**3GPP TSG-RAN WG4 Meeting # 107 R4-2309843**

**Incheon, KR, May 22 – May 26, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.115-2** | **CR** | **0005** | **rev** | **1** | **Current version:** | **17.1.0** |  |
|  | | | | | | | | |
| *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:*** | CR for TS 38.115-2, Add manufacturer declarations for test configurations and RF channels | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT,NEC | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_repeaters-Perf | | | | |  | ***Date:*** | | | 2023-05-10 |
|  |  | | | |  | |  | | |  |
| ***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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. The definition of repeater RF Bandwidth used for test configurations and RF channels is missing. 2. Declared maximum passband Bandwidth used for test configurations is not defined in manufacturer declaration table. And it is confused with maximum repeater RF Bandwidth in RF Channels. 3. Occupied bandwidth and CA was not supported, so the RF channel for occupied bandwidth and CA is not needed. 4. Multi-band operation was not supported for repeater 2-O, so the RF channels for multi-band operation is not needed. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add Repeater RF Bandwidth terms in sub-clause 3.1. 2. Add Maximum repeater RF Bandwidth identifier (D.27) in Table 4.6-1. 3. Change Maximum repeater RF Bandwidth identifier from D.11 to D.27 in sub-clause 4.7. 4. Remove Occupied bandwidth and CA related content in sub-clause 4.9.1. 5. Remove multi-band operation related content in sub-clause 4.9.1. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Test configurations and RF channels for repeater would be unclear. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 4.6, 4.7.2.2.1, 4.7.2.4.1, 4.9.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Revised from R4-2307375. | | | | | | | | |

## **<Start of Change 1>**

# 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].

**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 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

**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

**Repeater RF Bandwidth**: RF bandwidth in which a repeater transmits and/or receives single or multiple passband(s) within a supported operating band

NOTE: In single passband operation, the Repeater RF Bandwidth is equal to the passband bandwidth.

**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 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 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 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*

**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.

## **<End of Change 1>**

## **<Start of Change 2>**

## 4.6 Manufacturer's declarations

The following repeater manufacturer's declarations listed in table 4.6-1, when applicable to the BS under test, are required to be provided by the manufacturer for radiated requirements testing for *repeater type 2-O*. Declarations can be made independently for UL and DL.

Table 4.6-1: Manufacturers declarations for *repeater type 2-O* radiated test requirements

