TECHNICAL REQUIREMENTS FOR IMMUNITY OF TELECOMMUNICATIONS EQUIPMENT

TR NO. 549001 Edition 3.2
3rd, September, 2018

Nippon Telegraph and Telephone Corporation

NOTICE

This document provides a summary of the basic technical requirements for the test level, test procedures, etc. for the minimum immunity to electromagnetic disturbances of telecommunications equipment used and provided by Nippon Telegraph and Telephone Corporation (NTT). For exceptional environmental conditions, special-mitigating measures may be required. This document is intended as reference material to be used by telecommunications equipment designers and manufactures.

The contents of this document may be changed without notice when related standards are revised, new technology is introduced to the equipment, or equipment requirements are modified.

If you have any questions about the contents of this document, please contact the following sections.

NTT Network Technology Laboratories
Environmental Technology and Management Project
EMC Technology Group
TEL +81-422-59-4222
FAX +81-422-59-5681
E-mail: emc-spec-p[at]hco.ntt.co.jp
(please replace “[at]” to “@” mark)

Revision History

Edition	Revision Date	Application Date	Reason for Revision
1	1st July, 1998	Same as the revision date	First edition
2	30 May 2002	Same as the revision date	Correspondence with the establishment of JT-K.48
3	11 May 2005	Same as the revision date	Correspondence with the revision of JT-K.43 and K.48
3.1	30 April 2015	Same as the revision date	Revision of contact address
3.2	3rd September 2018	Same as the revision date	Revision of contact address

Contents

1. Overview

1.1 Purpose

To ensure that telecommunication services provided by NTT keep the specified quality and reliability, this Technical Requirement (TR) prescribes the limits of testing immunity to electromagnetic disturbances for telecommunications equipment containing digital circuits, microprocessors, or switching power supplies, information technology equipment used on customer premises, and radio-communication equipment defined in ARIB standard T57.

The object of this TR is to establish requirements that will provide an adequate level of intrinsic immunity so that the equipment will operate as intended in its environment.

For exceptional environmental conditions, special-mitigating measures may be required.

Owing to testing and performance assessment considerations, some tests are specified in defined frequency bands or at selected frequencies.

The object of this TR is to define the immunity test requirements for equipment defined in the scope in relation to continuous and transient, and conducted and radiated disturbances, including electrostatic discharges (ESD).

The test requirements are specified for each port considered.

NOTES

1. Safety considerations are not covered in this TR.
2. In special cases, situations will arise where the level of disturbance may exceed the levels specified in this TR, for example where a hand-held transmitter is used in proximity to equipment. In these instances special-mitigating measures may have to be employed.

1.2 Outline

Section 2 describes key terms used in this document, laws and regulations referred to in this document, and some notices that are relevant when this document is used.

Section 3 describes requirements related to levels and methods for testing immunity to electromagnetic disturbances for *customer-premises equipment* and *telecom-center equipment*.

A normative annex describes immunity test methods for *customer-premises equipment* more in detail.

2. References and terminology

2.1 References

The following documents contain provisions, which through reference in this text, constitute provisions of this TR. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this TR are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest editions of the publications referred to apply. Members of ISO and IEC maintain registers of currently valid International Standards.

Japan Industrial Standards (JIS), except ones under consideration, take precedence over IEC standards when both JIS and IEC standards for the same topic are listed below.

[1] **JIS C 0161: 1997,** International Electrotechnical Vocabulary (IEV) –Chapter 161: Electromagnetic compatibility

[2] **IEC 60050(161): 1990,** International Electrotechnical Vocabulary (IEV) –Chapter 161: Electromagnetic compatibility

[3] **IEC 60318: 1970,** An artificial ear, of the wideband type, for the calibration of earphones used in audiometry

[4] **JIS C 1000-4-2: 1999,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 2: Electrostatic discharge immunity test- Basic EMC publication (in Japanese)

[5] **IEC 61000-4-2: 1995,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 2: Electrostatic discharge immunity test- Basic EMC publication

[6] **JIS C 1000-4-3: 1997,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 3: Radiated, radio-frequency, electromagnetic field immunity test- Basic EMC publication (in Japanese)

[7] **IEC 61000-4-3: 1995,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 3: Radiated, radio-frequency, electromagnetic field immunity test- Basic EMC publication

[8] **JIS C 1000-4-4: 1999,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 4: Electrical fast transient/burst immunity test- Basic EMC publication (in Japanese)

[9] **IEC 61000-4-4: 1995,** Electromagnetic compatibility (EMC)- Part 4: Testing and

measurement techniques- Section 4: Electrical fast transient/burst immunity test- Basic EMC publication
[10] **JIS C 1000-4-5: 1999,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 5: Surge immunity test- Basic EMC publication (in Japanese)
[11] **IEC 61000-4-5: 1995,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 5: Surge immunity test- Basic EMC publication
[12] **JIS C 1000-4-6: 1999,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 6: Immunity to conducted disturbances, induced by radio-frequency fields (in Japanese)
[13] **IEC 61000-4-6: 1996,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 6: Immunity to conducted disturbances, induced by radio-frequency fields
[14] **IEC 61000-4-8: 1993,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 8: Power frequency magnetic field immunity test
[15] **IEC 61000-4-11: 1994,** Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques- Section 11: Voltage dips, short interruptions and voltage variations immunity test
[16] **CISPR Publ. 22: 1997,** Information technology equipment- Radio disturbance characteristics- Limits and methods of measurement
[17] **ISO 9241-3: 1992,** Ergonomic requirements for office work with visual display terminals (VDTs)- Part 3: Visual display requirements
[18] **ITU-T Recommendation I. 241. 1:** Telephony
[19] **ITU-T Recommendation I. 411:** Integrated service digital network (ISDN) user network interfaces
[20] **ITU-T Recommendation K.15:** Protection of high capacity transmission systems against overvoltages and HF-disturbances
[21] **ITU-T Recommendation K.17:** Tests on power fed repeaters using solid state devices in order to check the arrangements for protection from external interference
[22] **ITU-T Recommendation K.20:** Resistibility of telecommunication switching equipment to overvoltages and overcurrents
[23] **ITU-T Recommendation K.21:** Resistibility of subscribers' terminals to overvoltages and overcurrents
[24] **ITU-T Recommendation K.22:** Overvoltage resistibility of equipment connected to an ISDN T/S bus, Blue Book, Volume IX, November 1988
[25] **CISPR Publ. 24: 1997,** Information technology equipment- Immunity

