ETSI TS 136 113 V18.1.0 (2024-05)

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Base Station (BS) and
repeater ElectroMagnetic Compatibility (EMC)
(3GPP TS 36.113 version 18.1.0 Release 18)

Reference
RTS/TSGR-0436113vi10

Keywords
LTE

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 https://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.

1 Scope

The present document covers the assessment of E-UTRA, E-UTRA with NB-IoT or NB-IoT base stations, repeaters and associated ancillary equipment in respect of Electromagnetic Compatibility (EMC).

The present document specifies the applicable test conditions, performance assessment and performance criteria for E-UTRA, E-UTRA with NB-IoT or NB-IoT base stations, repeaters and associated ancillary equipment in one of the following categories:

- base sations of E-UTRA, E-UTRA with NB-IoT or NB-IoT meeting the requirements of TS 36.104 [2], with conformance demonstrated by compliance to TS 36.141 [3].
- repeaters of E-UTRA meeting the requirements of TS 36.106 [4], with conformance demonstrated by compliance to TS 36.143 [5].

Technical requirements related to the antenna port of E-UTRA, E-UTRA with NB-IoT or NB-IoT base stations or repeaters are not included in the present document. These are found in the relevant product standards [2-5].

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], IEC 61000-6-3 [7] and IEC 61000-6-8 [27].

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 TR 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".

[3] 3GPP TR 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing ".

[4] 3GPP TR 36.106: "Evolved Universal Terrestrial Radio Access (E-UTRA); Repeater radio transmission and reception".

[5] 3GPP TR 36.143: "Evolved Universal Terrestrial Radio Access (E-UTRA); Repeater conformance testing ".

[6] IEC 61000-6-1: 2005; "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments".

[7] IEC 61000-6-3: 2020: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for equipment in residential environments".

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

[9] 3GPP TR 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

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

[11] Void

[12] Void

[13] IEC 61000-3-2 (2004): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A)".

[14] IEC 61000-3-12 (2005): "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 (2002): "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 (2000): "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 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency electromagnetic field immunity test".

[18] IEC 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge 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 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to contacted disturbances, induced by radio frequency fields".

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

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

[23] 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".

[24] 3GPP TS 37.113: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) Electromagnetic Compatibility (EMC)".

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

[26] IEC 61000-4-21: "Electromagnetic Compatibility (EMC) Part 4-21: Testing and Measurement Techniques Reverberation Chamber Test Methods".

[27] IEC 61000-6-8: 2020: "Electromagnetic compatibility (EMC) - Part 6-8: Generic standards - Emission standard for professional equipment in commercial and light-industrial locations".

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: Equipment (apparatus), used in connection with a receiver, transmitter or transceiver is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver, transmitter or transceiver 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, transmitter or transceiver; and

- the receiver, transmitter or transceiver 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).

Base Station equipment: Radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly (e.g. via an AC/DC converter or power supply) by AC mains network, or an extended local DC mains network.

Channel bandwidth: The RF bandwidth supporting a single E-UTRA 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 (continuous disturbance): Electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161 [8]).

Maximum throughput: The maximum achievable throughput for a reference measurement channel.

Multi-band Base Station: Base Station characterized by the ability of its transmitter and/or receiver to process two or more carriers in common active RF components simultaneously, where at least one carrier is configured at a different non-overlapping operating band than the other carrier(s).

NB-IoT In-band operation: NB-IoT is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier

NB-IoT guard band operation: NB-IoT is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

NB-IoT standalone operation: NB-IoT is operating standalone when it utilizes its own spectrum, for example the spectrum currently being used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

Radio communications equipment : Telecommunications equipment which includes one or more transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application. It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

Radio equipment: Equipment which contains Radio digital unit and Radio unit.

Radio digital unit: Equipment which contains base band and functionality for controlling Radio unit.

Radio unit: Equipment which contains transmitter and/or receiver.

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

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).

Receiver exclusion band: The receiver exclusion band is the band of frequencies over which no tests of radiated immunity of a receiver are made. The exclusion band for receivers is expressed relative to the base station receive band.

Repeater: A device that receives, amplifies and transmits the radiated or conducted RF carrier both in the down-link direction (from the base station to the mobile area) and in the up-link direction (from the mobile to the base station). In operating bands specified with only down-link or up-link, only the up-link or down-link as specified for the operating band is repeated.

Signal and control: Port which carries information or control signals, excluding antenna ports.

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 [25].

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

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 [8]).

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)).