| Declaration identifier | Declaration | Description |
| --- | --- | --- |
| D.1 | Coordinate system reference point | Location of coordinated system reference point in reference to an identifiable physical feature of the repeater enclosure. |
| D.2 | Coordinate system orientation | Orientation of the coordinate system in reference to an identifiable physical feature of the repeater enclosure. |
| D.3 | Beam identifier | A unique title to identify a beam, e.g. a, b, c or 1, 2, 3. The vendor may declare any number of beams with unique identifiers. The minimum set to declare for conformance, corresponds to the beams at the reference beam direction with the highest intended EIRP, and covering the properties listed below:  1) A beam with the narrowest intended BeWθ and narrowest intended BeWϕ possible when narrowest intended BeWθ is used.  2) A beam with the narrowest intended BeWϕ and narrowest intended BeWθ possible when narrowest intended BeWϕ is used.  3) A beam with the widest intended BeWθ and widest intended BeWϕ possible when widest intended BeWθ is used.  4) A beam with the widest intended BeWϕ and widest intended BeWθ possible when widest intended BeWϕ is used.  5) A beam which provides the highest intended EIRP of all possible beams.  When selecting the above five beam widths for declaration, all beams that the repeater is intended to produce shall be considered, including beams that during operation may be identified by any kind of cell or UE specific reference signals, with the exception of any type of beam that is created from a group of transmitters that are not all phase synchronised.  (Note 1) |
| D.4 | *Operating bands* and passband frequency ranges | List of NR *operating band(s)* supported by the repeater and passband frequency range(s) within the *operating band(s)* that the repeater can operate in.  Supported bands declared for every beam (D.3). (Note 2) |
| D.5 | Repeater class | Declared as Wide Area repeater, Medium Range repeater, or Local Area repeater. |
| D.6 | *OTA peak directions set* reference beam direction pair | The beam direction pair, describing the reference beam peak direction and the reference beam centre direction. Declared for every beam (D.3). |
| D.7 | OTA peak directions set | The OTA peak directions set for each beam. Declared for every beam (D.3). |
| D.8 | *OTA peak directions set* maximum steering direction(s) | The *beam direction pair(s)* corresponding to the following points:  1) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive Φ direction, while the θ value being the closest possible to the reference beam centre direction.  2) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *Φ* direction, while the *θ value being the closest possible to the* reference beam centre direction*.*  3) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction.  4) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction*.*  The maximum steering direction(s) may coincide with *the reference beam centre direction*.  Declared for every beam (D.3). |
| D.9 | Rated beam EIRP | The rated EIRP level per passband (Prated,p,EIRP) at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.8), as well as the reference *beam direction pair* (D.8). Declared for every beam (D.3).  (Note 5, 6, 7) |
| D.10 | Beamwidth | The *beamwidth* for the reference *beam direction pair* and the four maximum steering directions. Declared for every beam (D.3). |
| D.11 | Equivalent beams | List of beams which are declared to be equivalent.  Equivalent beams imply that the beams are expected to have identical *OTA peak directions sets* and intended to have identical spatial properties at all steering directions within the *OTA peak directions set* when presented with identical signals. All declarations (D.4 – D.10) made for the beams are identical and the transmitter unit*,* RDN and antenna array responsible for generating the beam are of identical design. |
| D.12 | Parallel beams | List of beams which have been declared equivalent (D.11) and can be generated in parallel using independent RF power resources.  Independent power resources mean that the beams are transmitted from mutually exclusive transmitter units. |
| D.13 | OTA coverage range | Declared as a single range of directions within which selected TX OTA requirements are intended to be met.  (Note 3) |
| D.14 | *OTA coverage range* reference direction | The direction describing the reference direction of the *OTA coverage range* (D.13).  (Note 4) |
| D.15 | OTA coverage range maximum directions | The directions corresponding to the following points:  1) The direction determined by the maximum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  2) The direction determined by the minimum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  3) The direction determined by the maximum θ value achievable inside the *OTA coverage range*, while φ value being the closest possible to the *OTA coverage range* reference direction.  4) The direction determined by the minimum θ value achievable inside the OTA coverage range, while φ value being the closest possible to the OTA coverage range reference direction. |
| D.16 | The rated passband OTA repeater power, Prated,p,TRP | Prated,p,TRP is declared as TRP OTA power per passband, declared per supported operating band.  (Note 5, 7) |
| D.17 | Rated transmitter TRP, Prated,t,TRP | Rated total radiated output power*.*  Declared per supported *operating band*.  (Note 5, 7) |
| D.18 | Spurious emission category | Declare the repeater spurious emission category as either category A or B with respect to the limits for spurious emissions, as defined in Recommendation ITU-R SM.329 [4]. |
| D.19 | Additional operating band unwanted emissions | The manufacturer shall declare whether the repeater under test is intended to operate in geographic areas where the additional operating band unwanted emission limits defined in clause 6.7.4 apply. |
| D.20 | Co-existence with other systems | The manufacturer shall declare whether the repeater under test is intended to operate in geographic areas where one or more of the systems GSM850, GSM900, DCS1800, PCS1900, UTRA FDD, UTRA TDD, E-UTRA and/or PHS operating in another operating band are deployed. |
| D.21 | Supported frequency range of the NR *operating band* | List of supported frequency ranges representing *fractional bandwidths* (FBW) of *operating bands* with FBW larger than 6%. |
| D.22 | Rated beam EIRP at lower end of the *fractional bandwidth* (Prated,out,FBWlow) | The rated EIRP level per passband at lower frequency range of the *fractional bandwidth* (Prated,out,FBWlow), at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.6).  Declared per beam for all supported frequency ranges (D.21).  (Note 5, 6, 7) |
| D.23 | Rated beam EIRP at higher frequency range of the *fractional bandwidth* (Prated,out,FBWhigh) | The rated EIRP level per passband at higher frequency range of the *fractional bandwidth* (Prated,out,FBWhigh), at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.6).  Declared per beam for all supported frequency ranges in (D.21).  (Note 5, 6, 7)] |
| D.24 | Long delay repeater | Declared only if the repeater internal delay between the input and output for this repeater does not fit within the TDD transient time. The repeater is intended for situations in which it will not cause interference to other nodes. This is achieved by RF isolation or by reservation of longer guard periods, which degrades frame utilization. The length of repeaters internal delay is declared using this declaration. |
| D.25 | Input signal EIRP for maximum output power | Declaration of input signal EIRP required to reach maximum output power. Declared per passband. |
| D.26 | Repeater radiating direction | Declaration on whether the repeater is intended to radiate in DL, UL or both. Testing shall be performed only for the direction(s) in which the repeater radiates. |
| D.27 | Maximum repeater RF Bandwidth | Maximum *repeater RF Bandwidth* in the *operating band* for single-band operation. Declared per supported *operating band.* (Note 8) |
| NOTE 1: Depending on the capability of the system some of these beams may be the same. For those same beams, testing is not repeated.  NOTE 2: These *operating bands* are related to their respective single‑band RIBs.  NOTE 3: *OTA coverage range* is used for conformance testing of such TX OTA requirements as frequency error or EVM.  NOTE 4: The *OTA coverage range* reference direction may be the same as the Reference beam direction pair (D.8) but does not have to be.  NOTE 5: If a *Repeater type 2-O* is capable of 64QAM operation but not capable of 256QAM operation, then up to two rated output power declarations may be made. One declaration is applicable when configured for 64QAM operation and the other declaration is applicable when not configured for 64QAM operation.  NOTE 6: If D.22 and D.23 are declared for certain frequency range (D.21), there shall be no "Rated beam EIRP" declaration (D.9) for the *operating band* containing that particular frequency range.  NOTE 7: If a BS type 2-O is capable of 256QAM operation, then up to three rated output power declarations may be made. One declaration is applicable when configured for 256QAM operation, a different declaration is applicable when configured for 64QAM operation and the other declaration is applicable when not configured neither for 256QAM nor 64QAM operation.  NOTE 8: Parameters for contiguous or non-contiguous spectrum operation in the operating band are assumed to be the same unless they are separately declared. When separately declared, they shall still use the same declaration identifier. | | |

