

ETSI TS 138 124 V15.1.0 (2018-09)



**5G;
NR;
Electromagnetic compatibility (EMC)
requirements for mobile terminals and ancillary equipment
(3GPP TS 38.124 version 15.1.0 Release 15)**



Reference

RTS/TSGR-0438124vf10

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 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2018.

All rights reserved.

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 protected for the benefit of its Members.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is 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 IPR Policy, no investigation, 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.

Foreword

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, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 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

Intellectual Property Rights	2
Foreword.....	2
Modal verbs terminology.....	2
Foreword.....	4
1 Scope	5
2 References	5
3 Definitions, symbols and abbreviations	6
3.1 Definitions	6
3.2 Symbols.....	7
3.3 Abbreviations	7
4 Test conditions	8
4.1 General	8
4.2 Arrangements for establishing a communication link	8
4.3 Narrow band responses on receivers	8
4.4 Receiver exclusion band.....	9
5 Performance assessment.....	9
6 Performance criteria	10
7 Applicability overview tables.....	10
7.1 EMC Emissions.....	10
7.2 Immunity	11
8 Methods of measurement and limits for EMC emissions	11
8.1 Test configurations	11
8.2 Radiated Emission	12
8.2.1 General.....	12
8.2.2 Definition.....	12
8.2.3 Test method	12
8.2.4 Limits.....	12
9 Test methods and levels for immunity tests	13
9.1 Test configurations	13
9.2 RF electromagnetic field (80 MHz – 1000 MHz and [1400] MHz to [2700] MHz).....	13
9.2.1 Definition.....	14
9.2.2 Test method and level.....	14
9.2.3 Performance criteria.....	14
9.3 Electrostatic discharge.....	14
9.4 Fast transients common mode	14
9.5 RF common mode (0.15 MHz to 80 MHz)	14
9.6 Transients and surges, vehicular environment.....	15
9.7 Voltage dips and interruptions.....	15
9.8 Surges, common and differential mode	15
Annex A (informative): Change history	16
History	17

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.

1 Scope

The present document establishes the essential EMC requirements for "3rd generation" digital cellular mobile terminal equipment and ancillary accessories in combination with a 3GPP NR user equipment (UE).

The equipment conforming to the requirements laid out in the present document and used in its intended electromagnetic environment in accordance with the manufacturer's instructions

- shall not generate electromagnetic disturbances at a level which may interfere with the intended operation of other equipment;
- has an adequate level of intrinsic immunity to electromagnetic disturbances to operate as intended;

The present document specifies [the applicable EMC tests, methods of measurement, frequency ranges, applicable limits and minimum performance criteria for all types of NR UE(s) and their accessories]. NR base station equipment operating within network infrastructure is outside the scope of the present document. However, the present document does cover mobile and portable equipment that is intended to be operated in a fixed location while connected to the AC mains. NR base station equipment operating within network infrastructure is covered by the technical specification TS 38.113 [2].

[Requirements for the radiated emission from the enclosure port of integral antenna equipment and ancillaries are included in the present document. Technical specifications for conducted emissions from the antenna connector are found in the 3GPP specifications for the radio interface, e.g. TS 38.xyz, for the effective use of the radio spectrum.]

Requirements for the radiated emissions from the enclosure port and ancillaries cover two cases:

- [UE equipment supporting operations in a frequency range for which antenna connectors are available (i.e. for operations in Frequency Range 1 as defined in e.g. TS 38.101-1 [3] for the radio interface)]
- [UE equipment supporting operations in a frequency range for which only integral antennas may be available (i.e. for operations in Frequency Range 2 as defined in e.g. TS 38.101-2 [4] for the radio interface)]

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

Compliance of radio equipment to the requirements of the present document does not signify compliance to any requirement related to the use of the equipment (i.e. licensing requirements).

Compliance to the requirements of the present document does not signify compliance to any safety requirement. However, any temporary or permanent unsafe condition caused by EMC is considered as non-compliance.