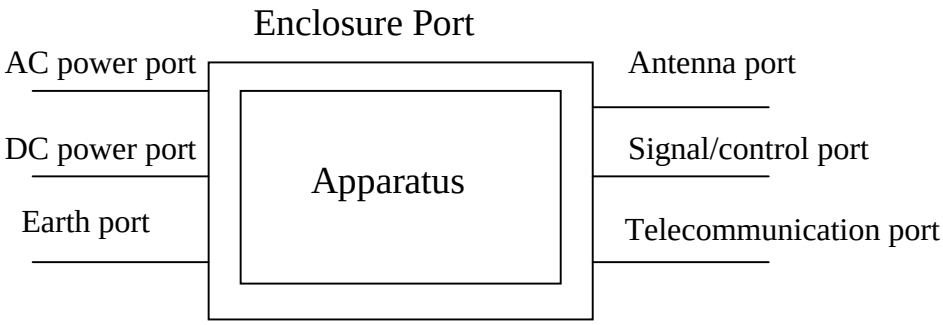

Figure 3.1.1: Examples of ports

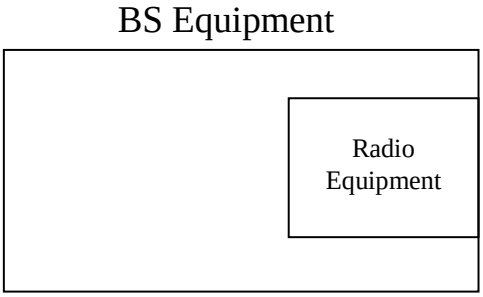

Figure 3.1.2: BS with single enclosure solution

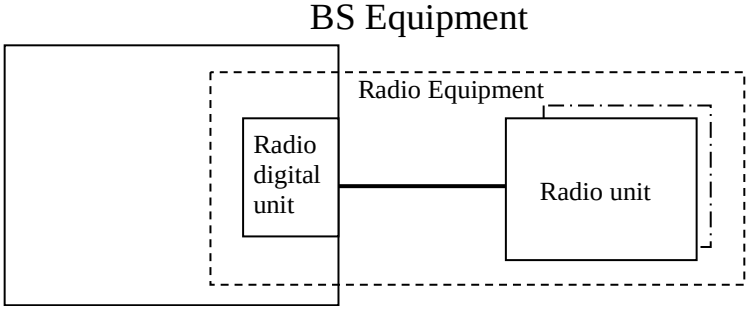

Figure 3.1.3: BS with multiple enclosure solution

3.2 Symbols

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

$BW_{Channel}$	Channel bandwidth
Δf_{OOB}	Maximum offset of the out-of-band boundary from the uplink operating band edge
$F_{UL,low}$	The lowest frequency of the uplink operating band
$F_{UL,high}$	The highest frequency of the uplink operating band

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
E-UTRA	Evolved Universal Terrestrial Radio Access
EMC	Electromagnetic Compatibility
EPC	Evolved Packet Core
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FRC	Fixed Reference Channel
NB-IoT	Narrowband – Internet of Things
RF	Radio frequency
rms	root mean square
SDL	Supplementary Downlink

4 Test conditions

4.1 General

The equipment shall be tested in normal test environment defined in base station conformance testing specification TS 36.141 [3] or in the E-UTRA repeater conformance testing specification TS 36.143 [5]. The test conditions shall be recorded in the test report.

For an EUT which contains more than one BS, it is sufficient to perform tests relating to each type of port of each representative type of the BS forming part of the EUT.

For BS 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 subclause 4.6. Tests shall be performed relating to each type of port and all bands shall be assessed during the tests.

4.2 Arrangements for establishing a communication link

The wanted RF input signal nominal frequency shall be selected by setting the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) to an appropriate number.

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 air interface and/or the S1 interface. The test system shall be located outside of the test environment.

When the EUT is required to be in the transmit/receive mode, the following conditions shall be met:

- the EUT shall be commanded to operate at maximum rated transmit power;
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- The wanted input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects e.g.15 dB above the reference sensitivity level as defined in TS 36.141 [3] to provide a stable communication link.

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

4.2.1 Multiple enclosure BS solution

For a BS with multiple enclosures, the BS part with Radio digital unit and the Radio unit may be tested separately. Communication link shall be set up in the same way as if they are in single BS enclosure. The Radio Digital unit and the Radio unit shall communicate over an interface enabling establishment of a communication link.

4.3 Narrow band responses on receivers

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 36.104 [2];
- if the deviation disappears in either or both of the above 2 x $BW_{Channel}$ 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.

Narrow band responses are disregarded.

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

4.4 Test condition for Repeater

The wanted RF input signal nominal frequency shall be selected by setting the Absolute Radio Frequency Channel Number (ARFCN) to an appropriate number within the operating band of the Repeater.

The Repeater path shall be tested with a suitable test system capable of measuring RF performance criteria (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 operational mode, the following conditions shall be met:

- the EUT shall be commanded to operate at maximum rated gain;
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;

For immunity tests conditions subclause 4.3 shall apply.

4.4.1 Arrangements for test signals for repeaters

For immunity tests of repeaters, the wanted RF input signal shall be coupled to one antenna port at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer in TS

36.141 [3]. The test shall either be repeated with a wanted signal coupled to the other antenna port, or a single test shall be performed with the specified input signals being simultaneously coupled to both antenna ports.

4.5 Exclusion bands

4.5.1 Transmitter exclusion band

For the purpose of EMC specifications there shall be a transmitter exclusion band.

- Lower carrier frequency used - 2.5 x $BW_{Channel}$ MHz to upper carrier frequency used + 2.5 x $BW_{Channel}$ MHz, where $BW_{Channel}$ is the channel bandwidth as defined in TS 36.104 [2].

4.5.2 Receiver exclusion band

The receiver exclusion band for base stations is the frequency range over which no tests of radiated immunity of a receiver are made. The receiver exclusion band is defined as:

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

Where:

Values of $F_{UL,low}$ and $F_{UL,high}$ are defined for each operating band in TS 36.104 [2], subclause 5.5.

For E-UTRA, the value of Δf_{OOB} is 20 MHz.

For BS capable of multi-band operation, the total receiver exclusion band shall be the combination of the exclusion bands for each operating band supported by the BS.

NOTE 1: The receiver exclusion bands do not apply for SDL bands.

NOTE 2: The receiver exclusion bands do not apply for Band 47.

4.6 BS test configurations

The present clause defines the BS test configurations that shall be used for demonstrating conformance. A single E-UTRA carrier shall be used for testing of single-carrier capable BS. For other E-UTRA BS types, the test configurations in Table 4.6.1 shall be used. The test configurations (ETCx) are defined in TS 36.141 [3], subclause 4.10.

Table 4.6.1: Test configurations for E-UTRA BS

BS test case	BS capable of multi-carrier and/or CA operation in contiguous spectrum in single band only	BS capable of multi-carrier and/or CA operation in both contiguous and non-contiguous spectrum in single band	BS capable of multi-band operation
Emission tests	ETC1	ETC3	ETC1/3 (Note 1), ETC5
Immunity tests	ETC1	ETC3	ETC1/3 (Note 1), ETC5
NOTE 1: ETC1 or ETC3 shall be applied in each supported operating band according to the respective capability in each band, as defined in the 2nd and 3rd column of the table.			

A NB-IoT standalone single carrier shall be used for testing of BS declared to be capable of single carrier operation only. For other NB-IoT BS types, the test configurations in Table 4.6.1a shall be used. The test configurations (ETCx) are defined in TS 36.141 [3], subclause 4.10.

