**3GPP TSG-RAN WG4 Meeting #104-e *R4-22xxxxx***

**Electronic Meeting,August 15-26, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.114** | **CR** |  | **rev** |  | **Current version:** | **17.0.1** |  |
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| *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 for TS38.114 NR repeater Maintenance, Rel-17 | | | | | | | | | |
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| ***Source to WG:*** | MCC, ZTE | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_repeaters-Core/Perf | | | | |  | ***Date:*** | | | 2022-8-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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:*** | | This big CR merges the multiple endorsed draft CRs. The reason for change in each endorsed draft CR is copied below.  **R4-2214759 CR to TS38.114 Clauses 4.1, 4.2 and 9.1**  During the RAN4 103-e meeting, the work split for the remaining empty clauses were carried out in R4-2210506. This CR fills the following clauses 4.1, 4.2 and 9.1.  **R4-2214874**  Recently, the IEC 61000-4-3 specification has been updated (from IEC 61000-4-3:2006+AMD1:2007+AMD2:2010 CSV to IEC 61000-4-3:2020), where one of the modifications introduced was the removal of the upper frequency limit of the RI requirements.  RAN4 EMC specifications are referring to the 61000-4-3 and reusing the upper frequency limit for the RI testing up to 6 GHz, so far.  As the removal of the 6 GHz frequency limit for the RI test was not agreed by RAN4, it is necessary to correct the reference to the IEC 61000-4-3 to refer to the right version of that specification, which still captures the 6 GHz limit for the RI requirement, i.e. IEC 61000-4-3:2006+AMD1:2007+AMD2:2010 CSV version,  **R4-2214875**  Adding missing sections, as per work-split agreed previously:  Exclusions bands  Performance assessment  Performance criteria  **R4-2214876**  /  **R4-2214877 REV OF R4-2214049 CR to 38.114 - rpt emc v1**  Test configurations and radiated emission requirements for NE repeaters are not defined in the specification. | | | | | | | | |
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| ***Summary of change:*** | | The summary of change in each endorsed draft CR is copied below.  **R4-2214759 CR to TS38.114 Clauses 4.1, 4.2 and 9.1**  The empty clauses 4.1, 4.2 and 9.1 has been added by this draft CR.  **R4-2214874**  Correction of the IEC 61000-4-3 referenece.  **R4-2214875**  Adding missing section:  Exclusions bands  Performance assessment  Performance criteria  **R4-2214876**  Scope wording correction to align with the TS 38.113  Incorporation of the NR repeater specific terminology and definitions, e.g. repeater type 1-C, repeater type 2-O  Spatial exclusion text further detailed and aligned with TS 38.113  Missing references and cross-references added.  **R4-2214877 REV OF R4-2214049 CR to 38.114 - rpt emc v1**  Introducing test configurations and radiated emission requirements based on agreements in RAN4 in Sections 8.1 and 8.2, respectively. | | | | | | | | |
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| ***Consequences if not approved:*** | | The consequences if not approved for each endorsed draft CR is copied below.  **R4-2214759 CR to TS38.114 Clauses 4.1, 4.2 and 9.1**  Empty clauses would remain.  **R4-2214874**  Incorrect upper frequency limit of 6 GHz and misleading testing limitation would be kept for the RI test, not aligned with the latest version of the external IEC 61000-4-3:2020 specification.  **R4-2214875**  Spec would not be ocmplete.  **R4-2214876**  /  **R4-2214877 REV OF R4-2214049 CR to 38.114 - rpt emc v1**  The specification is incomplete without test configurations and radiated emission requirements. | | | | | | | | |
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| ***Clauses affected:*** | | Clauses affected for each endorsed draft CR is copied below.  **R4-2214759 CR to TS38.114 Clauses 4.1, 4.2 and 9.1**  4.1, 4.2, 9.1  **R4-2214874**  2  **R4-2214875**  2, 4.4, 5.1, 5.2, 6.1, 6.2  **R4-2214876**  1, 2, 3.1, 4.3, 7.1, 9.2.2, 9.2.3, 9.3.3, 9.4.3, 9.5.2, 9.5.3, 9.6.3, 9.7.3  **R4-2214877 REV OF R4-2214049 CR to 38.114 - rpt emc v1**  8.1 and 8.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **x** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | |  | | |
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| ***Other comments:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

*------------------------------ Modified sections ------------------------------*

1 Scope

The present document covers the assessment of NR repeater and ancillary equipment in respect of Electromagnetic Compatibility (EMC).