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 38.113: "NR; Base Station (BS) ElectroMagnetic Compatibility (EMC)".

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

- [4] 3GPP TS 38.101-2: " NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
- [5] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".
- [6] IEC CISPR publication 22: "Information technology equipment; Radio disturbance characteristics - Limits and methods of measurement".
- [7] IEC CISPR publication 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods".
- [8] IEC 61000-3-2; (2000): "Electromagnetic compatibility; Part 3 - Limits; section 2 - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)"; Am.1 (1997-09)".
- [9] IEC 61000-3-3; (19952): "Electromagnetic compatibility; Part 3 - Limits; section 2 - Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A"
- [10] IEC 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 3: Radiated, radio-frequency electromagnetic field immunity test".
- [11] IEC 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 2: Electrostatic discharge immunity test - Basic EMC publication".
- [12] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 4: Electrical fast transient/burst immunity test - Basic EMC publication".
- [13] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 6: immunity to conducted disturbances induced by radio frequency fields".
- [14] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [15] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [16] IEC 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 11: Voltage dips, short interruptions, and voltage variations immunity test".
- [17] IEC 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 5: Surge immunity test".
- [18] ITU-R Recommendation SM.1539 (2001): "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".
- [19] IEC 60050(161): "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions 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].

Ancillary equipment: Equipment (apparatus), used in connection with a user equipment (UE) is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a UE to provide additional operational and/or control features to the UE, (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 UE; and
- the UE 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).

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.]

Enclosure port: Physical boundary of the apparatus through which electromagnetic fields may radiate or impinge. In the case of integral antenna equipment, this port is inseparable from the antenna port.

Idle mode: Idle mode is the state of User Equipment (UE) when switched on but with no Radio Resource Control (RRC) connection.

Integral antenna: Antenna designed to be connected directly to the equipment with or without the use of an external connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment.

Necessary bandwidth: For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Out of band emissions: Emission on a frequency or frequencies immediately outside the necessary bandwidth, which results from, the modulation process, but excluding spurious emissions.

NOTE: Any unwanted emission which falls at frequencies separated from the centre frequency of the emission by less than 250% of the necessary bandwidth of the emission will generally be considered out-of-band emission.

Spurious emission from ITU-R SM 329 [5]: Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

Transient phenomena: Pertaining to or designating a phenomenon 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 [19])

User equipment (UE): is a "Mobile Station" (MS) which is an entity capable of accessing a set of NR (and E-UTRA) services via one or more radio interfaces. This entity may be stationary or in motion within the NR (and E-UTRA) service area while accessing the NR (and E-UTRA) services, and may simultaneously serve one or more users.

3.2 Symbols

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

<symbol> <Explanation>

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].

<ACRONYM> <Explanation>

4 Test conditions

4.1 General

The equipment shall be tested under normal test conditions according to the relevant product and basic standards. [If these conditions are not specified then the manufacturers declared range of humidity, temperature and supply voltage shall be used. The test conditions shall be recorded in the test report.]

[Whenever the Equipment under test (EUT) is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise.]

Where the equipment incorporates an external 50 Ω RF antenna connector that is normally connected via a coaxial cable, then the wanted signal to establish a communication link also uses a coaxial cable.

Where the equipment has an external 50 Ω RF antenna connector that is not normally connected via a coaxial cable or where the equipment has no external 50 Ω RF connector (i.e., integral antenna equipment), then the wanted signal, to establish a communication link, shall be delivered from the equipment to an antenna located within the test environment.]

[Requirements throughout the RF specifications are in many cases defined separately for different frequency ranges (FR). The frequency ranges in which a UE equipment (NR) can operate according to this version of the specification are identified as described in Table 4.1-1. The test conditions may be different for operations in FR1 and FR2.]

