

# ETSI TS 136 113 V17.1.0 (2023-04)



**LTE;  
Evolved Universal Terrestrial Radio Access (E-UTRA);  
Base Station (BS) and repeater  
ElectroMagnetic Compatibility (EMC)  
(3GPP TS 36.113 version 17.1.0 Release 17)**

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**Reference**

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# Foreword

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# 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 stations 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] and IEC 61000-6-3 [7].

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

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# 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 61000-6-3:2006/AMD1:2010: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light industrial 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  $\leq 16$  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  $\leq 75$  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  $\leq 16$  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  $\leq 75$  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".

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## 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.

**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)).

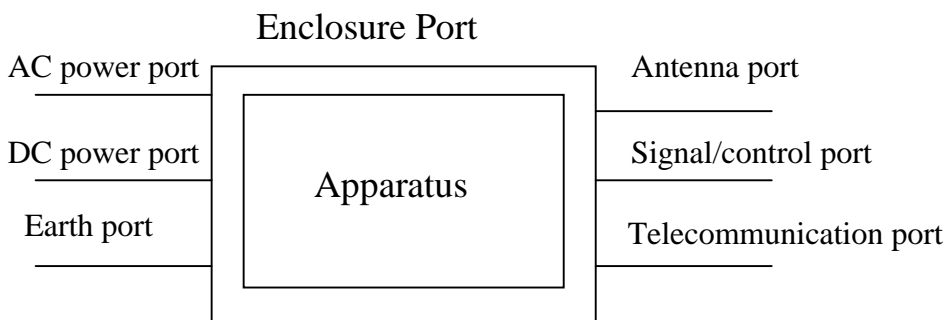


Figure 3.1.1: Examples of ports

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BS Equipment

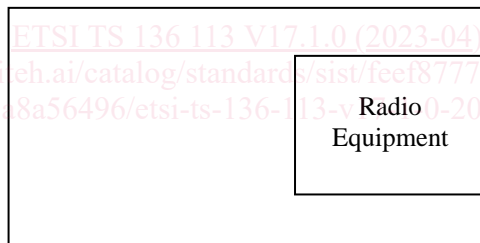


Figure 3.1.2: BS with single enclosure solution

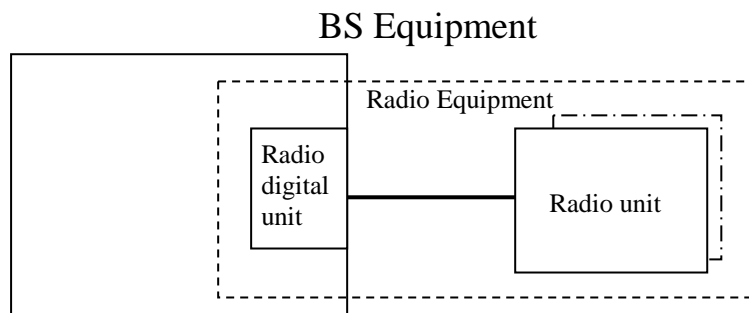


Figure 3.1.3: BS with multiple enclosure solution

## 3.2 Symbols

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

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

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## 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  $2 \times BW_{\text{Channel}}$  MHz, where  $BW_{\text{Channel}}$  is the channel bandwidth as defined in TS 36.104 [2];
- if the deviation disappears in either or both of the above  $2 \times BW_{\text{Channel}}$  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  $2.5 \times BW_{\text{Channel}}$  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. The test