The present document specifies the applicable requirements, procedures, test conditions, performance assessment and performance criteria for NR repeater and associated ancillary equipment in the following categories:

- NR repeater equipped with antenna connectors which are possible to be terminated during EMC testing, meeting the *repeater type 1-C* RF requirements of TS 38.106 [2], with conformance demonstrated by compliance to TS 38.115-1 [3].

- NR repeater not equipped with antenna connectors, i.e. with antenna elements radiating during the EMC testing, meeting the *repeater type 2-O* RF requirements of TS 38.106 [2], with conformance demonstrated by compliance to TS 38.115-2 [4].

The environment classification used in the present document refers to the residential, commercial and light industrial environment classification used in IEC 61000‑6-1 [6] and IEC 61000-6-3 [7].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial and light industrial environments. The levels, however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

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

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 38.106: "NR Repeater Radio Transmission and Reception"
3. 3GPP TS 38.115-1: "NR; Repeater conformance testing - Part 1: Conducted conformance testing"
4. 3GPP TS 38.115-2: "NR; Repeater conformance testing - Part 1: Radiated conformance testing"
5. CISPR 32: "Electromagnetic compatibility of multimedia equipment - Emission requirements".
6. IEC 61000‑6-1: "Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments".
7. IEC 61000-6-3: "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments".
8. IEC 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)".
9. IEC 61000-3-3: "Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection".
10. IEC 61000-3-11: "Electromagnetic compatibility (EMC) - Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connections".
11. IEC 61000-3-12: "Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage system with input current >16 A and ≤ 75 A per phase".
12. IEC 61000‑4‑2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
13. IEC 61000‑4‑3:2006+AMD1:2007+AMD2:2010 CSV: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".
14. IEC 61000‑4‑4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".
15. IEC 61000‑4‑5: "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".
16. IEC 61000‑4‑6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio frequency fields".
17. IEC 61000‑4‑11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".
18. IEC 61000‑4‑21: "Electromagnetic compatibility (EMC) - Part 4-21: Testing and measurement techniques - Reverberation chamber test methods".
19. ITU-R SM.329: "Unwanted emissions in the spurious domain".

[20] IEC 60050-161: "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility".

[21] ETSI EN 301 489-1: "Electromagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements - Harmonised Standard for Electromagnetic Compatibility ".

[22] ETSI EN 301 489-50: "Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 50: Specific conditions for cellular communication base station (BS), repeater and ancillary equipment; Harmonised standard covering the essential requirements of article 3.1(b) of the Directive 2014/53/EU".

[23] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

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3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

**ancillary equipment:** electrical or electronic equipment, that is intended to be used with a receiver or transmitter

NOTE: It is considered as an ancillary equipment if:

the equipment is intended for use with a receiver or transmitter to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and

the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver or transmitter; and

the receiver or transmitter, to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

**antenna port:** for EMC purposes, port for connection of an antenna used for intentional transmission and/or reception of radiated RF energy, equivalent to an RF antenna connector.

**channel bandwidth:** the RF bandwidth supporting a single NR RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell. The *channel bandwidth* is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

**continuous phenomena:** electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161 [20]).

**exclusion band:** frequency range(s) not subject to test or assessment.

**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

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

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

**port:** A particular interface, of the specified equipment (apparatus), with the electromagnetic environment. For example, any connection point on an equipment intended for connection of cables to or from that equipment is considered as a port (see Figure 3.1-1).

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**Figure 3.1-1: Examples of ports**

**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

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

**signal/control port:** portintended for the interconnection of components of an EUT, or between an EUT and associated equipment and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it).

**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*

**spatial exclusion zone:** range of angles where no tests of radiated immunity are made for *repeater type 2-O* (i.e. half sphere around the EUT's radiating direction).

