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**Requirements and measurement methods of
electromagnetic compatibility for cellular mobile
telecommunications equipment - Part 14: LTE user
equipment and ancillary equipment**

蜂窝式移动通信设备电磁兼容性能要求和测量方法

第 14 部分：LTE 用户设备及其辅助设备

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Table of Contents

Foreword.....	4
1 Scope	6
2 Normative references	6
3 Terms, definitions and abbreviations	8
3.1 Terms and definitions	8
3.2 Abbreviations	12
4 Test conditions	14
4.1 General conditions.....	14
4.2 Test arrangement.....	14
4.3 Narrowband response of the receiver	16
4.4 Frequency band free from test.....	17
5 Performance evaluation method.....	17
5.1 General.....	17
5.2 EUT which can establish continuous communication connections.....	18
5.3 EUT which cannot establish continuous communication connections	18
5.4 EUT (packet data/transmission) which can only provide discontinuous communication link.....	18
5.5 Method of evaluating the ancillary equipment applicability	18
5.6 EUT classification	19
6 Performance criteria	19
6.1 General.....	19
6.2 Performance criteria A (continuous phenomena).....	20
6.3 Performance criteria B (transient phenomena)	20
6.4 Performance criteria c (intermittent phenomenon)	20
7 Applicability	21
7.1 Disturbance measurement	21
7.2 Immunity test	21
8 Disturbance measurement methods and limits.....	22
8.1 Radiation spurious (enclosure port).....	22
8.2 Radiation continuous disturbance (enclosure port of ancillary equipment)	23
8.3 Conduction continuous disturbance (DC power input/output port)	24
8.4 Conduction continuous disturbance (AC power input/output port).....	25
8.5 Conduction continuous disturbance (telecommunication port).....	26
8.6 Harmonic current (AC power input port)	26
8.7 Voltage fluctuation and flicker (AC power input port)	26
8.8 Transient conduction disturbance (DC power input/output port)	27
9 Methods and levels of immunity test	27

9.1 Radiation disturbance immunity test (80MHz ~ 2700MHz).....	27
9.2 Electrostatic discharge immunity test	28
9.3 Electrical fast transient burst immunity test	28
9.4 Conduction disturbance immunity of radio frequency field induction (0.15MHz ~ 80MHz).....	29
9.5 Transient and surge immunity test (on-board environment).....	30
9.6 Voltage dip and short interruption immunity test.....	31
9.7 Surge (impulse) immunity test	32
9.8 Power frequency magnetic field immunity test.....	33
Appendix A (Normative) Performance test method for voice call - Audio breakthrough.....	34
Appendix B (Normative) Performance test for data transmission - Throughput percentage.....	37

Foreword

This part is part 14 of the standard series of “Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment”. AND this standard series include the following parts:

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 1: General requirements for base stations and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 2: General requirements for user equipment and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 3: Multi-system base stations and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 4: Multimode terminals and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 5: 900/1800MHz TDMA base station and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 6: 900/1800MHz TDMA user equipment and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 7: 2GHz TD-SCDMA base station and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 8: 2GHz TD-WCDMA user equipment and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 9: 2GHz WCDMA base station and ancillary equipment

Requirements and measurement methods of electromagnetic compatibility for cellular mobile telecommunications equipment - Part 14: LTE user equipment and ancillary equipment

1 Scope

This part specifies the electromagnetic compatibility requirements of the LTE digital mobile communication system user equipment and ancillary equipment, including limits, performance criteria and measurement methods.

This part applies to the user equipment and ancillary equipment of LTE digital mobile communication system.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this Standard.

