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TECHNICAL SPECIFICATION

**LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Electromagnetic compatibility (EMC)
requirements for mobile terminals and ancillary equipment
(3GPP TS 36.124 version 16.3.0 Release 16)**

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Foreword

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1 Scope

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

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

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

The present document specifies the applicable EMC tests, the methods of measurement, the frequency range, the limits and the minimum performance criteria for all types of E-UTRA UE's and their accessories. E-UTRA base station equipment operating within network infrastructure is outside the scope of the present document. However, the present document does cover mobile and portable equipment that is intended to be operated in a fixed location while connected to the AC mains. E-UTRA base stations in the radio access network are covered by the technical specification TS36.113 [2].

Requirements for the radiated emission from the enclosure port of integral antenna equipment and ancillaries have been included. Technical specifications for conducted emissions from the antenna connector are found in the 3GPP specifications for the radio interface, e.g. TS36.521 [3], for the effective use of the radio spectrum.

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

The environment classification used in the present document refers to the environment classification used in the Generic Standards IEC 61000-6-1 [4], IEC 61000-6-3 [5], except the vehicular environment class which refers to ISO 7637 Part 1 [6] and Part 2 [7].

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

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

2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific;
- for a specific reference, subsequent revisions do not apply;
- for a non-specific reference, subsequent revisions do apply. 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 25.990: "Vocabulary for UTRAN".
3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 36.113: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base station and repeater electromagnetic compatibility (EMC)".
- [3] 3GPP TS 36.521: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); User Equipment (UE) conformance specification Radio transmission and reception".

- [4] IEC 61000-6-1 (1997): "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity standard for residential, commercial and light-industrial environments".
- [5] IEC 61000-6-3 (1996): "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments.
- [6] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [7] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [8] IEC 60050(161): "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility".
- [9] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".
- [10] IEC CISPR publication 22: "Information technology equipment; Radio disturbance characteristics - Limits and methods of measurement".
- [11] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (FDD)".
- [12] 3GPP TS 36.508: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Common test environments for User Equipment (UE) conformance testing".
- [13] 3GPP TS 36.523: " Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); User Equipment (UE) conformance specification".
- [14] IEC CISPR publication 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods".
- [15] IEC 61000-3-2; (2000): "Electromagnetic compatibility; Part 3 - Limits; section 2 - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)"; Am.1 (1997-09)".
- [16] IEC 61000-3-3; (19952): "Electromagnetic compatibility; Part 3 - Limits; section 2 - Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A"
- [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 - Basic EMC publication".
- [19] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 4: Electrical fast transient/burst immunity test - Basic EMC publication".
- [20] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - section 6: immunity to conducted 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 test".
- [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 36.509: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Terminal logical test interface; Special conformance testing functions".
- [25] ETSI ETR 027 (1991): "Radio Equipment and Systems (RES); Methods of measurement for private mobile radio equipment".
- [26] ITU-T Recommendation P.64: "Telephone transmission quality, Telephone installations, Local line networks, Objective electro-acoustical measurements. Determination of sensitivity/frequency characteristics of local telephone systems".
- [27] ITU-T Recommendation P.76: "Telephone transmission quality, Measurements related to speech loudness, Determination of loudness ratings; Fundamental principles, Annex A".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

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

- the equipment is intended for use in conjunction with a UE to provide additional operational and/or control features to the UE, (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a UE; and
- the UE to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

Average power: The average transmitter output power obtained over any specified time interval, including periods with no transmission, when the transmit time slots are at the maximum power setting.

Camped on a cell: The UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information. Note that the services may be limited, and that the PLMN may not be aware of the existence of the UE within the chosen cell.

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]).

Data application ancillary: Ancillary which provides send and/or receive data access to UMTS services via UE.

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

End- User data: Manufacturer defined data patterns for data transfer testing. Represents EUT's typical user application (e.g. photo, video, text file, message) in its characteristics.

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

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

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

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

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

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

Port: 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 1).

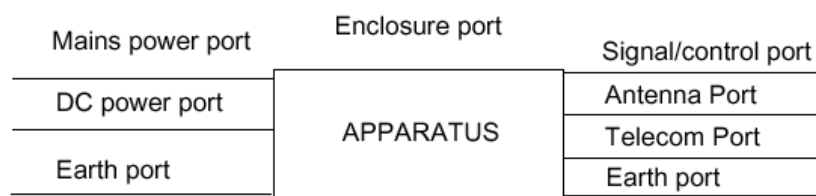


Figure 1: Examples of ports

Spurious emission from ITU-R SM 329 [9]: Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

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 (see CISPR 22 [10]).

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])

Traffic mode: Is the state of User Equipment (UE) when switched on and with Radio Resource Control (RRC) connection established.