**telecommunication port:** ports which are intended to be connected to telecommunication networks (e.g. public switched telecommunication networks, integrated services digital networks), local area networks (e.g. Ethernet, Token Ring) and similar networks.

NOTE: *Telecommunication port* is called "wired network port" in CISPR 32 [5] and ETSI EN 301 489-1 [21].

**transient phenomena:** pertaining to or designating a phenomena or a quantity which varies between two consecutive steady states during a time interval short compared with the time-scale of interest (IEC 60050-161 [20]).

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

4 Test conditions

4.1 General

Requirements throughout the EMC specifications are in some cases defined separately for different frequency ranges (FR). The frequency ranges FR1 and FR2 are defined in clause 5.1 of TS 38.106 [x].

The equipment shall be tested in normal test environment defined in the corresponding NR Repeater conformance testing specification TS 38.115-1 [x] for *NR Repeater type 1-C* or TS 38.115-2 [x] for *NR Repeater type 2-O.* The test conditions shall be recorded in the test report.

For Repeater capable of multi-band operation, the requirements in the present document apply for each supported *operating band* unless otherwise stated. *Operating bands* shall be activated according to the test configuration in clause 4.5. Tests shall be performed relating to each type of port and all *operating bands* shall be assessed during the tests.

The manufacturer shall declare the supported *operating band(s)* according to the list of NR repeater *operating bands* defined in TS 38.106 [x].

NOTE 1: NR *operating bands* for *repeater type 1-C*, are declared by the manufacturer according to the declaration D.3 specified in TS 38.115-1 [x], table [x].

NOTE 2: NR *operating bands* for *repeater type 2-O,* are declared by the manufacturer according to the declaration D.4 specified in TS 38.115-2 [x], table [x].

4.2 Arrangements for establishing a communication link

The wanted RF input signal nominal frequency shall be selected by setting the NR Absolute Radio Frequency Channel Number (NR-ARFCN) to an appropriate number, as defined in TS 38.106 [x], clause 5.3.1.2.

A communication link shall be set up with a suitable test system capable of evaluating the required performance criteria (hereafter called "the test system") at the radio interface and *telecommunication port(s)* (the BS interface). The test system shall be located outside of the test environment.

When the EUT is required to be in the uplink/downlink operation, the following conditions shall be met:

- For the *repeater type 1-C* , the EUT shall be commanded to operate at maximum rated output power;

- For the r*epeater type 2-O* testing, the EUT output power shall be configured as stated in clause 8.1 for emission test and clause 9.1 for immunity test accordingly;

- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;

For immunity tests clause 4.3 shall apply and the conditions shall be as follows.

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

4.3 Narrow band responses

Responses on receivers or duplex transceivers occurring during the immunity test at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method:

- if during an immunity test the quantity being monitored goes outside the specified tolerances (clause 6), it is necessary to establish whether the deviation is due to a narrow band response or to a wide band (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency increased, and then decreased by 2 x BWChannel MHz, where BWChannel is the channel bandwidth as defined in TS 38.106 [2], clause 5.3;

- if the deviation disappears in either one or both of the above MHz offset cases, then the response is considered as a narrow band response;

- if the deviation does not disappear, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal set to 2.5 x BWChannel MHz;

- if the deviation does not disappear with the increased and/or decreased frequency, the phenomenon is considered wide band and therefore an EMC problem and the equipment fails the test.

For immunity test narrow band responses are disregarded.

For EUT capable of multi-band operation, all supported *operating bands* shall be considered for narrowband responses.

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

4.4 Exclusion bands

The *exclusion band* for NR repeater is the frequency range over which no tests of radiated immunity are made in UL or DL.

The *exclusion band* for DL is defined as:

FDL,low – ΔfOBUE < f < FDL,high + ΔfOBUE

Where values of FDL,low and FDL,high are defined for each *operating band* in TS 38.106 [2], clause 5.2.

The *exclusion band* for UL is defined as:

FUL,low – ΔfOBUE < f < FUL,high + ΔfOBUE

Where values of FUL,low and FUL,high are defined for each *operating band* in TS 38.106 [2], clause 5.2.