Table 4.6.1a: Test configurations for NB-IoT BS

BS test case	NB-IoT standalone BS capable of multi-carrier in contiguous spectrum in single band only	E-UTRA and NB-IoT standalone BS capable of multi-carrier in contiguous spectrum in single band only	E-UTRA with NB-IoT operating in-band BS capable of multi-carrier in contiguous spectrum in single band only	E-UTRA with NB-IoT operating in guard band or NB-IoT operating in-band and in guard band BS capable of multi-carrier in contiguous spectrum in single band only
Emission tests	ETC6	ETC7	ETC8	ETC9
Immunity tests	ETC6	ETC7	ETC8	ETC9

4.7 Manufacturer declarations

The following EMC-specific manufacturer's declarations listed in table 4.7-1 are required to be provided by the manufacturer for E-UTRA BS requirements testing.

NOTE: The below listed manufacturer's declarations are supplementary to declarations covered in TS 36.141 [3].

Table 4.7-1 EMC-specific manufacturer declarations

Declaration identifier	Declaration	Description
DEMC.1 (NOTE)	Ports intended to be used with cables less than 3 m	Declaration of any port(s) intended to be used with cables less than 3 m.
NOTE: This manufacturer declaration is optional.		

5 Performance assessment

5.1 General

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

- the primary functions of the radio equipment to be tested during and after the EMC testing;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the method to be used to verify that a communications link is established and maintained;
- the user-control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;
- the ancillary equipment to be combined with the radio equipment for testing (where applicable);
- the information about ancillary equipment intended to be used with the radio equipment;
- information about the common and/or band-specific active RF components and other HW blocks for a communication link in BS capable of multi-band operation;
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as AC or DC power.

Performance assessment of a BS with multiple enclosures may be done separately for the BS part with the Radio digital unit and the Radio unit respectively, according to the manufacturer's choice.

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

5.2 Assessment of throughput in Downlink

The output of the transmitter shall be connected to an equipment which meet the requirements for the throughput assessment of TS 36.101 [9] for the bearer used in the immunity tests. The level of the signal supplied to the equipment should be within the range for which the assessment of throughput is not impaired. Power control shall be off during the immunity testing.

5.3 Assessment of throughput in Uplink

The value of the throughput at the output of the receiver shall be monitored at S1 interface by using suitable test equipment.

5.4 Ancillary equipment

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

5.5 Repeaters

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

6 Performance Criteria

6.1 Performance criteria for continuous phenomena for BS

The test should, where possible, be performed using a bearer with the characteristics of data rate and throughput defined in Table 6.1.1 and Table 6.1.1a. If the test is not performed using one of these bearers (for, example, of none of them are supported by the BS), the characteristics of the bearer used shall be recorded in the test report.

The throughput in Table 6.1.1 or Table 6.1.1a is stated relative to the maximum throughput of the FRC. For E-UTRA the maximum throughput for an FRC is equal to the payload size * the number of uplink subframes per second. For NB-IoT the Maximum throughput for an FRC equals the Payload size / (Number of Resource Unit * time to send one Resource Unit).

The BS Uplink and Downlink paths shall each meet the performance criteria defined in Table 6.1.1 and Table 6.1.1a during the test. If the Uplink and Downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in Table 6.1.1 and Table 6.1.1a. After each test case BS shall operate as intended with no loss of user control function, stored data and the communication link shall be maintained.

Table 6.1.1: BS E-UTRA Performance Criteria for continuous phenomena for BS

E-UTRA Channel Bandwidth [MHz]	Bearer Information Data Rate (as in Annex A.1 in TS 36.104 [2])	Performance Criteria [1,2]
1.4	FRC A1-1	Throughput > 95 % No loss of service
3	FRC A1-2	
3	FRC A1-6for E-UTRA with NB-IoT in-band operation	
5	FRC A1-3	
5	FRC A1-7for E-UTRA with NB-IoT in-band operation	
10	FRC A1-3[3] FRC A1-8[4]	
10	FRC A1-7 for E-UTRA with NB-IoT in-band operation	
15	FRC A1-3[3]	
15	FRC A1-7 for E-UTRA with NB-IoT in-band operation	
20	FRC A1-3[3] FRC A1-9[4]	
20	FRC A1-7 for E-UTRA with NB-IoT in-band operation	

Table 6.1.1a: NB-IoT BS Performance criteria for continuous phenomena for BS

NB-IoT Sub-carrier spacing [kHz]	Bearer Information Data Rate (as in Annex A.14 in TS 36.104 [2])	Performance Criteria [1, 2]
15	FRC A14-1	Throughput > 95 % No loss of service
3.75	FRC A14-2	

NOTE 1: The performance criteria, Throughput > 95 % / No loss of service, applies also if a bearer with another characteristics is used in the test.

NOTE 2: The performance criteria, Throughput > 90 % / No loss of service, applies instead if the Uplink and Downlink paths are evaluated as a one loop.

NOTE 3: This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each. This reference measurement channel is not applied for Band 46 and Band 49.

NOTE 4: This is the information data rate of a single instance of the bearer mapped to a single interlace. The performance criteria shall be met for each application of a single instance of the bearer mapped to each single interlace. This reference measurement channel is only applied for Band 46 and Band 49.

6.2 Performance criteria for transient phenomena for BS

The test should be, where possible, be performed using a bearer with the characteristics of data rate and throughput defined in Table 6.2.1 and Table 6.2.1a. If the test is not performed using one of these bearers (for, example, of none of them are supported by the BS), the characteristics of the bearer used shall be recorded.

The throughput in Table 6.2.1 or Table 6.2.1a is stated relative to the maximum throughput of the FRC. For E-UTRA the maximum throughput for an FRC is equal to the payload size * the number of uplink subframes per second. For NB-

IoT the Maximum throughput for an FRC equals the Payload size / (Number of Resource Unit * time to send one Resource Unit).

The BS Uplink and Downlink paths shall each meet the performance criteria defined in Table 6.2.1 and Table 6.2.1a during the test. If the Uplink and Downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in Table 6.2.1 and Table 6.2.1a. After each test case BS shall operate as intended with no loss of user control function, stored data and the communication link shall be maintained.

