**3GPP TSG-RAN4 Meeting #112 *revision of R4-2413256***

**Maastricht, Netherlands, 19th Aug 2024 - 23rd Aug 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.106** | **CR** | **0092** | **rev** | **1** | **Current version:** | **17.9.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Clarification on extreme conditions | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_repeaters-Core | | | | |  | ***Date:*** | | | 2024-08-09 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | It was observed that the NR repeater specification does not capture clarification on the source of the normal and extreme conditions specification.  Furthermore, only limited set of requirements is defined for extreme test conditions, while all the others are defined for normal test conditions. Therefore, we introduce clarifications in clauses 6.1 and 7.1 to avoid unnecessary clarifications on normal conditions.  Finally, this specification mentions “normal conditions” for the purpose of testing, as well as very similar “normal operating conditions” or “normal operation” which relate to typical product behavior. To distinguish those two cases properly, we clarify related test cases.  In this CR we introduce missing information, pointing to related test specification, where normal and extreme test conditions are specified. Additionally, clarification on normal conditions being default is added. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * 6.1, 7.1: clarification saying that normal test conditions are default, * 6.2.2, 7.2.2: clarifying on test conditions, to distinguish from “normal operating conditions” or “normal operation”, * 6.9.2, 7.8.2: removal of unnecessary clarifications for normal test conditions, which were not used consistently for all the other requirement sections. * Addition of sentence to clarify where normal and extreme test conditions are specified.   Other minor editorial corrections. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Ambiguity would remain on the specification, with unclear definition of the test conditions. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.1, 6.2.1, 6.2.2, 6.9.2, 7.1, 7.2.2, 7.8.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*------------------------------ Modified section ------------------------------*

# 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.

All requirements are defined for normal conditions, unless otherwise stated.

## 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* 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* 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* 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)) | |

### 6.2.2 Minimum requirement

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.

*------------------------------ Next modified section -------------------------*

### 6.9.2 Minimum Requirements

For a repeater operating at *passband* below 2496 MHz, the ACRR requirements in table 6.9.2-1 shall apply in downlink. 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. 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. 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. 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. | | | |

*------------------------------ Next modified section -------------------------*

# 7 Radiated characteristics

## 7.1 General

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

All requirements are defined for normal conditions, unless otherwise stated.

## 7.2 OTA output power

### 7.2.1 General

*Repeater 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.

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 9.2.1-1.

Table 7.2.1-1: Repeater *rated TRP 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)) | | |

### 7.2.2 Minimum requirement

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.

*------------------------------ Next modified section -------------------------*

### 7.8.2 Minimum Requirements

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. 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 |
| 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 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 |
| NR | Wide Area repeater | BWNominal/2 | 28 (Note 2)  26 (Note 3) |
| Local Area repeater | BWNominal/2 | 17 (Notes 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. | | | |

*------------------------------ End of modified section -------------------------*