For NR repeater capable of multi-band operation, the total *exclusion band* is a combination of the *exclusion bands* for each *operating band* supported by NR repeater.

The ΔfOBUE values for *Repeater type 1-C and Repeater type 2-O* are defined in table 4.4-1 for both DL and UL.

**Table 4.4-1: ΔfOBUE offset values for NR *repeater 1-C and repeater 2-O***

|  |  |  |
| --- | --- | --- |
| **NR repeater type** | ***Operating band* characteristics** | **ΔfOBUE (MHz)** |
| *Repeater type 1-C* | FUL,high – FUL,low < 100 MHz, or  FDL,high – FDL,low < 100 MHz | 20 |
| 100 MHz ≤ FUL,high – FUL,low ≤ 900 MHz  100 MHz ≤ FDL,high – FDL,low ≤ 900 MHz | 60 |

NOTE: As the radiated immunity testing is defined in the frequency range 80 MHz to 6 GHz, there is no exclusion band defined for repeater type 2-O.

Where the values of ΔfRIexclusion are defined in table 4.4-2.

**Table 4.4-2: Maximum ΔfRIexclusion offset outside the operating band**

|  |  |
| --- | --- |
| ***Operating band* characteristics** | **ΔfRIexclusion (MHz)** |
| 100 MHz ≥ FUL,high – FUL,low, or  100 MHz ≥ FDL,high – FDL,low | 60 |
| 100 MHz < FUL,high – FUL,low, or  100 MHz ≥ FDL,high – FDL,low | 200 |

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

5 Performance assessment

5.1 General

The following information shall be recorded in or annexed to the test report:

- The primary functions of the radio equipment to be tested during and after the EMC testing;

- The intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;

- The method to be used to verify that a communications link is established and maintained;

- The user-control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;

- The *ancillary equipment* to be combined with the radio equipment for testing (where applicable);

- The information about *ancillary equipment* intended to be used with the radio equipment;

- Information about the common and/or band-specific active RF components and other hardware blocks for a communication link in EUT capable of multi-band operation;

- An exhaustive list of ports (or RIBs), classified as either power or signal/control. Power ports shall further be classified as AC or DC power.

Performance assessment of a NR repeater with multiple enclosures may be done separately, according to the manufacturer's choice.

A communication link used by more than one *operating band*, shall be assessed on all *operating band*s. Communication link(s) and/or radio performance parameters for the *operating band*s can during the test be assessed simultaneously or separately for each band, depending on the test environment capability.

5.2 NR repeaters

The parameter used for assessment of performance of a NR repeater is the [gain] within the operating band.

5.3 Ancillary equipment

At the manufacturer's discretion the test may be performed on the *ancillary equipment* separately or on a representative configuration of the combination of radio and *ancillary equipment*. In each case EUT is tested against all applicable immunity and emission clauses of the present document and in each case, compliance enables the *ancillary equipment* to be used with different radio equipment.

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

6 Performance criteria

6.1 Performance criteria for continuous phenomena for NR repeaters

The gain of the EUT shall be measured throughout the period of exposure of the phenomenon. The gain measured during the test shall not change from the gain measured before the test by more than ± 1 dB. At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data.

6.2 Performance criteria for transient phenomena for NR repeaters

The gain of the EUT shall be measured before the test and after each exposure. At the conclusion of each exposure the gain of the EUT shall not have changed by more than ± 1 dB. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the gain of the EUT shall not have changed by more than ± 1 dB.