## 4.7 Test configurations

### 4.7.1 General

Test configurations in this specification refer to the configuration of test signals from test equipment that are provided to the repeater input.

The test configurations shall be constructed using the methods defined below subject to the parameters declared by the manufacturer as listed in clause 4.6.

The applicable test models for generation of the carrier transmit test signal are defined in clause 4.9.2.

NOTE: If required, carriers are shifted to align with the channel raster.

### 4.7.2 Test signal configurations

#### 4.7.2.1 Test signal used to build Test Configurations

The signal's channel bandwidth and subcarrier spacing used to build NR Test Configurations shall be selected according to tables 4.7.2.1-1.

Table 4.7.2.1-1: Signal to be used to build NR TCs

|  |  |  |
| --- | --- | --- |
| *Operating band* characteristics | | FDL\_high – FDL\_low ≤ 3250 MHz |
| TC signal | BWchannel | 100 MHz (Note 1, Note 2) |
| characteristics | Subcarrier spacing | Smallest supported subcarrier spacing declared per operating band (D.7) |
| NOTE 1: Repeater vendor can decide to test with 50 MHz channel bandwidth and smallest supported SCS declared per *operating band* (D.7) instead of 100 MHz channel bandwidth in certain regions, where spectrum allocation and regulation require testing with 50 MHz.  NOTE 2: The narrowest specified *BS channel bandwidth* for the *operating band* (D.7) shall be used if 100MHz channel bandwidth is not specified for the band. | | |

#### 4.7.2.2 RTC1: Contiguous spectrum operation

The purpose of test configuration RTC1 is to test all repeater requirements that need an input signal in the *passband* when there is only one *passband* per *operating band*.

