3GPP TSG-RAN WG4 Meeting # 95-e DRAFT R4-2008727

Electronic Meeting, 25 May – 5 June, 2020

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.113** | **CR** | **0019** | **rev** | **1** | **Current version:** | **15.9.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | CR to TS 38.113: direct field strength measurements for the EMC RE, Rel-15 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_newRAT-Perf | | | | |  | ***Date:*** | | | 2020-05-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-15 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Based on motivation paper in R4-2003995 updated in R4-2007449, the direct field strength approach is proposed to measure the EMC radiated emission from the enclosure port of BS equipped with the antenna connectors / TAB connectors. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * 2: updated references * 3.3: upadted abbreviations * 8.2.1.2: test procedure for the EMC RE (BS) updated with the addition of direct field strength measurement * 8.2.1.3: EMC Radiated emission limits updated with addition of limits for 3m and 10m measurement distances. * 8.2.1.4: MU for the field strength measurement added * 8.2.2.3: editorials | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | An alternative, time-efficient EMC RE measurement method will not be allowed in the standard. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.3, 8.2.1.2, 8.2.1.3, 8.2.1.4, 8.2.2.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 51.021, TS 25.113, TS 36.113, TS 37.113, TS 37.114 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | During this e-meeting, only CR for NR spec can be processed, but there are other EMC specs affected (TS 51.021, TS 25.113, TS 36.113, TS 37.113, TS 37.114) which are planned to be addressed at later stage. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*------------------------------ 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 38.104: "NR; Base Station (BS) radio transmission and reception"

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

[4] 3GPP TS 38.141-2: "NR; Base Station (BS) conformance testing Part 2: Radiated conformance testing"

[5] 3GPP TS 37.113: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) Electromagnetic Compatibility (EMC)"

[6] 3GPP TS 37.114: "Active Antenna System (AAS) Base Station (BS) Electromagnetic Compatibility (EMC)"

[7] IEC 61000-6-1: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments"

[8] IEC 61000-6-3: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light industrial environments"

[9] IEC 60050(161): "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility"

[10] 3GPP TR 38.817-02 "NR: General aspects for Base Station (BS) Radio Frequency (RF) for NR"

[11] CISPR 32: "Electromagnetic compatibility of multimedia equipment - Emission requirements"

[12] void

[13] IEC 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A)"

[14] IEC 61000-3-12: "Electromagnetic compatibility (EMC) - Part 3-12: Limits- Limits for harmonic current produced by equipment connected to public low-voltage system with input current >16 A and ≤ 75 A"

[15] IEC 61000-3-3: "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A"

[16] IEC 61000-3-11: "Electromagnetic compatibility (EMC) - Part 3-11: Limits –Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 75 A and subject to conditional connections"

[17] IEC 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test"

[18] IEC 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency electromagnetic field immunity test"

[19] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test"

[20] IEC 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test"

[21] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to contacted disturbances, induced by radio frequency fields"

[22] IEC 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations. Immunity tests"

[23] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements"

[24] Recommendation ITU-R SM.329-12: "Unwanted emissions in the spurious domain"

[25] 3GPP TS 37.105: "Active Antenna System (AAS) Base Station (BS) transmission and reception"

[26] Recommendation ITU-R SM.1539-1: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329"

[27] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements"

[28] 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"

[29] CISPR 16-1-4: "Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements"

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

## 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/*TAB connector* in TS 37.105 [25].

**BS type 1-C:** NR base station operating at FR1 with requirements set consisting only of conducted requirements defined at individual antenna connectors.

**BS type 1-H:** NR base station operating at FR1 with a requirement set consisting of conducted requirements defined at individual *TAB connectors* and OTA requirements defined at RIB.

**BS type 1-O:** NR base station operating at FR1 with a requirement set consisting only of OTA requirements defined at the RIB.

**BS type 2-O:** NR base station operating at FR2 with a requirement set consisting only of OTA requirements defined at the RIB.

**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 [9]).

**enclosure port:** physical boundary of the equipment through which electromagnetic fields may radiate or impinge.

NOTE: In the case of *integral antenna* equipment, this port is inseparable from the antenna port.

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

**free-space open area test site:** reference test site with precautions to ensure that reflections do not influence the measurement.

NOTE: The free-space open area test site (FSOATS) is the concept of the test site. A practical approximation is a fully (FAR) that meets the validation requirements.

**fully-anechoic room:** shielded enclosure, the internal surfaces of which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest.

**integral antenna:** antenna designed for permanent connection to the equipment and considered part of the enclosure port.

NOTE: An *integral antenna* may be fitted internally or externally.

**lower RF bandwidth edge:** the frequency of the lower edge of the Base Station RF bandwidth, used as a frequency reference point for transmitter and receiver requirements.

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

**port:** particular interface of EUT used for EMC requirements testing purposes.

NOTE: Any connection point on EUT intended for connection of cables to or from EUT during the EMC testing is considered as a port.

EXAMPLE 1: Examples of ports for *BS type 1-C* and *BS type 1-H* are as presented in figure 3.1‑1:



Figure 3.1-1: Examples of *port*s for *BS type 1-C* and *BS type 1-H*

EXAMPLE 2: Examples of ports for *BS type 1-O* and *BS type 2-O* (i.e. with no *antenna ports*) are as presented in figure 3.1-2:



Figure 3.1-2: Examples of *port*s for *BS type 1-O* and *BS type 2-O*

**receiver exclusion band:** band of frequencies over which no tests of radiated immunity of a receiver are made, and expressed relative to the BS receive band.