characteristics- Limits and methods of measurement
[26] **ITU-T Recommendation K.43: 2003,** Immunity requirements for telecommunication equipment
[27] **EN55024: 1998,** Information technology equipment- Immunity characteristics- Limits and methods of measurement
[28] **ETS 300 386-1: 1994, 1997,** Equipment engineering (EE); Public telecommunications network equipment electromagnetic compatibility (EMC) requirements; Part 1: Product family overview, compliance criteria and test levels
[29] **Report from Telecommunication Technology Council: 1998,** Partial Reply to Inquiry No. 3 "About Various Standards of International Special Committee on Radio Interference (CISPR)": "Limits and Measurement Methods of Immunity of ITE" (in Japanese)
[30] **TTC JT-K43: 2004,** Immunity Requirements for Telecommunications Equipment (in Japanese)
[31] **ARIB STD-T57: 2001,** EMC standard for radio-communication equipment (in Japanese)
[32] **ITU-T Recommendation K.48: 2003**, Product family EMC Requirements for each telecommunication network equipment – Product Family
[33] **TTC JT-K48: 2004**, EMC Requirements for each telecommunication network equipment (in Japanese)
[34] **CISPR Publ. 24 Amendment 1: 2001,** Information technology equipment- Immunity characteristics- Limits and methods of measurement

NOTE: Quoted Japan Industrial Standards ([8], [10] and [12]) consider the Japanese-specific grounding condition.

2.2 Terminology

For the purpose of this TR, the definitions contained in the following documents apply; ITU-T recommendation I.411, JIS C 0161, International Electrotechnical Vocabulary (IEV)- Chapter 161. In addition, the following specific definitions apply:

(1) **continuous wave (CW)**: Electromagnetic waves, the successive oscillations of which are sinusoidal and identical under steady-state conditions, which can be interrupted or modulated to convey information.
(2) **degradation**: The unwanted change in operational performance of EUT due to electromagnetic disturbances. This does not necessarily mean malfunction or

catastrophic failure.

(3) **equipment under test (EUT)**: A representative ITE or functionally interactive group of ITE (that is a system) which includes one or more host units and is used for evaluation purposes.

(4) **information technology equipment (ITE)**: The definition of ITE is as described in Report from Telecommunication Technology Council: 1997, Partial Reply to Inquiry No. 3 "About Various Standards of International Special Committee on Radio Interference (CISPR)": "Limits and Measurement Methods of Radio Disturbance Characteristics of ITE".

(5) **jitter (of a cathode ray tube (CRT) monitor)**: Peak-to-peak variation in the geometric location of picture elements on the viewing surface of the CRT monitor.

(6) **temporal instability (flicker)**: The perception of unintended temporal variation in luminance.

(7) **port**: Particular interface of the specified equipment with the external electromagnetic environment (see figure 1).

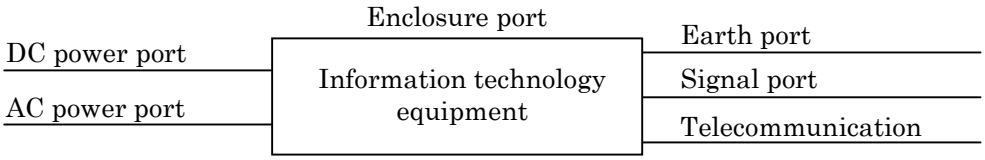

Figure 1. Description of ports

(8) **enclosure port**: The physical boundary of the equipment through which electromagnetic fields may radiate or impinge. For plug-in units, the physical boundary will be defined by the host unit.

(9) **cable port**: A point at which a conductor or a cable is connected to the equipment. Examples are signal and power ports.

(10) **a telephony call**: The process exercised in a network and the telecommunication terminal equipment (TTE) to allow interchange of information (speech, video, or data) with another TTE through the network.

NOTE- The call shall be operated in the way specified by the manufactures. For circuit-switched services the exchange of data shall be considered to be possible when a 64 kbit/s channel or equivalent is available for both parties. For packet service the exchange of information shall be

considered to be possible when a virtual path is established to the called TTE.

(11) **to establish a telephony call**: The operating procedure for a user or an automatic process in conjunction with the network to reach the capability to exchange information with another TTE. See note to (10).

(12) **to receive a telephony call**: The operating procedure for a user or an automatic process initiated by, and in conjunction with, the network to reach the capability to exchange information with another TTE. See note to (10).

(13) **to maintain a telephony call**: The capability of exchanging information without having to clear and re-establish a call. See note to (10).

(14) **to clear a telephony call**: The operating procedure for a user or an automatic process in conjunction with the network (either at the initiative of the local party or the distant party) to stop the capability of exchanging information by an orderly return to a state where the establishment of a new call is possible. See note to (10).

(15) **network terminator (NT)**: Ancillary equipment representing the termination of the telecommunication network.

(16) **telephony service**: A service providing users with the ability for real-time two-way speech conversation via a network (see ITU-T Recommendation I.241.1).

(17) **telecommunication terminal equipment**: Equipment intended to be connected a public or private telecommunication network, that is:

a) to be connected directly to the termination of a telecommunication network in order to send, process or receive information or:

b) to interwork with a telecommunications network being connected directly or indirectly to the termination of a telecommunications network in order to send, process or receive information.