GB 9254-2008 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement

GB 17625.1 Electromagnetic compatibility - Limits - Limits for harmonic current emissions (equipment input current $\leq 16\text{A}$ per phase)

GB 17625.2 Electromagnetic compatibility - Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16\text{A}$ per phase

GB/T 17626.2 Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test

GB/T 17626.3 Electromagnetic compatibility - Testing and measurement techniques - Radiated radio frequency electromagnetic field immunity test

GB/T 17626.4 Electromagnetic compatibility - Testing and measurement techniques - Electrical fast transient/burst immunity test

GB/T 17626.5 Electromagnetic compatibility - Testing and measurement techniques - Surge immunity test

GB/T 17626.6 Electromagnetic compatibility - Testing and measurement techniques - Immunity to conducted disturbances induced by radio-frequency fields

GB/T 17626.8 Electromagnetic compatibility - Testing and measurement techniques - Power frequency magnetic field immunity test

GB/T 17626.11 Electromagnetic compatibility - Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests

GB/T 17626.29 Electromagnetic compatibility - Testing and measurement techniques - Voltage dips short interruptions and voltage variations on DC input power port immunity tests

GB/T 21437.2 Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only

GB/T 22451 Common requirements of electromagnetic compatibility for radio communication equipment

GB/T 6113.104-2008 Radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Radiated disturbance measuring antenna and test site

YD/T 1483 Technical requirement and measurement method for spurious emission of radio equipment

YD/T 1484 Measurement method for radiated RF power and receiver performance of mobile stations

3GPP TS 36.101 Evolved universal terrestrial radio access (E-UTRA); User equipment (UE) radio transmission and reception

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

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

services, the public land mobile network (PLMN) may not be able to aware of the presence of the user equipment.

3.1.4

Channel bandwidth

It refers to the transmission bandwidth in the cellular uplink and downlink which is configured with E-UTRA single carrier. The unit of the channel bandwidth is MHz, which provides a reference for the radio equipment of the transmitter and the receiver.

3.1.5

Continuous disturbance

It refers to the electromagnetic interference having an effect on certain equipment which cannot be clearly differentiated as a series of effect.

3.1.6

Data application ancillary

It refers to the ancillary equipment which accesses the universal mobile telecommunication system (UMTS) via the user equipment, thus providing the transmitting and receiving data.

3.1.7

Enclosure port

It refers to the physical boundary through which the electromagnetic field radiates or invades. The physical boundaries of the plugins are defined by the host unit.

3.1.8

Host equipment

It refers to any equipment which can realize functions completely without connecting to the wireless communication equipment. AND the wireless communication device only provides additional functionality.

3.1.9

End-user data

Necessary bandwidth

It refers to, for certain radiations, the frequency bandwidth required to guarantee the information transmission rate AND satisfy the quality requirements under the particular situation.

3.1.15

Out of band emissions

It refers to the additional radiation of a single frequency or multiple frequencies outside the necessary bandwidth as generated in the modulation process, excluding spurious emissions.

Note: Radiation having a distance to the center frequency less than 250% of the necessary bandwidth is referred to as out of band emission.

3.1.16

Spurious emission

It refers to the disturbance on the single frequency or multiple frequencies outside the necessary bandwidth, which can be divided into conduction and radiation.

3.1.17

Telecommunication port

It refers to the port through which the equipment is directly connected to the telecommunication network.

3.1.18

Throughput

It refers to the valid data bits that can be successfully received per second by a reference test channel in a specific environment.

3.1.19

Transient phenomena

It refers to the disturbance within a short time interval, which cannot be differentiated into two consecutive steady states.

3.1.20

4 Test conditions

4.1 General conditions

The equipment under test shall be tested in a normal test environment. If the test conditions are uncertain, the manufacturer shall provide information on the humidity, temperature and supply voltage of the equipment under test. These test conditions shall be documented in the test report.

When the antenna of the equipment under test is detachable, unless otherwise specified, it shall install the antenna in accordance with the method of normal use to conduct test.

The test arrangement shall be as close as possible to normal or typical actual operating conditions.

If the EUT is part of the system OR connected to the ancillary equipment, then during the test, the EUT shall be connected to the ancillary equipment of the smallest typical configuration, AND the port as connected to the ancillary device must be activated.

