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### **Common requirements of electromagnetic compatibility for radio communication equipment**

无线通信设备电磁兼容性通用要求

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# Common requirements of electromagnetic compatibility for radio communication equipment

## 1 Scope

This Standard specifies electromagnetic compatibility (EMC) limits, performance criteria and measurement methods for wireless communication equipment and its associated ancillary equipment.

This Standard is applicable to all kinds of wireless communication equipment.

For specific products that are not suitable for testing in a laboratory environment (such as high-power radio transmitters), it may conduct on-site testing. In this case, if there is no applicable field test standard and method, then the basic principle and limits used to evaluate the EUT measurement method of the equipment to be tested shall be consistent with the provisions of this Standard.

## 2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 6113.1, *Specifications for radio disturbance and immunity measuring apparatus*

GB 9254, *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement* (GB 9254-2008, CISPR 22: 2006, IDT)

GB/T 17618, *Information technology equipment - Immunity characteristics - Limits and methods of measurement* (GB/T 17618-1998, idt CISPR24: 1997)

GB 17625.1, *Electromagnetic compatibility - Limits - Limits for harmonic current emissions (equipment input current  $\leq 16$  A per phase)* (GB 17625.1-2003, IEC 61000-3-2:2001, IDT)

GB 17625.2, *Electromagnetic compatibility - Limits - Limitation of voltage*

CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements*

CISPR 16-2-3, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements*

IEC 61000-3-12, *Limits for Harmonic Currents Produced by Equipment Connected to Public Low-Voltage Systems with Input Current >16A and ≤75A Per Phase*

ISO 7637-2, *Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only*

## **3 Terms, definitions and abbreviations**

### **3.1 Terms and definitions**

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

#### **3.1.1 radio communications equipment**

including one or more radio transmitters and/or receivers and/or communication equipment for fixed use, vehicle use, portable use, or some of them; radio communications equipment can be used with ancillary equipment, but basic functions can be realized without ancillary equipment

#### **3.1.2 operating frequency range**

radio frequency band occupied by radio communications equipment

#### **3.1.3 telecommunication center**

"telecommunication center" refers to an electromagnetic environment with the following characteristics:

- a) The power supply in the area adopts -48V, -60V DC power supply or 50Hz 220/380V AC power supply;
- b) Must ensure that DC-powered loads rarely switch;
- c) The internal AC cables must be kept a certain distance from the DC cables and signal lines, so as to avoid mutual coupling;
- d) No protection distance is required between DC cable and signal line;

### **3.1.14 combined radio equipment**

those that meet the following two definitions can be called combined radio equipment:

- a) A device containing two or more radio transmitters and/or receivers. These radio transmitters and/or receivers use different technologies but can work simultaneously;
- b) The equipment contains two or more separate product functions, but at least one function is a radio service function.

### **3.1.15 continuous phenomena**

the disturbance that the effect on a particular device cannot be clearly distinguished as a series of effects

### **3.1.16 transient phenomena**

a physical phenomenon or quantity that changes between two adjacent stable states; the change time is less than the time scale of interest

### **3.1.17 portable equipment**

the radio communications equipment and (or) its ancillary equipment is powered by its own battery; it is designed for portable use

### **3.1.18 primary function**

the main function of the combined radio equipment claimed by the manufacturer

### **3.1.19 primary equipment**

the equipment that supports the main function in the combined radio equipment

### **3.1.20 multimode wireless terminal equipment**

those that meet the following two definitions can be defined as multi-mode wireless terminal equipment:

- a) Two or more radio terminal equipment of mobile communication mode (such as GSM + CDMA terminal);
- b) A terminal with a mobile communication mode but containing two or more sets of related modules.

## **3.2 Abbreviations**

The following abbreviations apply to this Standard:

## **4.2 Test arrangement**

### **4.2.1 Test arrangement for transmitter input terminal**

Through the appropriate normal modulation signal generated by internal or external signal source, enter the transmitter input terminal. The external signal source must be outside the test environment.