Table 6.2.1: BS Performance Criteria for transient phenomena for BS

E-UTRA Channel Bandwidth [MHz]	Bearer Information Data Rate (as in Annex A.1 in TS 36.104 [2])	Performance Criteria [1, 2]
1.4	FRC A1-1	Throughput < 95 % temporarily, however the communication link shall be maintained
3	FRC A1-2	
3	FRC A1-6for E-UTRA with NB-IoT in-band operation	
5	FRC A1-3	
5	FRC A1-7for E-UTRA with NB-IoT in-band operation	
10	FRC A1-3[3] FRC A1-8[4]	
10	FRC A1-7 for E-UTRA with NB-IoT in-band operation	
15	FRC A1-3[3]	
15	FRC A1-7 for E-UTRA with NB-IoT in-band operation	
20	FRC A1-3[3] FRC A1-9[4]	
20	FRC A1-7 for E-UTRA with NB-IoT in-band operation	

Table 6.2.1a: NB-IoT BS Performance Criteria for transient phenomena for BS

NB-IoT Sub-carrier spacing [kHz]	Bearer Information Data Rate (as in Annex A.14 in TS 36.104 [2])	Performance Criteria [1, 2]
15	FRC A14-1	Throughput < 95 % temporarily, however the communication link shall be maintained
3.75	FRC A14-2	

NOTE 1: The performance criteria, Throughput < 95 % temporarily / however the communication link shall be maintained, applies also if a bearer with another characteristics is used in the test.

NOTE 2: The performance criteria, Throughput < 90 % temporarily / however the communication link shall be maintained, applies instead if the Uplink and Downlink paths are evaluated as a one loop.

NOTE 3: This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each. This reference measurement channel is not applied for Band 46 and Band 49.

NOTE 4: This is the information data rate of a single instance of the bearer mapped to a single interlace. The performance criteria shall be met for each application of a single instance of the bearer mapped to each single interlace. This reference measurement channel is only applied for Band 46 and Band 49.

6.3 Performance criteria for continuous phenomena for Ancillary equipment

The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

6.4 Performance criteria for transient phenomena for Ancillary equipment

The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. During the test, degradation of performance is however allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

6.5 Performance criteria for continuous phenomena for repeaters

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

6.6 Performance criteria for transient phenomena for repeaters

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

7 Applicability overview

7.1 Emission

Table 7.1.1: Emission applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document	Reference Standard
		BS equipment	Ancillary equipment	Repeater		
Radiated emission (NOTE)	Enclosure	applicable		applicable	8.2.1	ITU-R SM.329 [10]
Radiated emission	Enclosure		applicable		8.2.2	CISPR 32 [25]
Conducted emission	DC power input/output port	applicable	applicable	applicable	8.3	CISPR 32 [25], CISPR 16-1-1 [12]
Conducted emission	AC mains input/output port	applicable	applicable	applicable	8.4	CISPR 32 [25]
Harmonic current emissions	AC mains input port	applicable	applicable	applicable	8.5	IEC 61000-3-2 [13] or IEC 61000-3-12 [14]
Voltage fluctuations and flicker	AC mains input port	applicable	applicable	applicable	8.6	IEC 61000-3-3 [15] or IEC 61000-3-11 [16]
Conducted emission	Telecommunica-tion port	applicable	applicable	applicable	8.7	CISPR 32 [25]
NOTE: The radiated emissions requirement for the BS equipment covers radiated emissions in the spurious domain. Note that in ETSI standards and in 3GPP GERAN specifications it is considered a part of radio aspects.						

7.2 Immunity

Table 7.2.1: Immunity applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document	Reference standard
		BS equipment	Ancillary equipment	Repeater		
RF electromagnetic field (80 - 6000 MHz)	Enclosure	applicable	applicable	applicable	9.3	IEC 61000-4-3 [17]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.4	IEC 61000-4-2 [18]
Fast transients common mode	Signal, telecommunications and control ports, DC and AC power input ports	applicable	applicable	applicable	9.5	IEC 61000-4-4 [19]
RF common mode 0,15 - 80 MHz	Signal, telecommunications and control ports, DC and AC power input ports	applicable	applicable	applicable	9.6	IEC 61000-4-6 [20]
Voltage dips and interruptions	AC mains power input ports	applicable	applicable	applicable	9.7	IEC 61000-4-11 [21]
Surges, common and differential mode	AC power input ports and telecommunications port	applicable	applicable	applicable	9.8	IEC 61000-4-5 [22]

7.3 Applicability of requirements in TS 37.113

For a BS that is E-UTRA (single-RAT) capable only, the requirements in the present document are applicable and additional conformance to TS 37.113 [24] is optional. For a BS additionally conforming to TS 37.113 [24], conformance to some of the emission test requirements in the present document can be demonstrated through the corresponding requirements in TS 37.113 [24] as listed in Table 7.3.1 and conformance to some of the immunity test requirements in the present document can be demonstrated through the corresponding requirements in TS 37.113 [24] as listed in Table 7.3.2.

Table 7.3.1: Alternative emission test requirements for a BS additionally conforming to TS 37.113 [24]

Phenomenon	Application	Clause in the present document	Alternative clause in TS 37.113 [24]
Radiated emission	Enclosure	8.2.1	8.2.1
Conducted emission	DC power input/output port	8.3	8.3
Conducted emission	AC mains input/output port	8.4	8.4
Harmonic current emissions	AC mains input port	8.5	8.5
Voltage fluctuations and flicker	AC mains input port	8.6	8.6
Conducted emission	Telecommunication port	8.7	8.7

Table 7.3.2: Alternative immunity test requirements for a BS additionally conforming to TS 37.113 [24]

Phenomenon	Application	Clause in the present document	Alternative clause in TS 37.113 [24]
RF electromagnetic field (80 - 6000 MHz)	Enclosure	9.3	9.2
Electrostatic discharge	Enclosure	9.4	9.3
Fast transients common mode	Signal, telecommunications and control ports, DC and AC power input ports	9.5	9.4
RF common mode (0,15 - 80 MHz)	Signal, telecommunications and control ports, DC and AC power input ports	9.6	9.5
Voltage dips and interruptions	AC mains power input ports	9.7	9.6
Surges, common and differential mode	AC power input ports and telecommunications port	9.8	9.7

8 Emission

8.1 Test configurations

This subclause defines the configurations for emission tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;
- the test configuration shall be as close to normal intended use as possible;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of ancillary equipment necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;

- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the ancillary equipment, 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.