(18) **telecom-center equipment**: Telecommunication equipment or facilities used only within buildings that are supervised by telecommunication operators.

a) Switching equipment, transmission equipment, power supply equipment, and radio equipment.

b) Peripheral equipment directly connected to or used with the equipment listed in a).
E.g., workstations controlling equipment listed in a).

c) Equipment mounted on vehicles (excluding vehicle components and components designed as part of telecommunications equipment)
E.g., radio transmitting and receiving equipment on radio-relay vehicles.

(19) **customer-premises equipment**: Information technology equipment used for telecommunications other than "telecom-center equipment".

(20) **immunity**: The ability of devices, equipment, or systems to operate without any performance degradation under electromagnetic disturbances.

(21) **immunity level**: The maximum immunity test level at which the device, equipment, or system can operate as intended.

(22) **immunity limit**: The specified minimum immunity level.

(23) **CISPR**: French acronym meaning "International Special Committee on Radio Interference". This special committee was established by the International Electrotechnical Commission to study standards for limits, test methods, and test facilities with regard to radiated emission.

(24) **ITU-T**: Abbreviation for "International Telecommunication Union-Telecommunication standardization sector".

(25) **ETS**: Abbreviation for "European Telecommunication Standard" produced by the "European Telecommunication Standard Institute (ETSI)".

(26) **TTC**: Abbreviation for "The Telecommunication Technology Committee" in Japan.

(27) **ARIB**: Abbreviation for "Association of Radio Industries and Businesses" in Japan.

3. Requirements for customer-premises equipment

3.1 Applicability

Tests shall be applied to the relevant ports of the equipment according to tables 1 to 4. Tests shall only be carried out if the relevant port exists.

It may be determined from consideration of the electrical characteristics and usage of particular equipment that some of the tests are inappropriate and therefore unnecessary. In such a case, it is required that both the decision and the justification not to apply any particular test to any particular port be recorded in the test report.

3.1.1 Enclosure port

Immunity requirements for an enclosure port are specified in table 1.

Table 1 Immunity requirements for an enclosure port of customer-premises equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
1.1	Power-frequency magnetic field	50 or 60 1	Hz A/m	See clause 2.4 in normative annex	A See 1)	See 2)
1.2	Radio-frequency electromagnetic field Amplitude modulation	≦80-800 3 80	MHz V/m (unmodulated, rms) % AM (1 kHz)	See clause 2.3 in normative annex	A	The test level specified is prior to modulation See 3) and 4)
		800-960 10 80	MHz V/m (unmodulated, rms) % AM (1 kHz)			
		960-1000 3 80	MHz V/m (unmodulated, rms) % AM (1 kHz)			
		1400-2000 10 80	MHz V/m (unmodulated, rms) % AM (1 kHz)			
1.3	Electrostatic discharge	4 (contact discharge) 8 (air discharge)	kV(charge voltage) kV(charge voltage)	See clause 2.1 in normative annex	B	

1) See clause 6.2 in normative annex

2) Applicable only to equipment containing devices susceptible to magnetic fields, such as CRT monitors, Hall elements, electrodynamic microphones, magnetic field sensors, etc.

3) The frequency range is scanned as specified. However, when specified in Annex A of normative Annex, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies are: 80, 120, 160, 230, 434, 460, 600, 863 and 900 MHz (±1 %).

4) The test may be performed with a start frequency lower than 80 MHz, but no less than 26 MHz.

3.1.2 Signal ports and telecommunication ports

Immunity requirements for signal and telecommunication ports are specified in table 2.

Table 2 Immunity requirements for signal and telecommunication ports of customer-premises equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
2.1	Radio-frequency continuous conducted	0.15-80 3	MHz V (unmodulated, rms)	See clause 2.3 in normative annex	A	See 1), 3), 4) and 6)
2.2	Surge	10/700 1.5 4	Tr/Th μs kV (peak) kV (peak)	See clause 2.5 in normative annex	See ITU-T Rec. K series	See 2), 5) and 7)
2.3	Fast transients	0.5 5/50 5	kV (peak) Tr/Th ns Repetition frequency kHz	See clause 2.2 in normative annex	B	See 3)

1) The frequency range is scanned as specified. However, when specified in clause 5 of normative annex, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted test are: 0.2, 1, 7.1, 13.56, 21, 27.12, and 40.68 MHz (±1 %).

2) Applicable only to ports which according to the manufacturer's specification may connect directly to outdoor cables.

3) Applicable only to cables which according to the manufacturer's specification supports communication on cable length greater than 3 m.

4) If the radiated test has been carried out from a frequency lower than 80 MHz, then the test range shall only extend up to this frequency.

5) For ports where primary protection is intended, surges are applied at voltages up to 4 kV with the primary protecters fitted. Otherwise the 1.5 kV best level is applied without primary protection place.

6) The result of testing immunity to a radio-frequency electromagnetic field does not always correspond to that of radio-frequency continuous conducted testing. A radio-frequency electromagnetic field test may be carried out when a continuous radio-frequency disturbance is to be considered.

7) Table 2 considers the integrated-grounding system. It is also necessary to take into account the separated-grounding* system in Japan.

* separated-grounding means that several kinds of grounding terminal are connected to earth.

3.1.3 DC power port

Immunity requirements for an input DC power port are specified in table 3. Equipment marketed with an AC/DC converter is excluded. If DC power is fed on conductors included in a signal cable, then the requirements of table 2 apply only to this cable.