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

7 Applicability overview

7.1 Emission

**Table 7.1-1: Emission requirements applicability**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Phenomenon** | **Application** | **Equipment test requirement** | | **Reference**  **clause in the** | **Reference**  **standard** |
|  |  | **NR repeater equipment** | **Ancillary equipment** | **present document** |  |
| Radiated emission | Enclosure | applicable for NR *repeater type 1-C*  (Note 1) | not applicable | 8.2.1 | ITU-R SM.329 [19] |
| Radiated emission | Enclosure of *ancillary equipment* | not applicable | applicable | 8.2.2 | CISPR 32 [5] |
| Conducted emission | DC power input/output port | applicable | applicable | 8.3 | CISPR 32 [5] |
| Conducted emission | AC mains input/output port | applicable | applicable | 8.4 | CISPR 32 [5] |
| Conducted emission | *Telecommunication port* | applicable | applicable | 8.5 | CISPR 32 [5] |
| Harmonic current emissions | AC mains input port | applicable | applicable | 8.6 | IEC 61000-3-2 [8] or  IEC 61000-3-12 [11]  (NOTE 2) |
| Voltage fluctuations and flicker | AC mains input port | applicable | applicable | 8.7 | IEC 61000-3-3 [9] or  IEC 61000-3-11 [10]  (NOTE 2) |
| NOTE 1: Radiated emission requirements for NR *repeater type 2-O* are described in clause 8.2.1.  NOTE 2: Selection of the reference IEC specification is based on the rated input current of the EUT’s power supply. | | | | | |

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

# 8 Emission

## 8.1 Test configurations

This clause defines the configurations for emission tests as follows:

- The equipment shall be tested under normal test conditions as specified in the functional standards;

- The test configuration shall be as close to normal intended use as possible;

- If the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;

- If the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;

- The test conditions, test configuration and mode of operation shall be recorded in the test report;

- Ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*; in case of *repeater type 1-C*, *antenna port*s shall be correctly terminated;

- For *repeater type 2-O* without *antenna ports* but intentionally radiating through the *antenna array*, the equipment shall be placed in a test setup suitable for the radiated power;

- Ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;

- The test arrangements for transmitter and receiver clauses of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter clause and receiver clause of the EUT may be carried out simultaneously to reduce test time.

## 8.2 Radiated emission

### 8.2.1 Radiated emission, Repeater

This test is applicable to *repeater type 1-C*. This test shall be performed on a representative configuration of repeater.

For *repeater type 2-O*, the radiated emission is covered by radiated spurious emission requirement in TS 38.106 [x1], conforming to the test requirement in TS 38.115-2 [x2].

#### 8.2.1.1 Definition

This test assesses the ability of repeater to limit unwanted emission from the *enclosure port*.

#### 8.2.1.2 Test method

a) A test site fulfilling the requirements of ITU-R SM.329 [x3] shall be used. The repeater shall be placed on a non-conducting support and shall be operated from a power source via a RF filter to avoid radiation from the power leads. One of the following two alternative measurement methods shall be used:

1) Field strength method measurement

The test method shall be in accordance with CISPR 32 [x4]. The field strength measurements shall be performed on a test site that is validated according to the methods and requirements of CISPR 16-1-4 [x5].

Unless otherwise stated, measurements are conducted at 3 m or 10 m on an open area test site (OATS) or semi anechoic chamber (SAC) for frequencies up to 1 GHz, or at 3 m on a free space open area test site (FSOATS) or fully-anechoic room (FAR) for frequencies above 1 GHz. Unless otherwise stated, all measurements are done with RMS detector and with the -3 dB bandwidth of the measuring filter equal to the reference bandwidth in table 8.2.1.3-1.

NOTE 1: Test site validation methods for radiated emissions tests are defined in CISPR 16-1-4 [x5], clause 6 and 7. Examples of test site validation methods are listed below:

- 30 - 1000 MHz frequency range: Normalized Site Attenuation (NSA), Reference Site Method (RSM).

- 1 - 18 GHz frequency range: SVSWR standard test procedure, SVSWR reciprocal test procedure.

2) Substitution method measurement (also called a substitution method)

Mean power of any spurious components shall be detected by the test antenna and measuring receiver (e.g. a spectrum analyser). At each frequency at which a component is detected, the repeater shall be rotated and the height of the test antenna adjusted to obtain maximum response, and the effective radiated power (e.r.p.) of that component determined by a substitution measurement. The measurement shall be repeated with the test antenna in the orthogonal polarization plane. Unless otherwise stated, all measurements are done as mean power (RMS).