##### 4.7.2.2.1 RTC1 generation

RTC1 shall be constructed on a per band basis using the following method:

- Declared maximum repeater RF Bandwidth supported shall be used (D.27);

- Select the carrier to be tested according to 4.7.2 and place it adjacent to the lower *passband* edge. If the width of the *passband* is at least twice the bandwidth of the signal to be tested then place a second signal adjacent to the upper *passband* edge. Otherwise reposition the carrier to be tested according to the single carrier test frequencies described in section 4.9.1.

The test configuration should be constructed sequentially on a per band basis. All configured component carriers are transmitted simultaneously in the tests where the repeater should be ON.

##### 4.7.2.2.2 RTC1 power allocation

Set the TRP of each carrier to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Prated,in or Prated,in + 10dB) according to the manufacturer's declaration in clause 4.6.

#### 4.7.2.4 RTC2: Non-contiguous spectrum operation

The purpose of RTC2 is to test all repeater requirements that need an input signal in the *passband* when there is more than one *passband* per *operating band*.

##### 4.7.2.4.1 RTC2 generation

RTC2 is constructed on a per band basis using the following method:

The repeater *passband* bandwidths shall be the declared maximum repeater RF Bandwidth supported for multiple passbands (D.27). The repeater RF Bandwidth consists of one sub-block gap and the two highest and lowest declared *passbands* .

- For each *passband*, select the carrier to be tested according to 4.7.2. If the the width of the *passband* is at least twice that of the carrier to be tested then place a carrier adjacent to the upper *passband* edge and another carrier (as described in 4.7.2) adjacent to the lower *passband* edge. Otherwise, tests shall be applied with one carrier adjacent to the lower sub-block edge and one carrier adjacent to the upper sub-block edge for each sub-block gap.

- The sub-block edges adjacent to the sub-block gap shall be determined using the specified Foffset\_high and Foffset\_low for the carriers adjacent to the sub-block gap.

##### 4.7.2.4.2 RTC2 power allocation

Set the power of each carrier to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Pin,p,EIRP or Pin,p,EIRP + 10dB) according to the manufacturer's declaration in clause 4.6.

## **<End of Change 2>**

## **<Start of Change 3>**

## 4.9 RF channels and test models

### 4.9.1 RF channels

For the single passband testing many tests in the present document are performed with appropriate frequencies in the bottom, middle and top channels of the supported frequency range of the repeater. These are denoted as RF channels B (bottom), M (middle) and T (top).

Unless otherwise stated, the test shall be performed with a single passband at each of the RF channels B, M and T.

Many tests in the present document are performed with the maximum *repeater RF Bandwidth* located at the bottom, middle and top of the supported frequency range in the operating band. These are denoted as BRFBW (bottom), MRFBW (middle) and TRFBW (top).

Unless otherwise stated, the test shall be performed at BRFBW, MRFBW and TRFBW defined as following:

- BRFBW: maximum *repeater RF Bandwidth* located at the bottom of the supported frequency range in the operating band.

- MRFBW: maximum *repeater RF Bandwidth* located in the middle of the supported frequency range in the operating band.

- TRFBW: maximum *repeater RF Bandwidth* located at the top of the supported frequency range in the operating band.

When a test is performed by a test laboratory, the position of B, M and T for single passband, BRFBW, MRFBW and TRFBW for single band operation shall be specified by the laboratory. The laboratory may consult with operators, the manufacturer or other bodies.

## **<End of Change 3>**