8.2 Radiated emission from Base station, Repeater and ancillary equipment

8.2.1 Radiated emission, Base stations and Repeater

This test is applicable to Base station and Repeater. This test shall be performed on a representative configuration of the Base station or Repeater.

8.2.1.1 Definition

This test assesses the ability of BS and Repeater to limit unwanted emission from the enclosure port.

8.2.1.2 Test method

a) A test site fulfilling the requirements of ITU-R SM. 329 [10] shall be used. The BS or Repeater shall be placed on a non-conducting support and shall be operated from a power source via a RF filter to avoid radiation from the power leads.

   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 or Repeater shall be rotated and the height of the test antenna adjusted to obtain maximum response, and the effective radiated power (e.r.p.) of that component determined by a substitution measurement. The measurement shall be repeated with the test antenna in the orthogonal polarization plane.

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.

$$\text{e.r.p. (dBm)} = \text{e.i.r.p. (dBm)} - 2{,}15$$ Ref: ITU-R SM.329 ANNEX 1 [10].

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 for measurement of spurious emission in the TS 36.141 [3].

   In case of a Repeater the gain and the output power shall be set to the maximum value as declared by the manufacturer.

c) The received power shall be measured over the frequency range 30 MHz to 12.75 GHz, excluding 2.5 x $BW_{Channel}$ MHz below the first carrier frequency to 2.5 x $BW_{Channel}$ MHz above the last carrier frequency used, where $BW_{Channel}$ is the channel bandwidth as defined in TS 36.104 [2]. The measurement bandwidth shall be 100 kHz between 30 MHz and 1 GHz and 1 MHz above 1 GHz as given in ITU-R SM.329 [10]. The video bandwidth shall be approximately three times the resolution bandwidth. If this video bandwidth is not available on the measuring receiver, it shall be the maximum available and at least 1 MHz. Unless otherwise stated, all measurements are done as mean power (RMS).

8.2.1.3 Limits

The frequency boundary and reference bandwidths for the detailed transitions of the limits between the requirements for out of band emissions and spurious emissions are based on ITU-R Recommendations SM.329 [10] and SM.1539 [23].

The BS or the Repeater shall meet the limits below:

Table 8.2.1: Limits for radiated emissions from BS and repeater

Frequency range	Minimum requirement (e.r.p.)/Reference Bandwidth
30 MHz≤ f <1000 MHz	-36 dBm/100 kHz
1 GHz≤ f <12,75 GHz	-30 dBm/ 1MHz
Fc1 - 2.5 x $BW_{Channel}$ MHz < f < Fc2 + 2.5 x $BW_{Channel}$ MHz (Note 1)	Not defined
NOTE 1: For BS capable of multi-band operation, the frequency ranges relating to the carriers of all supported bands apply.	

Key:

Fc1: Center frequency of first carrier frequency used by the BS and repeater.

Fc2: Center frequency of last carrier frequency used by the BS and repeater.

$BW_{Channel}$: Channel bandwidth as defined in TS 36.104 [2].

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 8.2.2 for BS and repeater.

Table 8.2.2 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 8.2.2: Maximum measurement uncertainty (BS, and Repeater)

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: 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 8.2.2, 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 8.2.2 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 8.2.2 does not increase the probability of passing an EUT that would otherwise have failed a test if a Test System compliant with Table 8.2.2 had been used.

8.2.2 Radiated emission, Ancillary equipment

This test is applicable to ancillary equipment. This test shall be performed on a representative configuration of the ancillary equipment.

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 [25].

8.2.2.3 Limits

The ancillary equipment shall meet the limits according to CISPR 32 [25] table A.4 and table A.5.

Where there is a step in the relevant limit, the lower value should be applied at the transition frequency, as per CISPR 32 [25].

Table 8.2.2.3-1: Void

Table 8.2.2.3-2: Void

Alternatively, for *ancillary equipment* intended to be used in telecommunication centres only, the class A limits given in CISPR 32 [25] table A.2 and table A.3 shall be used.

8.3 Conducted emission DC power input/output port

This test is applicable to equipment which may have DC cables longer than 3 m.

If the DC power cable of the radio equipment is intended to be less than 3 m in length, and intended only for direct connection to a dedicated AC to DC power supply, then the measurement shall be performed only on the AC power input of that power supply as specified in subclause 8.4.

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

8.3.1 Definition

This test assesses the ability of radio equipment and ancillary equipment to limit internal noise from the DC power input/output ports.

8.3.2 Test method

The test method shall be in accordance with CISPR 32 [25] and the Artificial Mains Network (AMN) shall be connected to a DC power source.

In the case of DC output ports, the ports shall be connected via an AMN to a load drawing the rated current of the source.

A measuring receiver shall be connected to each AMN measurement port in turn and the conducted emission recorded.

The equipment shall be installed with a ground plane as defined in CISPR 32 [25]. The reference earth point of the AMNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of section one of CISPR 16-1-1 [12].

8.3.3 Limits

The equipment shall meet the limits according to CISPR 32 [11] table A.9, which are defined for average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

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

Table 8.3.3-1: Void

8.4 Conducted emissions, AC mains power input/output port

This test is applicable to equipment powered by the AC mains.

This test is not applicable to AC output ports which are connected directly (or via a circuit breaker) to the AC power port of the EUT.

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

8.4.1 Definition

This test assesses the ability of radio equipment and ancillary equipment to limit internal noise from the AC mains power input/output ports.

8.4.2 Test method

The test method shall be in accordance with CISPR 32 [25].