**semi-anechoic chamber:** shielded enclosure in which all surfaces except the metal floor are covered with material that absorbs electromagnetic energy (i.e. RF absorber) in the frequency range of interest.

**signal 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).

**spatial exclusion zone:** range of angles where no tests of radiated immunity are made for *BS type 1-O* or *BS type 2-O* (i.e. half sphere around the EUT's radiating direction).

**TAB connector:** *transceiver array boundary* connector

**Throughput:** number of payload bits successfully received per second for a reference measurement channel in a specified reference condition.

**transceiver array boundary:** conducted interface between the *transceiver unit* array and the composite antenna.

**transceiver unit:** active unit consisting of transmitter and/or receiver which transmits and/or receives radio signals, and which may include passive RF filters.

**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 [11] and ETSI EN 301 489-1 [23].

**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 [9]).

**transmitter exclusion band:** band of frequencies over which no tests of radiated immunity of a transmitter are made and is expressed relative to the carrier frequencies used (the carrier frequencies of the base stations activated transmitter(s)).

**upper RF bandwidth edge:** the frequency of the upper edge of the Base Station RF bandwidth, used as a frequency reference point for transmitter and receiver requirements.

## 3.2 Symbols

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

β Bandwidth

BWChannel Channel bandwidth

ΔfOBUE Maximum offset of the *operating band* unwanted emissions mask from the downlink *operating band* edge

ΔfOOB Maximum offset of the out-of-band boundary from the uplink *operating band* edge

FDL,low The lowest frequency of the downlink *operating band*

FDL,high The highest frequency of the downlink *operating band*

FUL,low The lowest frequency of the uplink *operating band*

FUL,high The highest frequency of the uplink *operating band*

ΔfRIexclusion Maximum offset of the Radiated Immunity exclusion band from the uplink *operating band* edge for test without *spatial exclusion zone* applied

## 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

BC Band Category

BS Base Station

CA Carrier Aggregation

CDN Coupling/Decoupling Network

CS Capability Set

DC Direct Current

EIRP Equivalent Isotropic Radiated Power

EMC Electromagnetic Compatibility

ESD Electrostatic Discharge

EUT Equipment Under Test

FR Frequency Range

FAR Fully-Anechoic Room

FRC Fixed Reference Channel

FSOATS Free Space OATS

NC Non Contiguous

NG Next Generation

NGC Next Generation Core

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NRTC NR Test Configuration

NTC Test Configuration for Non-contiguous operation

OATS Open Area Test Site

RAT Radio Access Technology

RF Radio Frequency

RIB Radiated Interface Boundary

rms root mean square

SAC Semi Anechoic Chamber

SC Single Carrier

SDL Supplementary Downlink

TC Test Configuration

UL Uplink

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

## 8.2 Radiated emission

### 8.2.1 Radiated emission, BS

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

For *BS type 1-O* and *BS type 2-O*, the radiated emission is covered by radiated spurious emission requirement in TS 38.104 [2], conforming to the test requirement in TS 38.141-2 [4].

#### 8.2.1.1 Definition

This test assesses the ability of BS 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 [24] shall be used. The BS 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 [11]. The field strength measurements shall be performed on a test site that is validated to the requirements of CISPR 16-1-4 [29]. 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) 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.

2) Power 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 BS 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: 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 [24].

e.r.p. (dBm)  EIRP (dBm)  2.15

b) The BS shall transmit with maximum power declared by the manufacturer with all transmitters active. Set the base station 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. 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.

#### 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 [24] and SM.1539 [26].

The *BS type 1-C* and *BS type 1-H* shall meet the limits below:

Table 8.2.1.3-1: Limits for radiated emissions from BS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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 6) | 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 | 1 |
| FDL,low - ΔfOBUE < f < FDL,high +ΔfOBUE | Not defined | Not defined | Not defined | Not defined | 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 BS 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 6.6.1 of TS 38.104 [2].  NOTE 4: The field strength measurements shall be conducted on OATS or SAC for frequencies up to 1 GHz, or on FSOATS 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, and increased by the site gain value of 4 dB. The value of the site gain is based on ITU-R Recommendations SM.329 [24].  NOTE 6: Limits for radiated emissions are translated from the e.r.p. limit of -30 dBm into the field strength limit of 50.9 dBµV/m, and increased by the site gain value of 4 dB. The value of the site gain is based on ITU-R Recommendations SM.329 [24]. | | | | | |

#### 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 BS.

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 (BS)

|  |  |  |
| --- | --- | --- |
| Parameter | Uncertainty for EUT dimension ≤ 1 m | Uncertainty for EUT dimension >1 m |
| Effective radiated RF power between 30 MHz to 180 MHz | ±6 dB | ±6 dB |
| Effective radiated RF power between 180 MHz to 4 GHz | ±4 dB | ±6 dB |
| Effective radiated RF power between 4 GHz to 12,75 GHz | ±6 dB | ±9 dB (NOTE) |
| Field strength between 30 MHz to 12,75 GHz | ±6 dB | ±6 dB |
| NOTE: This value may be reduced to ±6 dB when further information on the potential radiation characteristic of the EUT is available. | | |

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 - 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 a 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 [11].

#### 8.2.2.3 Limits

The *ancillary equipment* shall meet the limits according to CISPR 32 [11] 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.

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