ETSI TS 138 115-1 V17.0.0 (2023-01)

5G;
NR;
Repeater conformance testing -
Part 1: Conducted conformance testing
(3GPP TS 38.115-1 version 17.0.0 Release 17)

Reference
DTS/TSGR-0438115-1vh00

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 specifies the Radio Frequency (RF) test methods and conformance requirements for NR repeater *type 1-C*. These have been derived from, and are consistent with the conducted requirements for *repeater type 1-C* in NR repeater specification defined in TS 38.106 [2].

A *repeater type 1-C* only has conducted requirements so it requires compliance to this specification only.

Arepeater type 2-O has only radiated requirements so it requires compliance to TS 38.115-2 [3] only.

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 38.115-2: "NR; Repeater conformance testing, Part 2: Radiated conformance testing"

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

[5] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception"

[6] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception"

[7] 3GPP TS 38.141-1: "NR; Base Station (BS) conformance testing, Part 1: Conducted conformance testing"

[8] 3GPP TS 38.211: "NR; Physical channels and modulation"

[9] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone"

[10] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification"

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

[12] ITU-T Recommendation O.150, "Equipment for the measurement of digital and analogue/digital parameters"

[13] Federal Communications Commission: "Title 47 of the Code of Federal Regulations (CFR) "

[14] ECC/DEC/(17)06: "The harmonised use of the frequency bands 1427-1452 MHz and 1492-1518 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL)"

[15] 3GPP TR 25.942: "RF system scenarios"

[16] IEC 60 721-3-3: "Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weather protected locations"

[17] IEC 60 721-3-4: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Clause 4: Stationary use at non-weather protected locations"

[18] IEC 60 721: "Classification of environmental conditions"

[19] IEC 60 068-2-1 (2007): "Environmental testing - Part 2: Tests. Tests A: Cold"

[20] IEC 60 068-2-2: (2007): "Environmental testing - Part 2: Tests. Tests B: Dry heat"

[21] IEC 60 068-2-6: (2007): "Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal)"

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

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

Fractional bandwidth: *fractional bandwidth* FBW is defined as $FBW = 200 \cdot \frac{F_{FBWhigh} - F_{FBWlow}}{F_{FBWhigh} + F_{FBWlow}} \%$

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

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

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

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

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

Nominal channel bandwidth: Bandwidth calculated as min(100MHz, $BW_{passband}$) in FR1 or min(400MHz, $BW_{passband}$) 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 $BW_{passband}$.

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

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

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

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

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

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

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

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

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

3.2 Symbols

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

BW_{Config}	Transmission bandwidth configuration, where $BW_{Config} = N_{RB}$ x SCS x 12
$BW_{Nominal}$	Nominal channel bandwidth
$BW_{Passband}$	*Passband* bandwidth
Δf	Separation between the *passband edge* frequency and the nominal -3 dB point of the measuring filter closest to the carrier frequency
Δf_{max}	f_offset_{max} minus half of the bandwidth of the measuring filter
Δf_{OBUE}	Maximum offset of the *operating band* unwanted emissions mask from the *operating band* edge$F_{DL,low}$ The lowest frequency of the downlink *operating band*
$F_{DL,high}$	The highest frequency of the downlink *operating band*
$F_{FBWhigh}$	Highest supported frequency within supportedoperating band, for which *fractional bandwidth* support was declared
F_{FBWlow}	Lowest supported frequency within supported operating band, for which *fractional bandwidth* support was declared
F_{filter}	Filter centre frequency
$F_{offset,high}$	Frequency offset from $F_{C,high}$ to the upper *passband edge*
$F_{offset,low}$	Frequency offset from $F_{C,low}$ to the lower *passband edge*
f_offset	Separation between the *passband edge* frequency and the centre of the measuring
f_offset_{max}	The offset to the frequency Δf_{OBUE} outside the *operating band*
$F_{UL,low}$	The lowest frequency of the uplink *operating band*
$F_{UL,high}$	The highest frequency of the uplink *operating band*
$P_{EM,n50/n75,ind}$	Declared emission level for Band n50/n75; ind = a, b
$P_{max,p,AC}$	*Maximum passband output power* measured per *antenna connector*
W_{gap}	*Inter passband Bandwidth gap* size

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ACLR	Adjacent Channel Leakage Ratio
BW	Bandwidth
CACLR	Cumulative ACLR
CP-OFDM	Cyclic Prefix-OFDM
DFT-s-OFDM	Discrete Fourier Transform-spread-OFDM
DL	Downlink
EVM	Error Vector Magnitude
FBW	Fractional Bandwidth
FR	Frequency Range
ITU-R	Radiocommunication Sector of the International Telecommunication Union
LA	Local Area
MR	Medium Range
NR	New Radio
OBUE	Operating Band Unwanted Emissions
OOB	Out-of-band
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency

RX	Receiver
SCS	Sub-Carrier Spacing
TX	Transmitter
UL	Uplink
WA	Wide Area

4 General conducted test conditions and declarations

4.1 Measurement uncertainties and test requirements

4.1.1 General

The requirements of this clause apply to all applicable tests in part 1 of this specification, i.e. to all conducted tests defined for FR1. The frequency ranges FR1 and FR2 are defined in clause 5.1 of TS 38.106 [2].

The minimum requirements are given in TS 38.106 [2]. Test Tolerances for the conducted test requirements explicitly stated in the present document are given in annex C of the present document.

Test Tolerances are individually calculated for each test. The Test Tolerances are used to relax the minimum requirements to create test requirements.

When a test requirement differs from the corresponding minimum requirement, then the Test Tolerance applied for the test is non-zero. The Test Tolerance for the test and the explanation of how the minimum requirement has been relaxed by the Test Tolerance are given in annex C.

4.1.2 Acceptable uncertainty of Test System

4.1.2.1 General

The maximum acceptable uncertainty of the Test System is specified below for each test defined explicitly in the present specification, where appropriate. The maximum acceptable uncertainty of the Test System for test requirements included by reference is defined in the respective referred test specification.

The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified tolerance and 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.

For RF tests, it should be noted that the uncertainties in clause 4.1.2 apply to the Test System operating into a nominal 50 ohm load and do not include system effects due to mismatch between the DUT and the Test System.

4.1.2.2 Conducted characteristics measurements

Table 4.1.2.2-1: Maximum Test System uncertainty for conducted characteristics tests