrier of the repeater in the *passband* to the average gain of the repeater over an adjacent channel outside the repeater *passband*. The requirement shall apply to the uplink and downlink of the Repeater. The bandwidth of the channel inside the *passband* and the adjacent channel shall be of the same type (reference carrier) with bandwidths as defined by *nominal channel bandwidth*.

The requirement is differentiated between downlink and uplink.

The requirement shall apply during the *transmitter ON state*.

The ACRR is a ratio of gain in the adjacent channel to gain in the wanted channel. The gain in each case is defined as the ratio of TRP output power to directional input power.

### 7.8.2 Minimum Requirements for NR repeater

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal in the *passband* and a received signal on an adjacent channel outside repeater *passband* is from the same direction and are the same as the TX reference direction for the opposite DL/UL setting*.*

For a repeater operating at *passband* operating in FR2, the ACRR requirements in table 7.8.2-1 shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 7.8.2-1.

**Table 7.8.2-1: Repeater Downlink ACRR**

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit (dB) |
| NR | Wide Area repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Medium Range repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Local Area repeater | BWNominal/2 | 28 (Notes 1, 2)  26 (Note 1, 3) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 3: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | |

For a repeater operating at *passband* operating in FR2, the ACRR requirements in table 7.8.2-2 shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 7.8.2-2.

**Table 7.8.2-2: Repeater Uplink ACRR**

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit (dB) |
| NR | Wide Area repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Local Area repeater | BWNominal/2 | 17 (Note 1, 2)  16 (Note 1, 3) |
| NOTE 1: This requirement does not applicable if the *passband* occupies the entire *operating band*.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 3: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | |

### 7.8.3 Minimum Requirements for NCR

7.8.3.1 Minimum Requirements for NCR-Fwd

##### 7.8.3.1.1 Minimum Requirements for NCR-Fwd type 2-O

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal in the *passband* and a received signal on an adjacent channel outside repeater *passband* is from the same direction and are the same as the TX reference direction for the opposite DL/UL setting*.*

For *NCR-Fwd type 2-O* operating at *passband* operating in FR2, the ACRR requirements in table 7.8.3.1.1-1 shall apply in downlink. In normal conditions the ACRR for downlink shall be higher than the value specified in the Table 7.8.3.1.1-1.

**Table 7.8.3.1.1-1: NCR-Fwd type 2-O Downlink ACRR**

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit (dB) |
| NR | Wide Area repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Medium Range repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Local Area repeater | BWNominal/2 | 28 (Notes 1, 2)  26 (Note 1, 3) |
| NOTE 1: This requirement is not applicable if the *passband* occupies the entire *operating band*.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 3: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | |

For *NCR-Fwd type 2-O* operating at *passband* operating in FR2, the ACRR requirements in table 7.8.3.1.1-2 shall apply in uplink. In normal conditions the ACRR for uplink shall be higher than the value specified in the Table 7.8.3.1.1-2.

**Table 7.8.3.1.1-2: NCR-Fwd type 2-O Uplink ACRR**

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater Class | Channel offset from frequency edge of *passband* (MHz) | ACRR limit (dB) |
| NR | Wide Area repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Local Area repeater | BWNominal/2 | 17 (Note 1, 2)  16 (Note 1, 3) |
| NOTE 1: This requirement is not applicable if the *passband* occupies the entire *operating band*.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 3: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz | | | |

## 7.9 OTA transmit ON/OFF power

### 7.9.1 General

OTA transmit ON/OFF power requirements apply only to TDD operation of repeater. The requirements apply to both downlink and uplink of the repeater.

### 7.9.2 OTA transmitter OFF power

#### 7.9.2.1 General

OTA transmitter OFF power is defined as the mean power measured over 70/N µs filtered with a square filter of bandwidth equal to the *passband bandwidth* of the repeater (BWpassband ) centred on the assigned channel frequency during the *transmitter OFF period*. N = SCS/15, where SCS is Sub Carrier Spacing in kHz of the input signal. The For *repeater type 2-O* and *NCR-Fwd type 2-O*, the OTA transmitter OFF power is defined as TRP.

#### 7.9.2.2 Minimum requirement for NR repeater

The OTA transmitter OFF TRP spectral density for *repeater type 2-O* shall be less than ‑36 dBm/MHz.

#### 7.9.2.3 Minimum requirement for NCR

##### 7.9.2.3.1 Minimum requirement for NCR-Fwd

###### 7.9.2.3.1.1 Minimum requirement for NCR-Fwd *type 2-O*

The requirements in clause 7.9.2.2 apply for NCR-Fwd type 2-O.