8.4.3 Limits

The equipment shall meet the limits according to CISPR 32 [11] table A.10, which are defined for the average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

For the referred limit values 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.

Table 8.4.3-1: Void

Alternatively, for equipment intended to be used in telecommunication centres the limits given in CISPR 32 [11] table A.9 shall be used.

Table 8.4.3-2: Void

8.5 Harmonic Current emissions (AC mains input port)

The requirements of IEC 61000-3-2 [13] for harmonic current emission apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16 A per phase, IEC 61000-3-12 [14] applies.

8.6 Voltage fluctuations and flicker (AC mains input port)

The requirements of IEC 61000-3-3 [15] for voltage fluctuations and flicker apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16 A per phase, IEC 61000-3-12 [14] applies.

8.7 Telecommunication ports

This test is applicable for radio equipment and/or ancillary equipment for fixed use which have telecommunication ports.

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

8.7.1 Definition

This test assesses the EUT unwanted emission present at the telecommunication ports.

8.7.2 Test method

The test method shall be in accordance with CISPR 32 [25].

The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies (see subclause 4.5) for measurements in the transmit mode of operation.

8.7.3 Limits

The telecommunication ports shall meet the limits according to CISPR 32 [25] shown in Table 8.7.1.

Table 8.7.1: Limits for conducted emissions from telecommunication ports

Frequency range	Voltage limits dB (µV)		Current limits dB (µA)	
MHz	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	84 to 74	74 to 64	40 to 30	30 to 20
0,5 to 30	74	64	30	20
NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz. NOTE 2: The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$ 150/I = 44 dB).				

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in Table 8.7.2 may be used.

Table 8.7.2: Limits for conducted emissions from telecommunication ports of equipment intended for use in telecommunication centres only

Frequency range	Voltage limits dB (µV)		Current limits dB (µA)	
MHz	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	97 to 87	84 to 74	53 to 43	40 to 30
0,5 to 30	87	74	43	30
NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz. NOTE 2: The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN), which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$ 150/I = 44 dB).				

9 Immunity

9.1 Test methods and levels for immunity tests

9.2 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 functional standards;
- the test configuration shall be as close to normal intended use as possible;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of ancillary equipment necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the ancillary equipment, 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;
- Immunity tests on the entire base station shall be performed by establishing communication links at the air interface (e.g. with the mobile simulator) and the S1 interface (e.g. with an EPC simulator) and evaluating the throughput (see Figure 9.2.1);
- Immunity tests shall be performed on both the Uplink and Downlink paths. The tests shall also include both the air interface and S1 interface. Throughput evaluation may be carried out at either interface, where appropriate, and the measurements for the Uplink and Downlink paths may be carried out as a single path looped at either the air interface or S1 interface. In case of looping is used care have to be taken that the throughput information doesn't change due to looping.
- For BS capable of multi-band operation, communication links shall be established in such a way that all operating band(s) are activated during the test according to the applicable test configurations in subclause 4.6. Performance assessment may be done separately for each operating band.

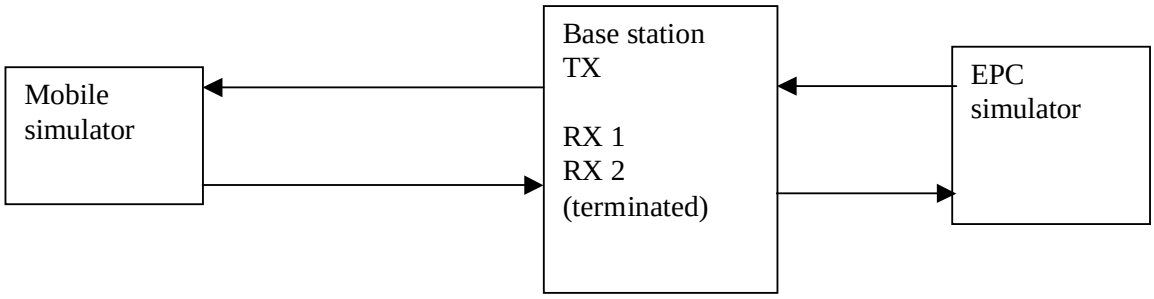

Figure 9.2.1: Communication link set up for BS immunity measurement

9.3 RF electromagnetic field (80 MHz - 6000 MHz)

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

9.3.1 Definition

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

9.3.2 Test method and level

The test method shall be in accordance with IEC 61000-4-3 [17], which specifies test methodology based on anechoic chamber. The use of reverberation chamber test method according to IEC 61000-4-21 [26], clause 6.1 and Annex D as alternative method is allowed.

The following requirements shall apply:

- the test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 1 % of the momentary frequency;
- the test shall be performed over the frequency range 80 MHz - 6000 MHz;
- 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 subclause 4.3;
- the frequencies selected during the test shall be recorded in the test report.

9.3.3 Performance criteria

Base station:

The performance criteria of subclause 6.1 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.3 shall apply.

Repeater:

The performance criteria of subclause 6.5 shall apply.

9.4 Electrostatic discharge

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

9.4.1 Definition

This test assesses the ability of radio equipment and ancillary equipment to operate as intended in the event of an electrostatic discharge.

9.4.2 Test method and level

The test method shall be in accordance with IEC 61000-4-2 [18]:

- for contact discharge, the equipment shall pass at ±4 kV;
- for air discharge shall pass at ±8 kV;

- electrostatic discharge shall be applied to all exposed surfaces of the EUT except where the user documentation specially indicates a requirement for appropriate protective measures.

NOTE: Ensure that the EUT is fully discharged between each ESD exposure.

9.4.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

Repeater:

The performance criteria of subclause 6.6 shall apply.

9.5 Fast transients common mode

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

This test shall be performed on signal ports, telecommunication 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 in DEMC.1 (see table 4.7-1) 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, the associated ancillary equipment, or representative configuration of the combination of radio and ancillary equipment.

9.5.1 Definition

This test assesses the ability of radio equipment and ancillary equipment to operate as intended in the event of fast transients present on one of the input/output ports.