### **4.2.2 Test arrangement for transmitter output terminal**

For integral antenna equipment, the useful signal for establishing a communication connection shall be transmitted from the equipment to the antenna located in the test environment. Test ancillary equipment that generates useful test signals shall be located outside the test environment. If the equipment that establishes communication connections is integral antenna equipment, then the test equipment for testing useful signals can be located in the test environment. In this case, priority will be given to testing all equipment as EUT. If none of the above conditions are met, appropriate measures (such as shielding, filtering) shall be adopted to prevent equipment located in the test environment from affecting the test results.

For non-integral antenna equipment, the useful signal for establishing a communication connection shall be led out from the antenna connector using a suitable shielded cable or waveguide. Test ancillary equipment that generates useful test signals shall be located outside the test environment.

Unless there are special regulations in other parts of this Standard, the transmitter works at the maximum transmit power specified in the EUT technical file.

### **4.2.3 Test arrangement of receiver input terminal**

The appropriate normal modulation signal generated by internal or external signal source enters the receiver input port. The external signal source must be outside the test environment.

For integral antenna equipment, the useful signal for establishing a communication connection shall be transmitted from the equipment to the antenna located in the test environment. This antenna shall be connected to an external signal source through a shielded cable.

For non-integral antenna equipment, the useful signal for establishing a communication connection shall be led out from the antenna connector using a suitable shielded cable or waveguide. Test ancillary equipment that generates useful test signals shall be located outside the test environment.

Unless there are special regulations in other parts of this Standard, in the

#### **4.4 Narrowband response of receiver**

The narrowband response of the receiver and receiver/transmitter during the discrete frequency test is determined by the following method:

During the immunity test, it must monitor whether its signal indicators meet the requirements of Clause 6. Both narrowband response and wideband phenomena may cause signal indicators to be out of tolerance. In this case, it needs to make further judgement.

Therefore, the frequency value of 2 times of 6dB bandwidth of intermediate frequency filter in receiver shall be increased or the frequency value greater than the equipment channel bandwidth is tested. Similarly, reduce the same frequency value before testing.

If the receiver is consistent with the performance criteria described in Clause 6, it is a narrowband response.

If the receiver still does not meet the performance criteria in Clause 6, then it may be caused by another narrowband response. At this time, increase or decrease the frequency value to 2.5 times the 6dB bandwidth of the intermediate frequency filter in the receiver and then perform the test. If it is still inconsistent, it is a broadband phenomenon. The equipment has EMC problems and fails in this test project.

Narrowband response shall be ignored.

### **5 Performance evaluation method**

#### **5.1 General**

The following information in the technical file of EUT shall be recorded in the test report if necessary:

- Main functions of EUT checked during and after the EMC test;
- Modulation type and characteristics used in the test (random bit stream, message format);
- Ancillary equipment used in connection with radio equipment in the test;
- Method used to verify the establishment and maintenance of a communication connection;
- User control functions (including volume control) under normal operation, stored data, and evaluation methods of whether these functions or data are missing after the immunity test;

- Or declare that it complies with other EMC standards;
- Or according to the applicable terms of the standard, connect to radio communications equipment to complete the test, so as to prove its performance.

## 5.5 Classification of EUT

In the EMC test, EUT is classified into the following three categories:

- Fixed equipment (such as base station);
- Equipment on vehicle;
- Portable equipment.

For portable equipment or combination of equipment, when it is declared that the vehicle battery can be used to work, it shall be considered additionally as equipment on vehicle.

For portable equipment, mobile equipment or combination of equipment, when it is declared that AC/DC power supply can be used, additional consideration shall be given to the equipment for fixed use.

In addition, when EUT can be inserted or integrated in the host device for use, it shall also meet the relevant regulations in this Standard.

## 6 Performance criteria

### 6.1 Performance criterion A (continuous phenomena)

During the test, EUT shall be able to maintain normal operation without loss of function, and performance is not allowed to be degraded.