Table 4.1-1: Definition of frequency ranges

Frequency range designation	Corresponding frequency range
FR1	450 MHz – 6000 MHz
FR2	24250 MHz – 52600 MHz

4.2 Arrangements for establishing a communication link

[For transmitters with an integral antenna, the wanted RF output signal to establish a communication link shall be delivered from the EUT to an antenna located within the test environment. This antenna shall be connected to the external measuring equipment by a coaxial cable.]

For transmitters with an antenna connector, the wanted RF output signal to establish a communication link shall be delivered from the antenna connector to the external measuring equipment by a shielded transmission line, such as a coaxial cable. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at the point of entry to the transmitter.]

The wanted RF input signal nominal frequency shall be selected by setting the NR Absolute Radio Frequency Channel Number to an appropriate number.

[For UE equipment only support operations in FR1 a communication link shall be set up with a suitable base station simulator (hereafter called "the test system"). The test system shall be located outside of the test environment.]

When the EUT is required to be in the traffic mode, a call is set up according to the generic call set-up procedure [and the following conditions shall be met.]

When the EUT is required to be in the idle mode [the following conditions shall be met.]

For immunity tests, sub-clause 4.3 applies.

4.3 Narrow band responses on receivers

Responses on receivers or duplex transceivers occurring during the 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, it is necessary to establish whether the deviation is due to an unwanted effect on the receiver of the UE or on the test system (narrow band response) or to a wide band (EMC) phenomenon. Therefore, the test shall be repeated with the

unwanted signal frequency increased or decreased by BW_{Channel} MHz, where BW_{Channel} is the channel bandwidth [as defined in TS 38.101-1];

- if the deviation does not disappear, the procedure is repeated the unwanted signal frequency increased or decreased by $2 \times BW_{\text{Channel}}$ MHz, where BW_{Channel} is the channel bandwidth as defined in TS 38.101-1 [3];
- 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.

Narrow band responses are disregarded.

The procedure above does not apply to conducted immunity tests in the frequency range 150 kHz to 80 MHz.

4.4 Receiver exclusion band

The receiver exclusion band for terminals extends from the lower frequency of the allocated receiver band minus 85 MHz to the upper frequency of the allocated receiver band plus 85 MHz. The exclusions bands are as set out below:

- 2025 MHz to 2255 MHz (Band n1);
- 1845 MHz to 2075 MHz (Band n2);
- 1720 MHz to 1965 MHz (Band n3);
- 784 MHz to 979 MHz (Band n5);
- 2535 MHz to 2775 MHz (Band n7);
- 840 MHz to 1045 MHz (Band n8);
- 661 MHz to 841 MHz (Band n13);
- 706 MHz to 906 MHz (Band n20);
- 673 MHz to 888 MHz (Band n28);
- 2485 MHz to 2705 MHz (Band n38);
- 2411 MHz to 2775 MHz (Band n41);
- 1347 MHz to 1602 MHz (Band n50);
- 1342 MHz to 1517 MHz (Band n51);
- 2025 MHz to 2285 MHz (Band n66);
- 1910 MHz to 2105 MHz (Band n70);
- 532 MHz to 737 MHz (Band n71);
- 1390 MHz to 1603 MHz (Band n74);
- 1347 MHz to 1602 MHz (Band n75);
- 1342 MHz to 1517 MHz (Band n76);
- 3215 MHz to 4285 MHz (Band n77);
- 3215 MHz to 3885 MHz (Band n78);
- 4315 MHz to 5085 MHz (Band n79);

5 Performance assessment

The present document

6 Performance criteria

The present document

7 Applicability overview tables

7.1 EMC Emissions

Table 7.1-1: Emission applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document	Reference Standard
		Equipment connected to fixed AC or DC power installations	Equipment connected to vehicular DC supplies	Equipment powered by integral battery		
Radiated emission	Enclosure	applicable	applicable	applicable	8.2	ITU-R SM.329 [5] TS 36.101 []
Conducted emission	DC power input/output port	applicable	applicable	not applicable	8.3	CISPR 22 [6], CISPR 16-1 [7]
Conducted emission	AC mains input/output port	applicable	not applicable	not applicable	8.4	CISPR 22 [6]
Harmonic current emissions	AC mains input port	applicable	not applicable	not applicable	8.5	IEC 61000-3-2 [8]
Voltage fluctuations and flicker	AC mains input port	applicable	not applicable	not applicable	8.6	IEC 61000-3-3 [9]

For UE equipment operating in FR1 (Table 4.1-1), the radiated emission applies to the enclosure port [antenna ports available].