9.5.2 Test method and level

The test method shall be in accordance with IEC 61000-4-4 [19]:

- the test level for signal ports, telecommunication ports and control ports shall be 0,5 kV open circuit voltage as given in IEC 61000-4-4 [19];

- the test level for DC power input/output ports shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [19];

- the test level for AC mains power input ports shall be 1 kV open circuit voltage as given in IEC 61000-4-4 [19].

For AC and DC power input ports the transients shall be applied (in parallel) to all the conductors in the cable with reference to the cabinet reference earth (true common mode) and the source impedance shall be 50 Ω.

9.5.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

Repeater:

The performance criteria of subclause 6.6 shall apply.

9.6 RF common mode (0,15 MHz - 80 MHz)

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

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

Where this test is not carried out on a port or any other ports because the manufacturer declares in DEMC.1 (see table 4.7-1) 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 equipment, the associated ancillary equipment, or representative configuration of the combination of radio and ancillary equipment.

NOTE: This test can also be performed using the clamp injection method, where appropriate, see IEC 61000-4-6 [20].

9.6.1 Definition

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

9.6.2 Test method and level

The test method shall be in accordance with IEC 61000-4-6 [20]:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1% frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- the test level shall be severity level 2 as given in IEC 61000-4-6 [20] corresponding to 3 V rms, at a transfer impedance of 150 Ω;
- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- the injection method to be used shall be selected according to the basic standard IEC 61000-4-6 [20];
- responses of stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see subclause 4.3;
- the frequencies of the immunity test signal selected and used during the test shall be recorded in the test report.

9.6.3 Performance criteria

Base station:

The performance criteria of subclause 6.1 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.3 shall apply.

Repeater:

The performance criteria of subclause 6.5 shall apply.

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 equipment, the associated ancillary equipment, or representative configuration of the combination of radio and ancillary equipment.

9.7.1 Definition

These tests assess the ability of radio equipment and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.7.2 Test method and level

The following requirements shall apply.

The test method shall be in accordance with IEC 61000-4-11 [21].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms;
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms;
- a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms.

9.7.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the performance criteria for transient phenomena shall be applied:

- Criteria 6.2 for base station
- Criteria 6.4 for ancillary equipment
- Criteria 6.6 for repeater

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms and/or a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms, the following applies:

1. In the case where the equipment is fitted with or connected to a battery back-up, the following performance criteria shall be applied:
   - Criteria 6.2 for base station
   - Criteria 6.4 for ancillary equipment
   - Criteria 6.6 for repeater
2. In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator:
   - No unintentional responses shall occur at the end of the test
   - In the event of loss of communications link or in the event of loss of user data, this fact shall be recorded in the test report

9.8 Surges, common and differential mode

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

This test shall be additionally performed on telecommunication ports.

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

9.8.1 Definition

These tests assess the ability of radio equipment and ancillary equipment to operate as intended in the event of surges being present at the AC mains power input ports and telecommunication ports.

9.8.2 Test method and level

The test method shall be in accordance with IEC 61000-4-5 [22].

The requirements and evaluation of test results given in clause 9.8.2.1 (telecommunication ports, outdoor cables), clause 9.8.2.2 (telecommunication ports, indoor cables) and clause 9.8.2.3 (AC power ports) shall apply, but no test shall be required where normal functioning cannot be achieved, because of the impact of the CDN on the EUT.

9.8.2.1 Test method for telecommunication ports directly connected to outdoor cables

The test level for telecommunications ports, intended to be directly connected to the telecommunications network via outdoor cables, shall be 1 kV line to ground as given in IEC 61000-4-5 [22], however, in telecommunications centres 0,5 kV line to ground shall be used. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [22].

The test generator shall provide the 1,2/50 μs pulse as defined in IEC 61000-4-5 [22].

9.8.2.2 Test method for telecommunication ports connected to indoor cables

The test level for telecommunication ports, intended to be connected to indoor cables (longer than 10 m) shall be 0,5 kV line to ground. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [22].

The test generator shall provide the 1,2/50 μs pulse as defined in IEC 61000-4-5 [22].

9.8.2.3 Test method for AC power ports

The test level for AC power input ports shall be 2 kV line to ground, and 1 kV line to line, with the output impedance of the surge generator as given in IEC 61000-4-5 [22].

In telecommunication centres 1 kV line to ground and 0,5 kV line to line shall be used.

The test generator shall provide the 1,2/50 μs pulse as defined in IEC 61000-4-5 [22].

9.8.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

Repeater:

The performance criteria of subclause 6.6 shall apply.