During the test, EUT transmitter shall not produce unintentional transmission operations when it is idle.

After the test, the running state has not changed, and the functions of storing data and user programs have not been lost.

During and after the test, the communication link can be maintained.

### 6.2 Performance criterion B (transient phenomena)

During the test, performance can be degraded, and some functions can be lost, but the actual working mode is not allowed to be changed. EUT transmitter shall not produce unintentional transmission operations when it is idle.

## 8.2 Chassis port (radiated stray)

The measurement method of this item refers to the relevant content in YD/T 1483.

The recommended measurement distance for radiated spurious disturbance is  $\geq 3\text{m}$ .

EUT is placed on a non-conductive support. The power supply shall pass through the RF filter before connecting to EUT, so as not to affect the measurement results by the power supply and cables.

If EUT is a non-integral antenna, then the antenna output port shall be terminated with a  $50\Omega$  matched load. EUT shall be transmitted at full power.

During the measurement, the influence of useful signal overload on the measurement equipment shall be prevented.

The upper limit of the measurement frequency is the 10th harmonic of the highest operating frequency, but not higher than 40GHz.

The choice of bandwidth is shown in Table 3. The limits are shown in Table 5.

**Table 5 -- Limit of stray radiation disturbance of chassis port**

| Frequency range | Limit (peak value) |
|-----------------|--------------------|
| 30MHz~1GHz      | -36dBm             |
| >1GHz           | -30dBm             |

## 8.3 Ancillary equipment

### 8.3.1 Measurement method

When ancillary equipment and radio communications equipment are measured together, the radiated emission and spurious emission of the working frequency of the transmitter/transceiver shall be ignored. But it shall be recorded in the test report.

The measurement shall be performed under the typical configuration of ancillary equipment. The highest test frequency is determined by the highest frequency  $f_{\text{high}}$  of the internal source of the radio communications equipment and its ancillary equipment. The highest frequency of internal source is defined as the highest frequency used or produced by EUT internally or the highest frequency produced by EUT work, tuning, as shown in Table 6.

NOTE 2: Within the frequency range of 0.15MHz ~ 0.50MHz, the limit decreases linearly with the logarithm of the frequency.

## 8.7 Harmonic current (AC power input port)

### 8.7.1 Measurement method

For the equipment with input current  $\leq 16\text{A}$  per phase, the measurement is carried out according to GB 17625.1. For the equipment with input current per phase  $> 16\text{A}$ , the measurement is carried out according to IEC 61000-3-12.

### 8.7.2 Limits

The equipment with input current  $\leq 16\text{A}$  per phase uses the limits for Class A equipment in GB 17625.1. The equipment with input current per phase  $> 16\text{A}$  uses the limits for Class A equipment in IEC 61000-3-12.

## 8.8 Voltage fluctuation and flicker (AC power input port)

### 8.8.1 Measurement method

For the equipment with input current  $\leq 16\text{A}$  per phase, the measurement is carried out according to GB 17625.2. For the equipment with input current per phase  $> 16\text{A}$ , the measurement is carried out according to GB/Z 17625.3.

### 8.8.2 Limits

The equipment with input current  $\leq 16\text{A}$  per phase uses the limits in GB 17625.2. The equipment with input current per phase  $> 16\text{A}$  uses the limits in GB/Z 17625.3.

## 8.9 Transient conducted disturbance (DC power input, output port)

### 8.9.1 Measurement method

The measurement is carried out according to ISO 7637-2.

### 8.9.2 Limits

The transient conducted disturbance limits of EUT are shown in Table 17.

**Table 17 -- Transient conducted disturbance of DC power port**

| Pulse polarity     | Limit / V  |            |
|--------------------|------------|------------|
|                    | 12V system | 24V system |
| Positive electrode | +75        | +150       |
| Negative electrode | -100       | -450       |

response at discrete frequency points, then this response shall be ignored.

The test frequency shall be recorded in the test report.