NOTE 2: Effective radiated power (e.r.p.) refers to the radiation of a half wave tuned dipole instead of an isotropic antenna. There is a constant difference of 2.15 dB between e.i.r.p. and e.r.p, as defined in ITU-R SM.329 annex 1 [x3].

e.r.p. (dBm)  EIRP (dBm)  2.15

b) The repeater shall transmit with maximum power declared by the manufacturer with all transmitters active. Set the repeater to transmit a signal as stated in clause 4.5.

c) The received power shall be measured over the frequency range from 30 MHz to FDL,low - ΔfOBUE and from FDL,high + ΔfOBUE up to 12750 MHz. 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 SM.329 [x3]. The video bandwidth shall be approximately three times the resolution bandwidth. If this video bandwidth is not available on the measuring receiver, it shall be the maximum available and at least 1 MHz. Unless otherwise stated, all measurements are done as mean power (RMS).

#### 8.2.1.3 Limits

The frequency boundary and reference bandwidths for the detailed transitions of the limits between the requirements for out of band emissions and spurious emissions are based on ITU-R Recommendations SM.329 [x3] and SM.1539 [x6].

The *repeater type 1-C* shall meet the limits below:

Table 8.2.1.3-1: Limits for radiated emissions from Repeater

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Frequency range | e.r.p.  (dBm) | Field strength at 3 m (dBµV/m)  (NOTE 4) | Field strength at 10 m  (dBµV/m)  (NOTE 4) | Reference bandwidth | Notes |
| 30 MHz ≤ f < 1000 MHz | -36 | 65.4 (NOTE 5) | 54.9 (NOTE 5) | 100 kHz |  |
| 1 GHz ≤ f < 12.75 GHz | -30 | 67.4 | Not applicable | 1 MHz |  |
| 12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the DL operating band in GHz | -30 | 67.4 | Not applicable | 1 MHz | NOTE 1 |
| FDL,low - ΔfOBUE < f < FDL,high +ΔfOBUE | Not defined | Not defined | Not defined | Not defined | NOTE 2,3 |
| NOTE 1: This 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.  NOTE 2: For repeater capable of multi-band operation, the frequency ranges relating to the RF bandwidths of all supported *operating bands* apply.  NOTE 3: ΔfOBUE is defined in clause 6.5.3 of TS 38.106 [x1].  NOTE 4: The field strength measurements shall be conducted on OATS or SAC for frequencies up to 1 GHz, or on FSOATS or FAR for frequencies above 1 GHz.  NOTE 5: Limits for radiated emissions are translated from the e.r.p. limit of -36 dBm into the field strength limit of 61.4 dBµV/m (at 3m) or 50.9 dBµV/m (at 10m), and increased by the site gain value of 4 dB. The value of the site gain is based on ITU-R Recommendations SM.329 [x3]. | | | | | |

#### 8.2.1.4 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the radiated emission measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;

- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;

- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 8.2.1-4-1 for repeater.

Table 8.2.1.4-1 specifies the maximum measurement uncertainty of the test system. The test system shall enable the equipment under test to be measured with an uncertainty not exceeding the specified values. All tolerances and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95 % is the measurement uncertainty tolerance interval for a specific measurement that contains 95% of the performance of a population of test equipment.

Table 8.2.1.4-1: Maximum measurement uncertainty (Repeater)

|  |  |  |
| --- | --- | --- |
| Parameter | Uncertainty for EUT dimension ≤ 1 m  (NOTE 2) | Uncertainty for EUT dimension >1 m  (NOTE 2) |
| Effective radiated RF power between 30 MHz and 180 MHz | ±6 dB | ±6 dB |
| Effective radiated RF power between 180 MHz and 4 GHz | ±4 dB | ±6 dB |
| Effective radiated RF power between 4 GHz and 12,75 GHz | ±6 dB | ±9 dB (NOTE 1) |
| Effective radiated RF power between 12,75 GHz and 26 GHz | ±6 dB | ±9 dB (NOTE 1) |
| Field strength between 30 MHz and 12,75 GHz | ±6 dB | ±6 dB |
| NOTE 1: This value may be reduced to ±6 dB when further information on the potential radiation characteristic of the EUT is available.  NOTE 2: These MU values estimates and are not based on the MU budget calculations. For more background on MU derivation analyses refer to CISPR 16-4-2 [x7] and ETSI TR 100 028-1 [x8]. | | |

NOTE: If the Test System for a test is known to have a measurement uncertainty greater than that specified in table 8.2.1.4-1, this equipment can still be used, provided that an adjustment is made follows:

Any additional uncertainty in the Test System over and above that specified in table 8.2.1.4-1 is used to tighten the test requirements, i.e. making the test harder to pass.

