ETSI TS 138 114 V17.1.0 (2022-10)

5G;
NR;
Repeaters ElectroMagnetic Compatibility (EMC)
(3GPP TS 38.114 version 17.1.0 Release 17)

Reference
RTS/TSGR-0438114vh10

Keywords
5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM**® and the GSM logo are trademarks registered and owned by the GSM Association.

Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

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

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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

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

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

1 Scope

The present document 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.

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".

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).

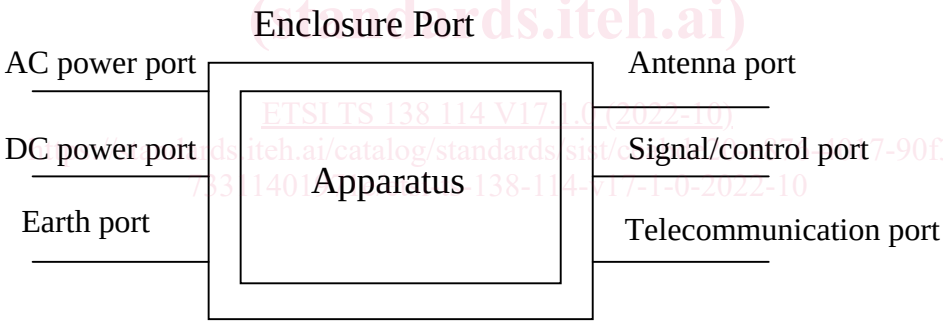

Figure 3.1-1: Examples of ports

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: port intended 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]).

3.2 Symbols

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

$BW_{Channel}$ Channel bandwidth

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

AC	Alternating Current
AMN	Artificial Mains Network
CDN	Coupling/Decoupling Network
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
FR	Frequency Range
NR	New Radio
RF	Radio Frequency
rms	root mean square

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.

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 $BW_{Channel}$ MHz, where $BW_{Channel}$ 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 $BW_{Channel}$ 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.

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:

$$F_{DL,low} - \Delta f_{OBUE} < f < F_{DL,high} + \Delta f_{OBUE}$$

Where values of $F_{DL,low}$ and $F_{DL,high}$ are defined for each *operating band* in TS 38.106 [2], clause 5.2.

The *exclusion band* for UL is defined as:

$$F_{UL,low} - \Delta f_{OBUE} < f < F_{UL,high} + \Delta f_{OBUE}$$