##### 7.9.2.3.2 Minimum requirement for NCR-MT

###### 7.9.2.3.2.1 Minimum requirement for NCR-MT type 2-O

For Wide Area NCR-MT type 2-O, the OTA transmitter OFF TRP spectral density for shall be less than ‑36 dBm/MHz.For Local Area *NCR-MT type 2-O,* the transmit OFF power shall not exceed the values specified in Tables 7.9.2.3.2.1-1 for each operating band supported. The requirement is verified with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

Table7.9.2.3.2.1-1: Transmit OFF power for FR2-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating band | Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth | | | |
|  | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| n257, n258, n259, n260, n261, n262 | -35 | -35 | -35 | -35 |
|  | 47.58 MHz | 95.16 MHz | 190.20 MHz | 380.28 MHz |

### 7.9.3 OTA transient period

#### 7.9.3.1 General

The OTA *transmitter transient period* is the time period during which the transmitter is changing from the tra*nsmitter OFF state* to the *transmitter ON state* or vice versa. The *transmitter transient period* is illustrated in figure 7.9.3.1-1.



Figure 7.9.3.1-1: Example of relations between transmitter *ON state*, transmitter *OFF state* and *transmitter transient period*

This requirement shall be applied at each RIB supporting transmission in the *operating band*. The beginning and end point of downlink and uplink bursts are referenced to the slot timing at the input.

#### 7.9.3.2 Minimum requirement for NR repeater

For *repeater type 2-O*, the OTA *transmitter transient period* shall be shorter than the values listed in the minimum requirement table 7.9.3.2-1.

**Table 7.9.3.2-1: Minimum requirement for the OTA *transmitter transient period* for *repeater type 2-O***

|  |  |
| --- | --- |
| **Transition** | **Transient period length (µs)** |
| OFF to ON | 3 |
| ON to OFF | 3 |

#### 7.9.3.3 Minimum requirement for NCR

##### 7.9.3.3.1 Minimum requirement for NCR-Fwd

##### 7.9.3.3.1.1 Minimum requirement for NCR-Fwd type 2-O

The requirements in clause 7.9.3.2 apply for NCR-Fwd type 2-O.

##### 7.9.3.3.2 Minimum requirement for NCR-MT

###### 7.9.3.3.2.1 Minimum requirement for NCR-MT type 2-O

For Wide Area NCR*-MT type 2-O*, the OTA *transmitter transient period* shall be shorter than the values listed in the minimum requirement table 7.9.3.3.2.1-1.

Table 7.9.3.3.2.1-1: Minimum requirement for the OTA *transmitter transient period* for Wide Area NCR*-MT type 2-O*

|  |  |
| --- | --- |
| Transition | Transient period length (µs) |
| OFF to ON | 3 |
| ON to OFF | 3 |

For Local Area *NCR-MT type 2-O,* the requirement from TS 38.101-2 section 6.3.3.2 applies.

## 7.10 OTA output power dynamics

### 7.10.1 General

### 7.10.2 Minimum requirement for NCR-MT

## 7.11 OTA transmit signal quality

### 7.11.1 General

Transmit signal quality is specified in terms of: frequency error and transmit modulation quality requirements.

### 7.11.2 Frequency error requirements for NCR-MT

#### 7.11.2.1 Minimum requirement for NCR-MT type 2-O

For NCR-MT type 2-O, the requirements specified in clause 9.6.1.2.3 in TS 38.174 applies.

### 7.11.3 Transmit modulation quality

#### 7.11.3.1 Minimum requirement for NCR-MT type 2-O

For NCR-MT type 2-O, the requirements specified in clause 9.6.2.2.3 in TS 38.174 applies.

## 7.12 Diversity characteristics

### 7.12.1 General

### 7.12.2 Minimum requirement for NCR-MT

The OTA diversity characteristic is specified the same as conducted diversity characteristic for FR1 NCR type 1-C, 1-H in sub-clause 6.13.

## 7.13 OTA reference sensitivity

### 7.13.1 General

The reference sensitivity power level REFSENS is defined as the EIS level at the centre of the quiet zone in the RX beam peak direction, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

### 7.13.2 Minimum requirement for NCR-MT type 2-O

The wide area NCR-MT reference sensitivity level is specified the same as the Wide Area IAB-MT reference sensitivity level requirement in TS 38.174 [xx], subclause 10.3.3.3.

The local area NCR-MT reference sensitivity level is specified the same as reference sensitivity power level for power class 3 in TS 38.101-2 [xx], subclause 7.3.2.3.