This procedure will ensure that a test system not compliant with table 8.2.1.4-1 does not increase the probability of passing an EUT that would otherwise have failed a test if a test system compliant with table 8.2.1.4-1 had been used.

### 8.2.2 Radiated emission, ancillary equipment

This test is only applicable to *ancillary equipment* not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the *ancillary equipment*.

This test is not applicable for *ancillary equipment* incorporated in the radio equipment, or for *ancillary equipment* intended to be measured in combination with the radio equipment. In these cases, the requirements of the relevant product standard for the effective use of the radio spectrum shall apply.

#### 8.2.2.1 Definition

This test assesses the ability of *ancillary equipment* to limit unwanted emission from the *enclosure port*.

#### 8.2.2.2 Test method

The test method shall be in accordance with CISPR 32 [x4].

#### 8.2.2.3 Limits

The *ancillary equipment* shall meet the limits according to CISPR 32 [x4] table A.4 and table A.5.

For the referred limit values, the following shall apply:

- Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

- Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Alternatively, for *ancillary equipment* intended to be used in telecommunication centres only, the class A limits given in CISPR 32 [x4], annex A, table A.2 and table A.3 may be used.

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

9 Immunity

9.1 Test configurations

This clause defines the configurations for immunity tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;

- during the test, the RF output power may be reduced to a power level sufficient for establishing and maintaining the required communication link;

- the test configuration shall be as close to normal intended use as possible;

- if the equipment is part of a system, or can be connected to *ancillary equipment*, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;

- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;

- the test conditions, test configuration and mode of operation shall be recorded in the test report;

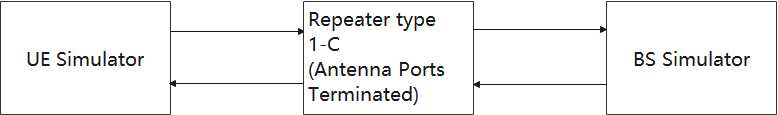
- ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*. In case of *repeater type 1-C*, *antenna ports* shall be correctly terminated;

- ports which are not connected to cables during normal operation, shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;

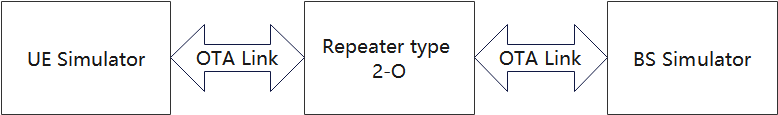
- immunity tests on the entire NR repeater shall be performed by establishing communication links at the radio interface (e.g. with the mobile simulator) and the BS interface (e.g. with a BS simulator) and evaluating the [power accuracy/gain];

- immunity tests shall be performed on both the uplink and downlink paths. The tests shall also include both the radio interface and the BS interface. [Power accuracy/Gain] evaluation may be carried out at either interface, where appropriate, and the measurements for the uplink and downlink paths may be carried out as a single path looped at either the radio interface or BS interface. In case of looping is used care have to be taken that the [power accuracy/gain] doesn't change due to looping;

- for NR repeater capable of multi-band operation, communication links shall be established in such a way that all *operating band*(s) are activated during the test according to the applicable test configurations in clause 4.5. Performance assessment may be done separately for each *operating band*.



**Figure 9.1-1: Communication link set up for *repeater type 1-C* immunity measurement**



**Figure 9.1-2: Communication link set up for *repeater type 2-O* immunity measurement**

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

9.2.2 Test method and level

The test method shall be in accordance with IEC 61000‑4‑3 [13], which specified test methodology based on anechoic chamber. The use of reverberation chamber test method according to IEC 61000-4-21 [18], clause 6.1 and Annex D as alternative method is allowed.