For UE equipment supporting operations in FR2 (Table 4.1-1) the enclosure port is inseparable from the antenna port

7.2 Immunity

Table 7.2-1: Immunity applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document	Reference standard
		Equipment connected to fixed AC or DC power installations	Equipment connected to vehicular DC supplies	Equipment powered by integral battery		
RF electro-magnetic field (80 MHz to [2700] MHz)	Enclosure	applicable	applicable	applicable	9.2	IEC 61000-4-3 [10]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	IEC 61000-4-2 [11]
Fast transients common mode	Signal and control ports, DC and AC power input ports	applicable	not applicable	not applicable	9.4	IEC 61000-4-4 [12]
RF common mode 0,15 MHz to 80 MHz	Signal and control ports, DC and AC power input ports	applicable	applicable	applicable	9.5	IEC 61000-4-6 [13]
Transients and surges, vehicular environment	DC power input ports	not applicable	applicable	not applicable	9.6	ISO 7637 Part 1 [14] And ISO 7637 Part 2 [15]
Voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	9.7	IEC 61000-4-11 [16]
Surges, common and differential mode	DC and AC power input ports	applicable	not applicable	not applicable	9.8	IEC 61000-4-5 [17]

8 Methods of measurement and limits for EMC emissions

8.1 Test configurations

This sub-clause defines the configurations for emission tests as follows:

- the equipment shall be tested under normal test conditions;
- 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, Radio Frequency (RF) input/output ports shall be correctly terminated;

- ports that 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;
- emission tests shall be performed in two modes of operation:
 - with a communication link established (traffic mode); and
 - in the idle mode.

8.2 Radiated Emission

8.2.1 General

This test is applicable to radio communications equipment and ancillary equipment.

This test shall be performed on the radio equipment and/or a representative configuration of the ancillary equipment.

8.2.2 Definition

This test assesses the ability of radio equipment and ancillary equipment to limit unwanted emissions from the enclosure port.

[For UE equipment supporting operations in FR2 (Table 4.1-1) with integral antennas only (no antenna connectors available), the EMC radiated emissions cannot be distinguished between the intended emissions nor to any spurious emissions related to these intentional transmissions.]

8.2.3 Test method

Whenever possible the site shall be a fully anechoic chamber (FAC) simulating the free-space conditions. EUT shall be placed on a non-conducting support. 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 EUT shall be rotated to obtain maximum response, and the effective radiated power (e.r.p.) of that component determined by a substitution measurement, which shall be the reference method. The measurement shall be repeated with the test antenna in the orthogonal polarization plane.

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.

$$\text{e.r.p. (dBm)} = \text{e.i.r.p. (dBm)} - 2.15 \quad \text{Ref. ITU-R SM. 329 ANNEX 1 [5]}$$

Measurements are made with a tuned dipole antenna or a reference antenna with a known gain referenced to an isotropic antenna. Unless otherwise stated, all measurements are done as mean power (RMS).

8.2.4 Limits

The references for these requirements are ITU-R SM 329 [5], SM.1539 [18] and TS 38.101-1 [3] for FR1 [and TS 38.101-2] for FR2.

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 SM 329 [5].

These requirements are only applicable for frequencies in the spurious domain. The limits are specified in Table 8.2.3-1 for UE equipment supporting operations in FR1 only.