## 7.14 OTA maximum input level

### 7.14.1 General

The maximum input level is defined as the maximum mean power, for which the throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

### 7.14.2 Minimum requirement for NCR-MT type 2-O

The local area NCR-MT maximum input power is specified the same as maximum input power in TS 38.101-2 [xx], subclause 7.4.

## 7.15 OTA adjacent channel selectivity

### 7.15.1 General

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a 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).

### 7.15.1 Minimum requirement for NCR-MT type 2-O

The wide area NCR-MT ACS requirement is specified the same as the Wide Area IAB-MT ACS requirement in TS 38.174 [xx], subclause 10.5.1.4.

The local area NCR-MT reference sensitivity level is specified the same as ACS requirement in TS 38.101-2 [xx], subclause 7.5.

## 7.16 OTA blocking characteristics

### 7.16.1 General

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

### 7.16.2 Minimum requirement for NCR-MT type 2-O

The wide area NCR-MT blocking requirement is specified the same as the Wide Area IAB-MT blocking requirement in TS 38.174 [xx], subclause 10.5.2.4.

The local area NCR-MT blocking requirement is specified the same as blocking requirement in TS 38.101-2 [xx], subclause 7.6.

## 7.17 OTA spurious emissions

### 7.17.1 General

The spurious emissions power is the power of emissions generated or amplified in a receiver. The spurious emissions power level is measured as TRP.

### 7.17.2 Minimum requirement for NCR-MT type 2-O

The wide area NCR-MT receiver spurious emission requirement is specified the same as the Wide Area IAB-MT receiver spurious emission requirement in TS 38.174 [xx], subclause 10.7.3.2.

The local area NCR-MT receiver spurious emission requirement is specified the same as receiver spurious emission requirement in TS 38.101-2 [xx], subclause 7.9.

Annex A (normative):  
Environmental requirements for the Repeater equipment

<Text will be added.>

Annex B (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 2022-03 | RAN#95e | RP-220790 |  |  | NR Repeater Radio Transmission and Reception |  | 1.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2022-03 | RAN#95 |  |  |  |  | Approved by plenary – Rel-17 spec under change control | 17.0.0 |
| 2022-06 | RAN#96 | RP-221681 | 0002 | 1 | F | CR to 38.106: TDD off power radiated requirement correction | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0003 | 1 | F | CR to 38.106: Corections to definitons, symbols and abbreviations | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0004 | 1 | F | CR to 38.106: Output power definitions for NR repeaters | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0006 | 1 | F | CR for TS 38.106 R17: clean up of clause 4 | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0007 | 1 | F | CR for TS 38.106 R17: clean up of clause 6 | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0008 | 1 | F | CR for TS 38.106 R17: clean up of clause 7 | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0009 | 1 | F | CR to TS38.106: clarification on the supported operating bands for NR repeater | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0011 | 1 | F | CR to TS 38.106 with corrections to repeater core specification | 17.1.0 |
| 2022-06 | RAN#96 | RP-221681 | 0012 |  | F | BIG CR to 38.106 maintenance | 17.1.0 |
| 2022-09 | RAN#97 | RP-222034 | 0013 |  | F | CR to 38.106: NR repeater ACLR requirements | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0015 | 1 | F | CR to 38.106: NR repeater receiver spurious emissions requirements | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0016 |  | F | CR to 38.106: Removal of unlicensed bands for NR repeaters | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0017 | 1 | F | CR to 38.106: Correction of LA ACLR requirements | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0018 |  | F | CR to 38.106: Correction of LA ACLR requirements | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0019 | 1 | F | CR to TS 38.106 with updates and corrections for conductive part | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0020 |  | F | CR to TS 38.106 with updates and corrections for radiated part | 17.2.0 |
| 2022-09 | RAN#97 | RP-222034 | 0021 |  | F | Big CR for TS 38.106 Maintenance (Rel-17, CAT F) | 17.2.0 |
| 2022-12 | RAN#98-e | RP-223310 | 0026 | 1 | F | CR to 38.106: ACLR requirements | 17.3.0 |
| 2022-12 | RAN#98-e | RP-223310 | 0027 | 1 | F | CR to 38.106: EVM requirements | 17.3.0 |
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|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
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| 2023-03 | RAN#99 | RP-230535 | 0030 | 1 | B | CR to 38.106 on introduction of Band n54 | 18.0.0 |
| 2023-03 | RAN#99 | RP-230533 | 0032 |  | B | CR to TS38.106 the introduction of APT600MHz | 18.0.0 |
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