The following requirements shall apply:

- The test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;

- The stepped frequency increments shall be 1 % of the momentary frequency;

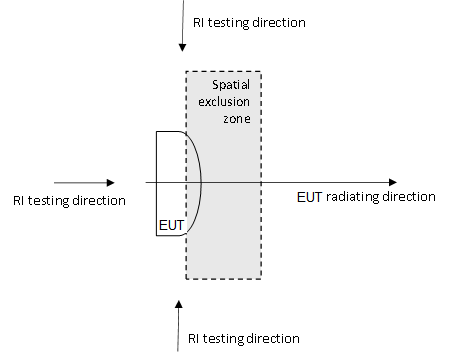
- The test shall be performed over the frequency range 80 MHz - 6000 MHz; with the exception of the exclusion band for receivers (see clause 4.4.2);

- Responses in stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see clause 4.3;

- The frequencies selected during the test shall be recorded in the test report.

- For the test method in accordance with IEC 61000-4-3 [13], for repeater operating in FR2 the *spatial exclusion zone* can be chosen to protect the NR repeater’s receiver. For the frequency arrange above 690 MHz (according to the test method in ETSI EN 301 489-50 [22) the EMC RF electromagnetic field immunity requirement applies on the non-radiating faces of the *repeater type 2-O,* as depicted on figure 9.2.2-1..

NOTE: Depending on the BS implementation, application of the spatial exclusion to all radiating faces of the NR repeater may not allow proper execution of the RI testing. In such cases, to protect the *repeater type 2-O* receiver(s), exclusion bands shall be considered, as in table 4.4.2-2.

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**Figure 9.2.2-1: EMC RF electromagnetic field immunity requirement testing directions for NR *repeater type 2-O* (horizontal plane depicted) with the *spatial exclusion zone* applied**

9.2.3 Performance criteria

**NR repeater:**

The performance criteria of clause 6.1 shall apply.

**Ancillary equipment:**

The performance criteria of clause 6.3 shall apply.

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

9.3.3 Performance criteria

**NR repeater:**

The performance criteria of clause 6.2 shall apply.

**Ancillary equipment:**

The performance criteria of clause 6.4 shall apply.

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

9.4.3 Performance criteria

**NR repeater:**

The performance criteria of clause 6.2 shall apply.

**Ancillary equipment:**

The performance criteria of clause 6.4 shall apply.

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

9.5.2 Test method and level

The test method shall be in accordance with IEC 61000‑4‑6 [16]:

- The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;

- The stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1% frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;

- The test level shall be severity level 2 as given in IEC 61000‑4‑6 [16] corresponding to 3 V rms, at a transfer impedance of 150 Ω;

- The test shall be performed over the frequency range 150 kHz - 80 MHz;

- The injection method to be used shall be selected according to the basic standard IEC 61000-4-6 [16];

- Responses of stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see clause 4.3;

- The frequencies of the immunity test signal selected and used during the test shall be recorded in the test report.

9.5.3 Performance criteria

**NR repeater:**

The performance criteria of clause 6.1 shall apply.

**Ancillary equipment:**

The performance criteria of clause 6.3 shall apply.

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

9.6.3 Performance criteria

For a 0 % residual voltage dip test, the performance criteria for transient phenomena shall be applied:

- Criteria 6.2 for NR repeater

- Criteria 6.4 for *ancillary equipment*

For a 70% residual voltage dip test and for voltage interruption test, the following applies:

1. In the case where the equipment is fitted with or connected to a battery back-up, the following performance criteria shall be applied:

- Criteria 6.2 for NR repeater

- Criteria 6.4 for *ancillary equipment*

2. In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator:

- No unintentional responses shall occur at the end of the test

- In the event of loss of communications link or in the event of loss of user data, this fact shall be recorded in the test report.

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

9.7.3 Performance criteria

**NR repeater:**

The performance criteria of clause 6.2 shall apply.

**Ancillary equipment:**

The performance criteria of clause 6.4 shall apply.

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