Table 3 Immunity requirements for input DC power port of customer-premises equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
3.1	Radio-frequency continuous conducted	0.15-80 3 80	MHz V (unmodulated, rms) % AM(1 kHz)	See clause 2.3 in normative annex	A	See 1) and 3)
3.2	Surge	1.2/50 (80/20) 0.5	Tr/Th μs kV (peak)	See clause 2.5 in normative annex	B	Test applies lines to earth (ground) See 2)
3.3	Fast transients	0.5 5/50 5	kV (peak) Tr/Th ns Repetition frequency kHz	See clause 2.2 in normative annex	B	

1) The frequency range is scanned as specified . However, when specified in clause 5 of normative annex, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted test are: 0.2, 1, 7.1, 13.56, 21, 27.12, and 40.68 MHz (±1 %).

2) Applicable only to ports which according to the manufacturer's specification may connect directly to outdoor cables.

3) If the radiated test has been carried out from a frequency lower than 80 MHz, then the test range shall only extend up to this frequency.

3.1.4 AC power port

Immunity requirements for AC power ports of customer-premises equipment are specified in table 4. Equipment marketed with an AC/DC converter is included.

Table 4-Immunity requirements for input AC power port of customer-premises equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
4.1	Radio-frequency continuous conducted	0.15-80 3 80	MHz V (unmodulated, rms) % AM(1 kHz)	See clause 2.3 in normative annex	A	See 1) and 3)
4.2	Voltage dips	> 95 0.5	% reduction period	See clause 2.6 in normative annex	B	See 2)
		30 25	% reduction period		C	
4.3	Voltage interruption	> 95 250	% reduction period	See clause 2.6 in normative annex	C	See 2)
4.4	Surge	1.2/50 (80/20) 1 line to line 2 line to earth (ground)	Tr/Th μs kV (peak) kV (peak)	See clause 2.5 in normative annex	B	See 4)
4.5	Fast transients	1 5/50 5	kV (peak) Tr/Th ns Repetition frequency kHz	See clause 2.2 in normative annex	B	

1) The frequency range is scanned as specified . However, when specified in clause 5 of normative annex, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted test are: 0.2, 1, 7.1, 13.56, 21, 27.12, and 40.68 MHz (±1 %).

2) Changes to occur at 0 degree crossover point of the voltage waveform.

3) If the radiated test has been carried out from a frequency lower than 80 MHz, then the test range shall only extend up to this frequency.

4) When the manufacture specifies protection measures and it is impractical to simulate these measures during the tests, then the applied test levels shall be reduced to 0.5 kV and 1 kV.

3.2 Test method and facility

The test method and facility may be in accordance with the specifications of any of the related standards* listed below besides those specified in tables 1 to 4. But the immunity requirements specified in tables 1 to 4 should be satisfied.

(1) CISPR publ.24
(2) ITU-T K.43
(3) EN55024
(4) ETS 300 386-1
(5) TTC JT-K43
(6) ARIB STD-T57
(7) ITU-T K.48
(8) TTC JT-K48

*NOTE- Report from Telecommunications Technology Council** and some standards authorized by industry associations such as the Communications Industry Association of Japan, exist besides those listed in clause 2.1.

**Report from Telecommunication Technology Council: 1998, Partial Reply to Inquiry No. 3 “About Various Standards of International Special Committee on Radio Interference (CISPR)”: “Limits and Measurement Methods of Immunity of ITE”

4. Requirements for telecom-center equipment

4.1 Applicability

Tests shall be applied to the relevant ports of the equipment according to tables 5 to 9. Tests shall only be carried out if the relevant port exists.

It may be determined from consideration of the electrical characteristics and usage of particular equipment that some of the tests are inappropriate and therefore unnecessary. In such a case, it is required that both the decision and the justification not to apply any particular test to any particular port be recorded in the test report.

4.1.1 Enclosure port

Immunity requirements for an enclosure port are specified in table 5.

Table 5 Immunity requirements for an enclosure port of telecom-center equipment

	Environmental phenomenon	Test levels	Units	Test method	Performance criterion	Remarks
5.1	Radio-frequency electromagnetic field	1	V/m	See clause 7.1 and section 7.2.4 in TTC JT-K43	A	80-800 MHz See 1)
		10				800-960 MHz
		1				960-1000 MHz
		10				1400-2000 MHz
5.2	Electrostatic discharge	4 (contact discharge) (air discharge)	kV	See clause 7.1 and section 7.2.1 in TTC JT-K43	B	Contact discharge and air discharge
1) The test may be performed with a start frequency lower than 80 MHz, but no less than 27 MHz.						

4.1.2 Outdoor telecommunication ports

Immunity requirements for outdoor telecommunication ports are specified in table 6.

Table 6 Immunity requirements for outdoor telecommunication ports of telecom-center equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
6.1	Radio-frequency continuous conducted	1	Vemf See 1)	See clause 7.1 and section 7.2.5 in TTC JT-K43	A	0.15-80 MHz See 2) and 3)
6.2	Surge	0.5 (line to line) 1 (line to ground)	kV	See clause 7.1 and section 7.2.3 in TTC JT-K43	B	10/700 μ s See 4)
6.3	Fast transients	0.25	kV	See clause 7.1 and section 7.2.2 in TTC JT-K43	B	Capacitive clamp used

1) Test level is specified by unmodulated level, but 80% AM(1 kHz) is needed during testing.
2) Above 10 MHz the lower test level can be applied. The specific level is under study.
3) The test level can be defined as equivalent current into 150 Ω.
4) This test can be applied when appropriate CDN cable exists.

4.1.3 Indoor telecommunication ports

Immunity requirements for indoor telecommunication ports are specified in table 7.

Table 7 Immunity requirements for indoor telecommunication ports of telecom-center equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
7.1	Radio-frequency continuous conducted	1	Vemf See 1)	See clause 7.1 and section 7.2.5 in TTC JT-K43	A	0.15-80 MHz See 2) and 3)
7.2	Surge	0.5 (line to ground)	kV	See clause 7.1 and section 7.2.3 in TTC JT-K43	B	1.2/50(8/20) μ s See 4)
7.3	Fast transients	0.25	kV	See clause 7.1 and section 7.2.2 in TTC JT-K43	B	Capacitive clamp used

1) Test level is specified by unmodulated level, but 80% AM(1 kHz) is needed during testing.
2) Above 10 MHz the lower test level can be applied. The specific level is under study.
3) The test level can be defined as equivalent current into 150 Ω.
4) This test can be applied when appropriate CDN cable exists.