### **9.2.2 Performance criterion**

Performance criterion A of 6.1 in this Standard applies to this sub-clause.

## **9.3 Immunity Test of electrical fast transient pulse group**

### **9.3.1 Test method and level**

When the signal/telecom/control port and DC power port connection cable of fixed equipment and its ancillary equipment exceeds 3m, the items of this test shall be carried out.

For radio communications equipment and ancillary equipment with cables longer than 3m or connected to AC power, the test is carried out according to GB/T 17626.4, but the following requirements shall be met:

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

### **9.3.2 Performance criterion**

Performance criterion B of 6.2 in this Standard applies to this sub-clause.

## **9.4 Surge (impact) immunity test**

### **9.4.1 Test method and level**

The test is carried out in accordance with GB/T 17626.5. At the same time, the following requirements shall be met:

- a) For AC power port, the test level of indoor equipment shall be 2kV (line-to-ground), 1kV (line-to-line); the test level of outdoor equipment shall be 4kV (line to ground), 2kV (line to line).
- b) The test level on the DC power line shall be 1kV (line-to-earth) and 0.5kV (line-to-line).
- c) For the telecommunications port directly connected to the outdoor cable, the test level shall be 1kV (line to ground), 0.5kV (line to line). But if EUT is a telecommunication center equipment, the test level shall be 0.5kV (line to ground). For the telecommunications port connected to indoor cable and the length of the connecting cable is greater than 10m, the test

## **9.7 Immunity tests of voltage dip, short interruption and voltage change**

### **9.7.1 Test method and level**

#### **9.7.1.1 AC power test method and level**

For the test method, see GB/T 17626.11.

Test levels shall be:

- a) When the power supply voltage drops by 30%, the duration is 10ms;
- b) When the power supply voltage drops by 60%, the duration is 100ms;
- c) When the power supply voltage drops by >95%, the duration is 5s.

#### **9.7.1.2 DC power test method and level**

For the test method, see GB/T 17626.29. If EUT has backup power supply or dual power supply, then the test shall be performed with the backup power supply or dual power supply working.

For the test level, see 9.7.2.2.

### **9.7.2 Performance criterion**

#### **9.7.2.1 AC power supply performance criterion**

For a voltage dip with a voltage drop of 30% and a duration of 10ms, the following performance criterion shall be used:

For EUT and its ancillary equipment, performance criterion B of 6.2 in this Standard applies to this sub-clause.

For a voltage dip with a voltage drop of 60% and a duration of 100ms AND a voltage interruption with a voltage drop of more than 95% and a duration of 5000ms, the following performance criteria shall be used:

- a) If EUT is equipped with or connected to a backup battery, then performance criterion B of 6.2 in this Standard applies to this sub-clause;
- b) If EUT is powered by AC power only (do not use backup battery), then performance criterion C of 6.3 in this Standard applies to this sub-clause.

In case of communication interruption or loss of user data, it shall be recorded in the test report.

#### **9.7.2.2 Performance criteria of DC power supply**

The evaluation of combined radio equipment can be carried out through electromagnetic compatibility tests that have been carried out on independent products. If this independent product has been used in accordance with the manufacturer's instructions, and the existing electromagnetic compatibility test configuration can represent its typical application on combined radio equipment, then it doesn't need to re-evaluate this product or the entire combined radio equipment. Only when the electromagnetic compatibility test of the independent product is not comprehensive or the evaluation result is not clear enough, re-evaluation is required.

#### **A.2.1.1 Disturbance test**

The independent products in the combined radio equipment need to meet different electromagnetic compatibility standards due to different combinations. However, for a given combined radio device, the applicable standards shall be selected based on the main equipment of the combined radio equipment. Ports not included in the electromagnetic compatibility standards of the main equipment shall be evaluated in accordance with the electromagnetic compatibility standards corresponding to other products in the combined radio equipment.