The work mode and configuration in the test process shall be accurately recorded in the test report.

If the equipment has a large number of ports, it must pick a sufficient number of ports to ensure that it can simulate the actual situation AND different types of ports can be tested.

Before test, the EUT shall be in the maximum power emission status AND its maximum total radiated power value is determined. The test method is as shown in YD/T 1484 AND the test results are recorded in the test report.

4.2 Test arrangement

The radio frequency input signal frequency shall be selected from the appropriate E-UTRA absolute radio frequency channel number.

It may select an appropriate base station simulator (also referred to herein as a test system) to establish a communication link. The base station simulator shall be placed outside the test environment.

The relevant information on the general call establishment process AND the throughput test loop plan is detailed in Appendix B.

- If the equipment has many ports, it shall select a number of ports to simulate the actual operating environment to satisfy all terminals of different types;
- Test conditions, test configurations and operating modes shall be recorded in the test report;
- The port in normal operation mode shall also be connected to ancillary equipment or typical cable to simulate the input and output characteristics of the ancillary equipment. AND the radio frequency input and output ports shall also be tested as terminals.
- A port that does not have a connecting cable in the operation mode of the service connector, programming connector, and temporary connector, etc. cannot be connected to other cables for EMC testing. These ports shall be connected to cables or the extended interconnection cables to test the equipment, AND it shall also take precautions to ensure that the assessment values of the equipment under test are not interfered with by these additional extension cables;
- DESCRIBE respectively the test methods of the transmitter and receiver. However, in actual test, the transmitter and receiver of the equipment under test may be tested at the same time to save time.

The immunity will be tested in the following two modes:

- The mode of establishing the communication link (service mode);
- Idle mode.

The immunity test will relate to the contents of part 4.3, AND the test conditions are described below.

4.3 Narrowband response of the receiver

The narrowband response as generated by the receiver/transceiver during the discrete frequency test process shall be determined by the following method:

- In the immunity test, the narrowband response and broadband phenomena of the user equipment receiver or test system are likely to cause disqualification of the equipment under test. In this case, it is necessary to make further judgment; therefore, the test frequency will be offset by 1 times the channel bandwidth to repeat the test;

- The general information on ancillary equipment working together with the equipment under test;
- The humidity, temperature and voltage range which is bearable by the equipment under test;

5.2 EUT which can establish continuous communication connections

It is same as the clause 5.2 of GB/T 22451.2008.

The test arrangement conditions and signals as defined in chapter 4 apply to the equipment under test AND the equipment under test to which ancillary equipment is added for the purposes of establishing the communication link. The equipment performance test based on voice calls and data transfers are detailed in Chapter 6.

5.3 EUT which cannot establish continuous communication connections

It is same as the clause 5.3 of GB/T 22451.2008.

5.4 EUT (packet data/transmission) which can only provide discontinuous communication link

If in the EMC test, the EUT cannot establish and maintain a communication link, the manufacturer needs to define the performance evaluation method. Manufacturers also need to provide a way to observe EUT performance degradation.

5.5 Method of evaluating the ancillary equipment applicability

It is same as the clause 5.4 of GB/T 22451.2008.

The ancillary equipment connected to the EUT shall be tested. If the ancillary equipment must be used in conjunction with the EUT, the ancillary equipment shall be tested in conjunction with the EUT.

6.2 Performance criteria A (continuous phenomena)

The communication link shall be established before the test, AND the communication connection shall be maintained during the test.

In the data transmission mode, the throughput shall reach 95% of the maximum throughput of the reference test channel.

For voice services, when measured by an audio bandpass filter (BPF) with a center frequency of 1kHz and a bandwidth of 200Hz, the speech output levels of the uplink and downlink shall be at least 35dB lower than the recorded reference level

Note: When the background noise is high, the bandwidth of the filter can be reduced to 40Hz minimum.