4.1.4 DC power ports

Immunity requirements for DC power ports are specified in table 8.

Table 8 Immunity requirements for DC power ports of telecom-center equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
8.1	Radio-frequency continuous conducted	1	Vemf See 1)	See clause 7.1 and section 7.2.5 in TTC JT-K43	A	0.15-80 MHz See 2) and 3)
8.2	Fast transients	0.25	kV	See clause 7.1 and section 7.2.2 in TTC JT-K43	B	
8.3	Voltage dips	0 0.004	% of nominal voltages s	See clause 7.1 and section 7.2.6 in TTC JT-K43	A	See 9) High impedance (output impedance of test generator)
		0 0.01 and 0.1	% of nominal voltages s		C	See 5),6) and 9)
		0 0.004	% of nominal voltages s		A	See 9) Low impedance (output impedance of test generator)
		0 0.01 and 0.1	% of nominal voltages s		C	See 5),6) and 9)
8.4	Abnormal voltage	0 to 90 1	% of nominal voltages s		C	See 7),8) and 9)
		110 to 125 1	% of nominal voltages s		C	See 7),8) and 9)
8.5	Voltage variation	From 100 to 90 2	% of nominal voltages s		A	The test simulates a charge in the DC voltage: is not a hole but a change from the nominal value to a lower value
		From 100 to 90 2	% of nominal voltages s		A	The test simulates a charge in the DC voltage: is not a hole but a change from the nominal value to a higher value

1) Test level is specified by unmodulated level, but 80% AM(1 kHz) is needed during testing.
2) Above 10 MHz the lower test level can be applied. The specific level is under study.
3) The test level can be defined as equivalent current into 150Ω.
4) Not assigned.
5) In some sensitive equipment, momentary and temporary interruption of the service may occur as a result of such transients. Lengthening of the interruption to service (equipment is not functioning as intended) due to the recovery of software shall be taken in account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.
6) To prevent system malfunctioning, additional arrangements concerning the power supply system may be necessary.

For example:
– dual feeding system;
– high Ohmic distribution system;
– independent power distribution.

7) Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The telecommunication equipment shall then resume operation according to its specifications. The abnormal service voltage shall not lead to the disconnection of the power supply e.g., by causing circuit breakers, fuses or other such

devices to operate.

8) For equipment with a low priority of service, it is acceptable to use the following performance criteria during the test: "Loss of function is allowed, the function can be restored by a manual operation of the user in accordance with the manufacturer's instructions. Functions and information protected by a battery backup shall not be lost."

9) This test is applicable only in equipments in which the battery back-up is not permanently connected to the DC distribution system.

4.1.5 AC power ports

Immunity requirements for AC power ports of telecom-center equipment are specified in table 9.

Table 9- Immunity requirements for AC power ports of telecom-center equipment

	Environmental phenomenon	Test specification	Units	Test method	Performance criterion	Remarks
9.1	Radio-frequency Continuous conducted	1	Vemf See 1)	See clause 6.1 and section 6.2.5 in TTC JT-K43	A	0.15-80 MHz See 2) and 3)
9.2	Surge	0.5 (line to line) 1 (line to ground)	kV	See clause 6.1 and section 6.2.3 in TTC JT-K43	B	1.2/50(8/20) μs See 4)
9.3	Fast transients	0.25	kV	See clause 6.1 and section 6.2.2 in TTC JT-K43	B	
9.4	Voltage dips	> 95 0.5	% reduction period	See clause 6.1 and section 6.2.6 in TTC JT-K43	B	
		30 25	% reduction period		C	
9.5	Voltage interruption	95 250	% reduction period	See clause 6.1 and section 6.2.6 in TTC JT-K43	C	

1) Test level is specified by unmodulated level, but 80% AM(1 kHz) is needed during testing.
2) Above 10 MHz the lower test level can be applied. The specific level is under study.
3) The test level can be defined as equivalent current into 150Ω.
4) This test can be applied when appropriate CDN exists.

4.2 Test method and facility

The test method and facility may be in accordance with the specifications of any of the related standards* listed below besides those specified in tables 5 to 9. But the immunity requirements specified in tables 5 to 9 should be satisfied.

(1) CISPR publ.24
(2) ITU-T K.43
(3) EN55024
(4) ETS 300 386-1
(5) TTC JT-K43
(6) ARIB STD-T57

(7) ITU-T K.48
(8) TTC JT-K48

*NOTE- Report from Telecommunications Technology Council** and some standards authorized by industry associations such as the Communication Industry Association, exist besides those listed in clause 2.1.
**Report from Telecommunication Technology Council: 1998, Partial Reply to Inquiry No. 3 “About Various Standards of International Special Committee on Radio Interference (CISPR)”: “Limits and Measurement Methods of Immunity of ITE”

Normative annex:
Immunity test method for customer-premises equipment

Contents

1. General

The immunity test requirements for equipment are given on a port-by-port basis.

Tests shall be conducted in a well-defined and reproducible manner.

The tests shall be carried out as single tests in sequence. The sequence of testing is optional.

The description of the test, the test generator, the test methods and the test set-up are given in JIS and IEC basic EMC standards which are referred to in previous tables 1 to 4 in clause 3.1 and tables 5 to 9 in clause 4.1.

The contents of these JIS and IEC basic EMC standards are not repeated here; however, modifications or additional information needed for the practical application of the tests are given in this TR.