Table 8.2.4-1: Radiated spurious emissions requirements for UE equipment supporting operations in FR1 only

Frequency	Minimum requirement (e.r.p.)/ Reference Bandwidth Idle mode	Minimum requirement (e.r.p.) / Reference Bandwidth Traffic mode
30 MHz \leq f < 1000 MHz	-57dBm / 100 kHz	-36 dBm / 100 kHz
1 GHz \leq f < [12.75] GHz	-47dBm / 1MHz	-30 dBm / 1 MHz
$f_c - 2.5 \times BW_{\text{Channel}}$ MHz < f < $f_c + 2.5 \times BW_{\text{Channel}}$ MHz	Not defined	Not defined

NOTE: f_c is the centre frequency of the TCH. The frequency range $f_c \pm 2.5 \times BW_{\text{Channel}}$ MHz are covered by the "Out of Band" emission requirements of TS 36.101-1 [1].

BW_{Channel} : Channel bandwidth as defined in TS 36.101-1 [1].

9 Test methods and levels for immunity tests

9.1 Test configurations

This subclause defines the configurations for immunity tests as follows:

- the equipment shall be tested under normal test conditions as specified in the core specification;
- 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, Radio Frequency (RF) input/output ports shall be correctly terminated;
- 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 sections of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter section and receiver section of the EUT may be carried out simultaneously to reduce test time;
- immunity tests shall be performed in two modes of operation:
 - with a communication link established (traffic mode); and
 - in the idle mode.

9.2 RF electromagnetic field (80 MHz – 1000 MHz and [1400] MHz to [2700] MHz)

The test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of UE and ancillary equipment.

9.2.1 Definition

This test assesses the ability of UE and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance at the enclosure.

9.2.2 Test method and level

The test method shall be in accordance with IEC 61000-4-3 [10]

- for UE and ancillary equipment, 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;
- when using the max hold detector method (see ANNEX A) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied;
- the test shall be performed over the frequency range 80 MHz to 1000 MHz and [1400] MHz to [2700] MHz;
- 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 sub-clause 4.3;
- the frequencies selected during the test shall be recorded in the test report.

9.2.3 Performance criteria

The performance criteria of [sub-clause 6.1] shall apply.

9.3 Electrostatic discharge

The test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of UE and ancillary equipment.

9.4 Fast transients common mode

The test shall be performed on AC mains power input ports.

This test shall be performed on signal ports, control ports and DC power input/output ports if the cables may be longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of UE and ancillary equipment.

9.5 RF common mode (0.15 MHz to 80 MHz)

This test is applicable for UE for fixed, mobile, and portable use and for ancillary equipment.

This test shall be performed on signal, control and DC power input/output ports, which may have cables longer than 3 m.

This test shall be performed on AC mains power input/output ports of UE for fixed use and for fixed ancillary equipment. Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of ports which were not tested shall be included in the test report.

This test shall be performed on a representative configuration of the UE or a representative configuration of the combination of UE and ancillary equipment.

9.6 Transients and surges, vehicular environment

The tests are applicable to UE intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V DC power input.

These tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of UE and ancillary equipment.

9.7 Voltage dips and interruptions

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the UE or a representative configuration of the combination of UE and ancillary equipment.

9.8 Surges, common and differential mode

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the UE or a representative configuration of the combination of UE and ancillary equipment.

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2017-10	R4#84bis	R4-1710899				Specification template	0.0.1
2017-12	RAN4#85	R4-1714548				Capture approved Text Proposals in RAN4#85 R4-1712520: TP to 38.124: Scope R4-1712521: TP to 38.124: Test conditions R4-1712522: TP to 38.124: Applicability R4-1712523: TP to 38.124: EMC emissions tests R4-1712524: TP to 38.124: Immunity tests	0.1.0
2017-12	RAN#78	RP-172249				Presentation to TSG RAN for approval	1.0.0
2017-12	RAN#78					Approved by plenary – Rel-15 spec under change control	15.0.0
2018-03	RAN#79	RP-180264	000 1		F	Implementation of agreed draft CRs	15.1.0

History

Document history		
V15.1.0	September 2018	Publication