After the test, the equipment under test shall be able to work properly without loss of user control functions or loss of stored data, AND to maintain communication connections.

In addition to confirming the above performance in the business mode, the test shall also be carried out in the idle mode. The transmitter shall not be misused during the test.

6.3 Performance criteria B (transient phenomena)

It shall establish the communication link before the test.

After the test, the user equipment shall not have any communication quality degradation in the communication process which is sensible by the user.

If the entire test consists of a series of small tests, after the test, the equipment under test shall be free of loss of user control function OR loss of stored data, AND the communication connection can be maintained.

In addition to confirming the above performance in the business mode, the test shall also be carried out in the idle mode. AND the transmitter shall not be misused during the test.

6.4 Performance criteria c (intermittent phenomenon)

In the test, the performance can be degraded AND the function can be lost; BUT the EUT transmitter in the idle state shall not be misused.

- d) If the receiver or receiver as part of the transceiver is a narrowband response at a discrete frequency point, this response can be ignored:
- e) The frequency of the narrowband response shall be recorded in the test report.

9.1.2 Performance criteria

Performance criteria A of the clause 6 in this part apply to these terms.

9.2 Electrostatic discharge immunity test

9.2.1 Test methods and levels

The test method shall be in accordance with GB/T 17626.2.

It shall comply with the following requirements:

For contact discharge, the equipment shall be able to pass the $\pm 2\text{kV}$ and $\pm 4\text{kV}$ test levels;

For air discharge, the equipment shall be able to pass the $\pm 2\text{kV}$, $\pm 4\text{kV}$ and $\pm 8\text{kV}$ test levels.

9.2.2 Performance criteria

Performance criteria B of the clause 6.3 in this part apply to these terms.

9.3 Electrical fast transient burst immunity test

9.3.1 Test methods and levels

If the connection cables of the AC power port, signal/communication/control port and DC power port of the fixed station and the ancillary equipment exceed 3m, it shall be subjected to this test item.

The manufacturer may declare that certain ports are not tested when using cables longer than 3m, AND these ports and the reasons for free of test shall be recorded in the test report.

Measurements shall be made in a typical configuration of the equipment under test OR in a typical configuration where the equipment under test and the ancillary equipment are combined.

The test method shall be in accordance with GB/T 17626.4, subject to the following requirements:

- a) The test level of the signal/communication/control port is open circuit voltage 0.5kV;
- b) The test level of the DC power input/output port is open circuit voltage 1kV;
- c) The test level of the AC power input port is open circuit voltage 1kV.

9.3.2 Performance criteria

The performance criterion B of clause 6.3 applies to these terms.

9.4 Conduction disturbance immunity of radio frequency field induction (0.15MHz ~ 80MHz)

9.4.1 Test methods and levels

This test item shall be carried out when the connection cable of the AC power port, signal/telecommunication/control port and DC power port of the fixed station, on-board equipment, and ancillary equipment is more than 3m.

The test shall be carried out in accordance with GB/T 17626.6 AND shall comply with the following requirements:

- a) It is preferable to select CDN injection method for the test; AND if the injection method is not applicable, it shall use the clamp injection method (electromagnetic clamp or current clamp)
- b) The test signal is subjected to 80% amplitude modulated by a 1kHz audio signal;
- c) In the frequency range of 150 kHz ~ 80 MHz, the step of frequency does not exceed 1% of the previous frequency;
- d) The test level is 3Vrms.

9.4.2 Performance criteria

The performance criteria A of clause 6.2 apply to these terms.

9.6 Voltage dip and short interruption immunity test

9.6.1 Test methods and levels

9.6.1.1 AC power test method and level

The test is carried out in accordance with GB/T 17626.11.

The test level of the voltage dip immunity is:

- a) The supply voltage drops by 100%, with the duration of 10ms;
- b) The supply voltage drops by 100%, with the duration of 20ms;
- c) The supply voltage drops by 30%, with the duration of 500ms;

The test level of voltage short-term interruption immunity is:

Supply voltage drops by 100%, with the duration of 5s.