2. Particular requirements

2.1 Electrostatic discharge (ESD)

Static electricity discharges shall be applied only to those points and surfaces of the EUT which are expected to be touched during usual operation, including user access, as specified in the user manual, for example for ribbon and paper roll changes.

The discharges shall be applied in two ways:

a) contact discharges to the conductive surfaces and to coupling planes:

The EUT shall be exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points (a minimum of 50 discharges at each point). One of the test points shall be subjected to at least 50 indirect discharges (contact) to the center of the front edge of the horizontal coupling plane. The remaining three test points shall each receive at least 50 direct contact discharges. If no direct contact test points are available, then at least 200 indirect discharges shall be applied in the indirect mode (see JIS C 1000-4-2 for use of the Vertical Conducting Plane (VCP)). Tests shall be performed at a maximum repetition rate of one discharge per second.

b) air discharge at slots and apertures, and insulating surface:

On these parts of the EUT where it is not possible to perform contact discharge testing, the equipment should be investigated to identify user accessible points where breakdown may occur; examples are openings at edges of keys, or in the covers of keyboard and telephone handsets. Such points are tested using the air discharge method. See also JIS C 1000-4-2 regarding painted surfaces. This

investigation should be restricted to those areas normally handled by the user. A minimum of 10 single air discharges shall be applied to the selected test point for each such area.

The application of electrostatic discharges to the contacts of open connectors is not required by this TR.

NOTE: The necessity of charge reduction is under study in international conferences. The following information is useful.

Charge reduction should be performed at each discharge when ground-less equipment, which has a plug without a ground-electrode, or equipment driven by DC power, etc., is tested by the contact discharge.

Ground-less equipment should be supplied with power via an isolated-transformer.

2.2 Electrical fast transients (EFT)

The test method is given in JIS C 1000-4-4. However, the test setup for *in-situ* measurements is not applicable for ITE.

The test procedure is as given in JIS C 1000-4-4 together with the following changes and clarifications:

- if the equipment contains identical ports, only one shall be tested;
- multiconductor cables, such as a 50-pair telecommunication cable, shall be tested as a single cable. Cables shall not be split or divided into groups of conductors for this test;
- interface ports, which are intended by the manufacture to be connected to data cables not longer than 3 m, shall not be tested.

2.3 Continuous radio frequency disturbances

The preferred frequency range for the radiated field test is 80 MHz to 1000 MHz. The preferred frequency range for the continuous conducted test is 0.15 MHz to 80 MHz. However, the radiated test may be performed with a start frequency lower than 80 MHz; in that case the continuous conducted test (where applicable) need only be carried out up to this start frequency.

The frequency ranges are scanned as specified; however, at a limited number of selected frequencies a more comprehensive functional test may be required. The requirement to undertake this additional selected frequency test is not universally applicable to all products, but only to products which have this requirement specified in

annex A (under particular product specific requirements). The selected frequencies are given in tables 1 to 4.

The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised and to be able to respond; however, the dwell time shall not exceed 5 s at each of the frequencies during the scan.

The time to exercise the EUT shall not be interrupted as a total time of a program or a cycle but related to the reaction time in case of failure of the EUT.

2.3.1 Continuous radiated disturbances

The test procedure is in accordance with JIS C 1000-4-3.

The EUT shall be positioned so that the four sides of the EUT shall be exposed to the electromagnetic field in sequence. In each position the performance of the EUT will be investigated.

In cases of dispute, testing on the four surface sides shall take precedence.

If the EUT is too large to be adequately illuminated by the radiating antenna partial illumination shall be used.

Partial illumination shall be carried out using one of the following techniques:

- the EUT can be repositioned so that the front surface remains separated from the radiating antenna by the test distance (perpendicular with the axis between the calibration point and the radiating antenna) in order to illuminate those sections of the EUT outside the previous antenna beam width;
- where the EUT consists of separate modules, the modules can be tested separately within the antenna beam with.

In cases of dispute, full illumination of the EUT will take precedence.

The frequency range can be swept incrementally with a step size not exceeding 4% of the fundamental with a test level of twice the value of the specified test level.

In cases of dispute, full illumination of the EUT will take precedence.

2.3.2 Continuous conducted disturbances

There shall be no additional deviations from JIS C 1000-4-6.

2.4 Power-frequency magnetic field

The test procedure shall be in accordance with IEC 61000-4-8.

The EUT shall be arranged and connected to satisfy its functional requirements, and shall be placed at the center of the coil system (immersion method).

The cables supplied by the equipment manufacture shall be used or, in their

absence, suitable alternative cables of the type appropriate to the signals involved shall be used.

Physically large products need not be completely submerged in the magnetic field, only the sensitive devices (such as CRT monitors if they are the only sensitive parts). In this case, and if the CRT monitor is integral with the ITE, then the CRT monitor or sensitive device can be removed for testing.

2.5 Surges

The test procedure shall be in accordance with JIS C 1000-4-5 or, if appropriate, ITU-T K20, K21 or K22.

2.6 Voltage dips and interruptions

The test procedure is in accordance with IEC 61000-4-11. There shall be no deviations from that standard.

3. Conditions during testing

3.1 General conditions

The tests shall be made exercising all primary functions in the most representative mode consistent with typical applications. The test sample shall be configured in a manner consistent with typical installation practice.

If the equipment is part of a system or can be connected to auxiliary equipment, then the equipment shall be tested while connected to the minimum representative configuration of auxiliary equipment necessary to exercise the ports in a similar manner to that described in the Report from Telecommunication Technology Council: 2000, Partial Reply to Inquiry No. 3 “About Various Standards of International Special Committee on Radio Interference (CISPR)”: “Limits and measurement method of disturbances emitted from ITE”.

The configuration and mode of operating during the tests shall be precisely noted in the test report. It is not always possible to test every function of the apparatus; in such cases, the most critical mode of operation shall be selected.