Annex A (informative): Change history

Table A-1. Change History

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2007-10	RAN4#45	R4-071911				TS skeleton created from 3GPP TS template.	0.0.1
2008-02	RAN4#46	R4-080456				The following text proposals are included: R4-080064, R4-080065, R4-080068, R4-080070, R4-080071, R4-080072, R4-080442, R4-080443, R4-080445.	0.1.0
2008-03	RAN #39	RP-080129				Specification presented for approval	8.0.0
2008-05	RAN #40	RP-080325	001	1		EMC for BS equipment divided into more than one cabinet	8.1.0
2009-05	RAN #44	RP-090559	002			Introduction of Extended LTE800 requirements	9.0.0
2009-12	RAN #46	RP-091286	003			Introduction of Extended LTE1500 requirements for TS36.113 (Technically endorsed at RAN 4 52bis in R4-093634)	9.1.0
2009-12	RAN #46	RP-091271	005			BS emission applicability correction (Technically endorsed at RAN 4 52bis in R4-093641)	9.1.0
2009-12	RAN #46	RP-091284	006			Introduction of EU 800 MHz band in TS 36.113 (Technically endorsed at RAN 4 52bis in R4-093642)	9.1.0
2010-09	RP-49	RP-100923	010			Clarification of radiated emissions requirement	9.2.0
2010-09	RP-49	RP-100927	009			CR LTE_TDD_2600_US spectrum band definition additions for BS to TS 36.113	10.0.0
2010-12	RP-50	RP-101327	020			Band 12 channel arrangement correction on 36.113	10.1.0
2010-12	RP-50	RP-101356	013	1		Band 42 and 43 parameters for UMTS/LTE 3500 (TDD) for TS 36.113	10.1.0
2010-12	RP-50	RP-101361	011			Introduction of L-band in TS36.113	10.1.0
2011-04	RP-51	RP-110344	026	-		Applicability of EMC requirements	10.2.0
2011-06	RP-52	RP-110804	017	2		Add Expanded 1900 MHz Band (Band 25) in 36.113	10.3.0
2011-06	RP-52	RP-110812	027	1		Add 2GHz S-Band (Band 23) in 36.113	10.3.0
2011-09	RP-53	RP-111255	028			Add Band 22/XXII for LTE/UMTS 3500 (FDD) to TS 36.113	10.4.0
2012-03	RP-55	RP-120305	030			Upper Extended 850 MHz addition to 36.113	11.0.0
2012-06	RP-56	RP-120769	035			Applicability of EMC requirements	11.1.0
2012-06	RP-56	RP-120793	036			Introduction of APAC700(FDD) into TS 36.113	11.1.0
2012-06	RP-56	RP-120793	037			Introduction of APAC700(TDD) into TS 36.113	11.1.0
2012-06	RP-56	RP-120791	038			Introduction of e850_LB (Band 27) to TS 36.113	11.1.0
2012-12	RP-58	RP-121901	039	1		Introduction of Band 29 into TS 36.113	11.2.0
2013-06	RP-60	RP-130792	040			Introduction of Band 30 in TS 36.113	12.0.0
2013-06	RP-60	RP-130790	041			Introduction of LTE 450 into TS 36.113	12.0.0
2014-06	RP-64	RP-140926	045			Introduction of Band 32 in TS 36.113	12.1.0
09-2014	RP-65	RP-141562	048	1		Update of definitions to support supplemental DL in TS36.113	12.2.0
12-2014	RP-66	RP-142146	050			EMC testing of multi-band operation for MSR BS	12.3.0
12-2015	RP-70	RP-152172	051			Introduction of Band 66	13.0.0
12-2015	RP-70	RP-152157	052			Introduction of Band 67	13.0.0
12-2015	RP-70	RP-152171	053			Introduction of Band 65 to TS 36.113	13.0.0
12-2015	RP-70	RP-152173	054			Introduction of 1447-1467MHz Band into 36.113	13.0.0
03/2016	RP-71	RP-160483	0055		B	Introduction of Band 68 into 36.113	13.1.0
03/2016	RP-71	RP-160490	0056		F	Introduction of Band 46 in TS 36.113	13.1.0
03/2016	RP-71					Correction of the Change History table	13.1.1
06/2016	RP-72	RP-161142	59	1	F	Clarification in EMC environmental conditions references	13.2.0
06/2016	RP-72	RP-161125	57	-	B	Introduction of Band 70	14.0.0
06/2016	RP-72	RP-161124	60	-	B	CR to 36.113 on receiver exclusion band update due to Band 69	14.0.0
12/2016	RP-74	RP-162456	0062	1	A	CR for 36.113: Introduction of NB-IoT	14.1.0
12/2016	RP-74	RP-162405	0063		B	Introduction of Band 48	14.1.0
03/2017	RP-75	RP-170553	0064		B	CR on eLAA BS for TS 36.113	14.2.0
09/2017	RP-77	RP-171948	0066		B	Introduction of the FDD L-band (Band 74) into TS 36.113	15.0.0
09/2017	RP-77	RP-171952	0067		B	CR to 36.113: Introduction of Band 71	15.0.0
09/2017	RP-77	RP-171946	0069		B	Introduction of Band 72 into TS36.113	15.0.0
09/2017	RP-77	RP-171950	0070	1	B	Introduction of SDL L-band into TS 36.113	15.0.0
09/2017	RP-77	RP-171949	0071	1	B	Introduction of TDD L-band into TS 36.113	15.0.0
12/2017	RP-78	RP-172593	0072	-	B	Introduction of Band 73 into TS 36.113	15.1.0
12/2017	RP-78	RP-172594	0073	-	B	CR to 36.113: Introduction of Band 49	15.1.0
2018-03	RAN#79	RP-180279	0074	-	B	CR to 36.113: Introduction of Band 85 (B12-extended)	15.2.0
2018-03	RAN#79	RP-180282	0075	1	F	CR to TS 36.113: correction of the CISPR reference and ESD levels	15.2.0
2018-03	RAN#79	RP-180278	0076	-	F	Introduction of TDD 3.3-3.4GHz band (band 52)	15.2.0
2018-12	RAN#82	RP-182388	0077	2	F	CR to TS 36.113 (subclause 2 and 8.4.2)	15.3.0
2018-12	RAN#82	RP-182376	0078		B	CR to 36.113: Introduction of Band 53	16.0.0
2019-06	RAN#84	RP-191256	0079		B	CR to 36.113: Introduction of Band 87 and 88	16.1.0

2019-09	RAN#85	RP-192056	0081		A	CR to TS 36.113: correction of Rx exclusion band into equation-based approach, Rel 16	16.2.0
2022-03	SA#95					Update to Rel-17 version (MCC)	17.0.0
2023-03	RAN#99	RP-230505	0086		A	TS 36.113: Corrections in clause 2 References and clause 9 Immunity	17.1.0
2023-12	RAN#102	RP-233334	0091		A	CR to TS 36.113 on adding link between telecommunication port and wired network port	17.2.0

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2023-12	RAN#102	RP-233360	0092	1	F	[LTE-RF, TEI18] CR to TS 36.113: framework for the EMC-specific manufacturer's declarations, Rel-18	18.0.0
2024-03	RAN#103	RP-240556	0096		A	(LTE-RF) CR to TS 36.113: clarification on the limit value for the step frequency case, Rel-18	18.1.0
2024-03	RAN#103	RP-240557	0099		A	(NB_IOT, LTE_3550_CBRS_US_LAA-Core) CR to TS 36.113 on update of FRC used in performance criteria	18.1.0

History

Document history		
V18.1.0	May 2024	Publication