9.6.1.2 DC power supply test method and level

The test is carried out in accordance with GB/T 17626.29. If the EUT has a backup power supply or a dual power supply, it shall be tested under the conditions that the backup power supply or dual power supply is in operation.

The test grade is as shown in clause 9.7.2.2.

9.6.2 Performance criteria

9.6.2.1 AC power performance criteria

For the voltage dip of voltage reduction of 100% for the duration of 10ms, the voltage reduction of 100% for the duration of 20ms AND the voltage reduction of 30% for the duration of 500ms, the performance criteria B of clause 6.3 in this part applies to this clause. If the communication link interruption or user data loss occurs, it shall be recorded in the test report.

For voltage interruption of the voltage reduction of 100% for the duration of 5s, it shall use the following performance criteria:

- a) If the UE is equipped with a backup battery or connected to a backup battery, the performance criterion B of the clause 6.3 in this part applies to this clause;

The test method shall be in accordance with GB/T 17626.5. AND it shall comply with the following requirements:

- a) For the AC power port, the test level shall be 2kV (wire to ground) and 1kV (wire to wire).
- b) For the telecommunication ports connected directly to the outdoor cable, the test level shall be 1 kV (wire to ground); BUT if the EUT is the telecommunication center equipment, the test level shall be 0.5kV (wire to ground); for the telecommunication port which is connected to the indoor cable AND the connection cable length is more than 10m, the test level shall be 0.5kV (wire to ground).
- c) The test level on the DC power supply line shall be 1kV (wire to ground) and 0.5kV (wire to wire).
- d) The test waveform is 12/50 μ s.

9.7.2 Performance criteria

The performance criterion B of clause 6.3 in this part applies to this clause.

9.8 Power frequency magnetic field immunity test

9.8.1 Test methods and levels

This test item is only applicable to EUT which is equipped with a magnetic field sensitive device. The test method is as shown in GB/T 17626.8.

The test level is 3A/m.

9.8.2 Performance criteria

The performance criteria A of clause 6.2 in this part apply to this clause.

Appendix A

(Normative)

Performance test method for voice call - Audio breakthrough

A.1 Audio calibration

For portable devices, the audio calibration process is as follows:

If the manufacturer provides the nominal audio level, it may set the volume of the equipment under test to provide the nominal audio level.

Before the test, the reference voltage of the uplink and downlink voice output signal shall be recorded on the tester (as shown in Figure A.1). For the downlink, if the input sound coupler is at 1kHz, the reference sound pressure level is 0dBPa. For the uplink, the sound pressure of the mouth reference point (defined in P.64 of ITU-T) is at -5dBPa at 1kHz.

Note 1: MRP is defined in the ITU-T P76 standard with reference to the artificial head. The microphone is placed on the artificial head, AND the ear is fixed on the artificial ear.

Note 2: If the device does not include an acoustic energy converter (such as a mobile phone and a loudspeaker), the manufacturer shall specify an equivalent reference level.

Audio processors often use noise and echo cancellation algorithms to attempt to eliminate or reduce the stable voice signals, such as 1kHz calibration signals. These algorithms may not work in the calibration process. It may require professional testing software. In order to determine the level of the audio before the noise and echo algorithms are implemented, it shall use the maximum containment detector to measure the audio level.

An external speaker will be used in a hands-free environment. In order to overcome environmental noise, the sound pressure level of the external speaker is higher than non-hands-free conditions. In order to compensate for the loss of the difference, it shall improve the reference level of the downlink. During the test process, the distance between the speaker and the test handset shall be adjusted to conform to the manufacturer's specifications. This is useful for test under dynamic test range.

In general, the uplink reference level is not corrected. However, if the above adjustments (such as headphones on a PC card) are not required, the manufacturer shall determine the distance between the mouth reference point MRP and the handset.

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