Universal mobile telecommunications system (UMTS): The telecommunications system, incorporating mobile cellular and other functionality, that is the subject of specifications produced by 3GPP

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

3.2 Symbols

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

BW_{Channel} Channel bandwidth

3.3 Abbreviations

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

| | |
|------|--|
| AC | Alternating Current |
| BCCH | Broadcast Control Channel *) |
| BS | Base Station |
| BSS | Base Station System |
| BTS | Base Transceiver Station |
| CCCH | Common Control Channel *) |
| CW | Continuous Wave (unmodulated carrier wave) |
| DC | Direct Current |

| | |
|--------|--|
| DL | Down Link (From BTS to UE) |
| DTX | Discontinuous Transmission *) |
| EMC | Electromagnetic Compatibility |
| EPC | Evolved Packet Core |
| ESD | ElectroStatic Discharge |
| EUT | Equipment Under Test (UE or UE with ancillaries) |
| FDD | Frequency Division Duplex |
| FRC | Fixed Reference Channel |
| LISN | Line Impedance Stabilizing Network |
| MRP | Mouth Reference Point (artificial head) |
| PCCPCH | Primary Common Control Physical Channel |
| RF | Radio Frequency |
| rms | root mean square |
| RRC | Radio Resource Control |
| SPL | Sound Pressure Level |
| TCH | Traffic channel |
| TDD | Time Division Duplex |
| UARFCN | UTRA Absolute Radio Frequency Channel Number *) |
| UE | User Equipment |
| UL | Up Link (From UE to BTS) |
| UMTS | Universal Mobile Telecommunication System |
| UTRA | Universal Terrestrial Radio Access network |

*) refer to Terminology specifications TS 21.905 and TS 25.990 [1] for further details.

4 Test conditions

4.1 General

The equipment shall be tested under normal test conditions according to the relevant product and basic standards (See Annex E of TS 36.101 [11] for environmental conditions). If these conditions are not specified then the manufacturers declared range of humidity, temperature and supply voltage shall be used. The test conditions shall be recorded in the test report.

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

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

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

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 base station simulator (hereafter called "the test system"). The test system shall be located outside of the test environment

When the EUT is required to be in the traffic mode, a call is set up according to the Generic call set-up procedure and the following conditions shall be met:

See TS 36.508 [12] and TS 36.509 [24] for details regarding generic call set-up procedure and throughput test loop scenarios.

- Set and send continuously positive TPC commands to the UE;

- the DTX shall be disabled;
- uplink power control shall be enabled;
- transmitting and/or receiving (UL/DL) bit rate for reference test channel shall be the reference measurement channel as specified in Annex C in TS 36.101 [11] with parameters specified in Table 7.3.1-1 and Table 7.3.1-2 in TS 36.101 [11];
- adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- for immunity testing, the wanted input signal level shall be set to 40 dB above the reference sensitivity level to provide a stable communication link. The reference sensitivity level is defined in TS 36.101 [11];
- for emission testing, the wanted input signal level shall be no more than 15 dB above the reference sensitivity level, such that the performance of the measuring receiver is not limited by strong signal effects.

When the EUT is required to be in the idle mode, the following conditions shall be met:

- UE shall be camped on a cell
- UE shall perform Location Registration (LR) before the test, but not during the test;
- UE's neighbour cell list shall be empty;
- Paging repetition period and DRX cycle shall be set to minimum (shortest possible time interval);

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

4.3 Narrow band responses on receivers

Responses on receivers or duplex transceivers occurring during the test at discrete frequencies, which are narrow band responses (spurious responses), are identified by the following method:

- If during an immunity test the quantity being monitored goes outside the specified tolerances, it is necessary to establish whether the deviation is due to an unwanted effect on the receiver of the UE or on the test system (narrow band response) or to a wide band (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency increased or decreased by BW_{Channel} MHz, where BW_{Channel} is the channel bandwidth as defined in TS 36.101 [11];
- if the deviation does not disappear, the procedure is repeated the unwanted signal frequency increased or decreased by $2 \times BW_{\text{Channel}}$ MHz, where BW_{Channel} is the channel bandwidth as defined in TS 36.101 [11];
- if the deviation does not disappear with the increased and/or decreased frequency, the phenomenon is considered wide band and therefore an EMC problem and the equipment fails the test.

Narrow band responses are disregarded.

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

4.4 Receiver exclusion band

The receiver exclusion band for terminals extends from the lower frequency of the allocated receiver band minus 85 MHz to the upper frequency of the allocated receiver band plus 85 MHz. The *receiver exclusion band* for UE is the frequency range over which no tests of radiated immunity of a receiver are made. The exclusions bands are as set out below:

$$F_{\text{DL,low}} - 85 < f < F_{\text{DL,high}} + 85 \text{ (MHz)}$$

Where values of $F_{\text{DL,low}}$ and $F_{\text{DL,high}}$ are defined for each operating band in TS 36.101 [11], clause 5.5.