If the equipment either has a large number of terminals or a large number of ports with similar connections, then a sufficient number shall be selected to simulate the actual operating conditions and to ensure that all the different types of termination are covered.

Coil cables (such as keyboard cables) shall not be intentionally stretched during testing. For such cables, the length specified in the table notes refers to unstretched

conditions.

The test equipment or auxiliary equipment (for example NT or simulator) connected to the EUT shall not have any influence on the result of the testing.

In cases where manufacture's specification requires external protection devices or measures which are clearly specified in the user's manual, then the test requirements of this standard shall be applied with the external protection devices or measures in place.

During testing the environmental conditions and supply voltages shall remain within the operating ranges specified for the product unless otherwise indicate in the basic standard.

If an earth connection independent of the power supply cable is provided, this earth connection shall be installed according to the specifications of the manufacturer for the tests (given in tables 1 to 4 in clause 3.1) at all other ports.

3.2 Particular conditions (EUT operational modes, etc.)

The particular conditions specified in the annex take precedence over the corresponding parts of the general conditions.

Where particular conditions for specific functions are not given in this standard, then the general conditions shall apply.

4. Performance criteria

The manufacturer has the obligation to express the performance criteria in terms, which relate to the performance of his specific product when used as intended.

The following performance criteria are applicable, and shall only be evaluated when the functions referred to, are implemented.

4.1 General performance criteria

Examples of functions defined by the manufacturer to be evaluated during testing include, but are not limited to, the following:

- essential operation modes and states;
- tests of all peripheral access (hard disks, floppy disks, printers, keyboard, mouse, etc.);
- quality of software execution;
- quality of data display and transmission;
- quality of speech transmission.

Performance criterion A

The equipment shall continue to operate as intended without operator intervention.

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

Performance criterion B

After the test, the equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance.

During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test.

If the minimum performance level (or the permissible performance loss) is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion C

Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the manufacturer's instructions.

Functions, and/or information stored in non-voltage memory, or protected by a battery backup, shall not be lost.

4.2 Particular performance criteria

The particular performance criteria, which are specified in annex, take precedence over the corresponding parts of the general performance criteria.

Where particular performance criteria for specific functions are not given, then the general performance criteria shall apply.

5. Performance criteria for Telecommunication terminal equipment

5.1 Telecommunications terminal equipment (TTE) having an analog interface

5.1.1 Particular test conditions

The telecommunications terminal equipment (TTE) shall be configured for connection to a telecommunication line (or reference line) at its nominal impedance. Auxiliary equipment may be used to simulate the telecommunications network.

5.1.2 Particular performance criteria

The following performance criteria are applicable only when the functions are implemented.

Performance criterion A

a) Swept frequency test

Testing shall be carried out in accordance with one of the two measurement methods described below.

In case of dispute, tests shall be carried out as originally performed (measurement method 1).

Measurement method 1

The volume control (where it exists) shall be set as close as possible to the position, which gives the nominal value as stated by the manufacturer.

The acoustic sound pressure level (spl) shall be measured using a calibrated artificial ear, as defined in IEC 60318, coupled without loss to the acoustic-receiving device of the TTE. The background acoustic noise shall be less than 40 dB(spl). The audio channel shall be open and active.

The following shall be fulfilled during a sweep in the whole-specified frequency range:

- the TTE shall be able to maintain an established call;
- for TTE supporting telephony service, the following also applies:

the demodulated narrow band 1 kHz (maximum measurement bandwidth of 100 Hz) differential mode signal measured on the telecommunications port* shall not be greater than the values given in table 5.1, measured at the TTE nominal impedance (as specified by the manufacturer);

*NOTE: The signal demodulated inside the EUT caused by the disturbance applied during the immunity testing and affects associated equipment connected to the EUT, are not considered.

- for TTE having an acoustic interface, the following also applies:
the acoustic demodulated sound pressure level (spl) in the receive direction shall not be greater than the values given in table 5.1.

Table 5.1 Maximum acoustic demodulated levels at the telecommunications port and at the acoustic-receiving device (measurement method 1)

Frequency band (MHz)	Type of immunity test	Noise signal (dBm)	Acoustic sound pressure level (dB(spl))
0.15 to 10	Conducted	-50	55
10 to 30 (except 26.95 to 27.29)	Conducted	-50 to –30 See 2)	55 to 75 See 2)
26.95 to 27.29	Conducted	-40	65
30 to 80	Conducted	-20	85
80 to 1000 (except at 900 See 1))	Radiated	-30	75
900 See 1)	Radiated	-50	55

1) This requirement is not applicable for countries where no digital mobile services operating at 900 MHz exist.
NOTE- These tests are designed to ensure a minimum acceptable immunity to amplitude modulated radio-frequency disturbances for devices having acoustic interfaces. The demodulated disturbance levels are higher than those that will be found acceptable in practice. The levels in the tests have been chosen for their practical test convenience, having regard for the maximum allowed background acoustic noise level of 40 dB(spl) and the test levels to be applied for functional testing. The amplitude-modulated disturbances will arise, almost invariably, from semi-conductor junctions behaving as inadvertent square law detectors. This means that for every 1 dB change in the level of the applied radio-frequency signal the demodulated level will change by 2 dB. Therefore, if a radiated immunity test subjecting the EUT to a test field carrier level of 3 V/m produces a resultant demodulated acoustic 1 kHz disturbance output of 55 dB(spl) (a distinctly annoying acoustic level for most listeners with normal hearing, but conveniently above the allowed background noise level of 40 dB(spl)), the test ensures that an amplitude modulated disturbance field of 1 V/m (approximately 10 dB lower field strength) applied to the same equipment in a real world situation can produce a demodulated acoustic disturbance level of approximately 35 dB(spl), which most people in a practical listening environment do not perceive as annoying.
2) The limits change linearly with the logarithm of the frequency.

Measurement method 2

The volume control (where it exists) shall be set at a fixed level during calibration and shall not be changed during the test.