#### **A.2.1.2 Immunity test**

For the various products that make up the combined equipment, different immunity test levels, test items and performance criteria may have been tested according to relevant standards. For the immunity test of the main product, it can be considered that it meets the immunity test requirements of the combined equipment.

If the immunity test of the main product does not include the following content, the following immunity tests shall be added:

- The immunity test of conducted disturbance induced by the radio frequency field of the telecommunication, signal and control ports of combined equipment.
- The immunity test of radio frequency electromagnetic field radiation for radio and/or telecommunication functions in combined equipment.

When there are one or more wireless products, the exempt-testing frequency band shall be derived from the electromagnetic compatibility standards of all corresponding wireless products. When evaluating the combined equipment, all exempt-testing frequency bands shall be used reasonably.

If there are additional immunity test requirements in the product standard, then the test must be included in the test requirements of the combined equipment.

For testing level of the combined equipment, the performance criterion and test method shall be carried out in accordance with the standard corresponding to the main function.

If the immunity test of the main product does not include the following content, the following immunity tests shall be added:

- The immunity test of conducted disturbance induced by the radio frequency field of the telecommunication, signal and control ports of composite equipment.
- The immunity test of radio frequency electromagnetic field radiation of radio and/or telecommunication functions in the combined equipment.

When there are one or more radio products, the exempt-testing frequency band shall be derived from the electromagnetic compatibility standards of all corresponding wireless products. When evaluating the combined equipment, all exempt-testing frequency bands shall be used reasonably.

If there are additional immunity test requirements in the product standard, then this test must be included in the test requirements of the combined equipment.

If the combined equipment can establish one or more communication links, then these communication links must remain connected during the immunity test.

In the immunity test, the link loss or performance degradation of radio products caused by narrowband phenomena shall be ignored. For performance criteria for transmitters of radio products of the combined equipment, it must consider the inadvertent emission in idle state.

### **A.3 Examples for various types of combined radio equipment**

#### **A.3.1 Example for equipment type 1**

GPRS base station: It is composed of GSM base station and IP digital switch in a single cabinet.

#### **A.3.2 Example for equipment type 2**

PC with wireless LAN card inserted: The wireless LAN card depends on the PC for power supply and control.

PDA with WAN card inserted: The WAN card relies on the personal digital assistant (PDA) for power supply and control.

#### **A.3.3 Example for equipment type 3**

Cordless automatic branch switch (PABX): The radio frequency unit is extended

## **Annex B**

(normative)

### **Test guides for multi-mode terminal electromagnetic compatibility**

This chapter gives general guidelines for electromagnetic compatibility test of multi-mode terminals. For narrative convenience, take dual-mode terminal as an example, other multi-mode terminals can be analogized.

The two systems of the dual-mode terminal are referred to as system A and system B respectively. System A and System B can respectively establish a circuit exchange link and a data exchange link with the corresponding base station simulator. If it does not support the data link format, relevant tests are not required. The following describes its electromagnetic compatibility test guidelines in detail.

#### **B.1 Terminal that does not support dual-mode simultaneous work**

If the dual-mode terminal does not support two modes to work at the same time (for example, it does not support simultaneous standby GSM/GPRS+CDMA dual-mode terminal), then conduct electromagnetic compatibility test in accordance with the following guidelines:

The electromagnetic compatibility test of standard A is carried out in accordance with the corresponding electromagnetic compatibility product standard of standard A. All indicators need to meet standard requirements;

The electromagnetic compatibility test of standard B is carried out according to the corresponding electromagnetic compatibility product standard of standard B. All indicators need to meet standard requirements.

#### **B.2 Terminal that supports dual-mode simultaneous work**

If the dual-mode terminal supports two modes to work at the same time (for example, GSM/GPRS+CDMA dual-mode dual-standby terminal), then conduct according to the following guidelines:

##### **B.2.1 Disturbance test**

For disturbance test, if two or more strong carrier frequency signals enter the receiver/spectrum analyzer at the same time during the test, pay attention to eliminate the resulting clutter interference.

##### **B.2.1.1 Spurious test**

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