The following shall be fulfilled during a sweep in the whole of the specified frequency range:

- the TTE shall be able to maintain an established call;
- for TTE supporting telephony service, the following also applies:
with the audio channel open and active, the demodulated differential mode noise on the telecommunications port measured at the TTE nominal impedance (as specified by the manufacturer), shall not be greater than the values given in table 5.1. The measurement bandwidth shall be 100 Hz maximum.
- for TTE having an acoustic interface the following also applies:

A sinusoidal signal of 1 kHz, -40 dBm is impressed on the telecommunication line (signal level without the carrier wave). The resulting acoustic sound pressure level is measured using a microphone. The measured level shall be recorded as the reference level and used. The signal used to establish the reference level is switched off during the actual test. The measurement bandwidth shall be 100 Hz maximum.

The background noise shall not exceed a level 15 dB below the reference level.

The demodulated differential mode noise in the receive direction, measured in the way described for the reference level, shall not be greater than the values given in table 5.2. *

*NOTE: The signal demodulated inside the EUT caused by the disturbance applied during the immunity testing and affects associated equipment connected to the EUT, are not considered.

Table 5.2 Maximum acoustic demodulated levels at the telecommunications port (measurement method 2)

Frequency band (MHz)	Type of immunity test	Demodulated differential mode noise (dBm)
0.15 to 10	Conducted	Reference level-10 dB
10 to 30 (except 26.95 to 27.29)	Conducted	Reference level-10 dB to +10 dB See 2)
26.95 to 27.29	Conducted	Reference level
30 to 80	Conducted	Reference level+20 dB
80 to 1000 (except at 900 See 1))	Radiated	Reference level+10 dB
900 See 1)	Radiated	Reference level-10 dB
1) This requirement is not applicable for countries where no digital mobile services operating at 900 MHz exist. See note to table 5.1. 2) The limits change linearly with the logarithm of the frequency.		

b) Selected frequency test

The following shall be fulfilled at the spot frequencies specified in tables 1, 2, 3, and 4 (this may be shown by checking the data sent to the line, to avoid having an operator in the field):

- the TTE shall be able to establish a call with telephony service;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call;
- where the TTE is intended to provide a data (non-telephony) services, the time required for a transmission shall not, as a consequence of the application of the test, increase beyond that defined by the manufacturer.

Performance criterion B

The following shall be fulfilled:

A call established prior to the application of the disturbance shall be maintained.

Requirements to be checked after the application of the disturbance:

- the TTE shall be able to establish a call;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call.

Performance criterion C

Requirements to be checked after the application of the disturbance:

- the TTE shall be able to establish a call;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call.

5.2 Telecommunications terminal equipment (TTE) having a digital interface

5.2.1 Particular test conditions

The TTE shall be configured for connection to a telecommunication line (or reference line) at its nominal impedance. Auxiliary equipment may be used to simulate the telecommunications network.

For digital basic access, ISDN interfaces providing telephony service to the TTE shall be in idle mode as defined for the applied digital to analog conversion.

5.2.2 Particular performance criteria

The following performance criteria are applicable only when the functions are implemented.

Performance criterion A

a) Swept frequency test

Testing shall be carried out in accordance with one of the two measurement methods described below.

In case of dispute, tests shall be carried out as originally performed (measured method 1).

Measured method 1

The volume control (where it exists) shall be set as close as possible to the position, which gives the nominal value as stated by the manufacturer.

The acoustic sound pressure level (spl) shall be measured using a calibrated artificial

ear, as defined in IEC 60318, coupled without loss to the acoustic-receiving device of the TTE. The background acoustic noise shall be less than 40 dB(spl). The audio channel shall be open and active.

The following shall be fulfilled during a sweep in the whole-specified frequency range:

- the TTE shall be able to maintain an established call;
- for TTE supporting telephony service, the following also applies:

the demodulated differential mode noise* and acoustic sound pressure levels in the receive direction shall not be greater than the values given in table 5.3;

*NOTE: This noise means the signal demodulated inside the EUT caused by the disturbance applied during the immunity testing and influences associated equipment connected to the EUT.

- for TTE having an acoustic interface, the following also applies:

the acoustic demodulated sound pressure level (spl) in the receive direction shall not be greater than the values given in table 5.3.

Table 5.3 Maximum demodulated differential mode noise and acoustic sound pressure levels at the telecommunications port and at the acoustic receiving device (measurement method 1)

Frequency band (MHz)	Type of immunity test	Demodulated differential mode noise (dBm0)	Acoustic sound pressure level (dB(spl))
0.15 to 10	Conducted	-50	55
10 to 30 (except 26.95 to 27.29)	Conducted	-50 to –30 See 2)	55 to 75 See 2)
26.95 to 27.29	Conducted	-40	65
30 to 80	Conducted	-20	85
80 to 1000 (except at 900 See 1))	Radiated	-30	75
900 See 1)	Radiated	-50	55
1) This requirement is not applicable for countries where no digital mobile services operating at 900 MHz exist. See note to table 5.1. 2) The limits change linearly with the logarithm of the frequency.			

NOTE: The meaning of “dBm0” is described in clause 3.4 of ITU-T recommendation O.101

Measurement method 2

The volume control (where it exists) shall be set at a fixed level during calibration and shall not be changed during the test.

The following shall be fulfilled during a sweep in the whole specified frequency range:

- the TTE shall be able to maintain an establish call;
- for TTE supporting telephony service, the following also applies:
with the audio channel open and active, the demodulated differential mode noise and acoustic sound pressure level from the EUT, measured in the assigned B-channel, shall not be greater than the values given in table 5.3. The measurement bandwidth shall be 100 Hz maximum at 1 kHz;
- for TTE having an acoustic interface the following also applies:
An "A-law" or a "μ-law"*1) coded digital signal representing a sinusoidal signal of 1 kHz, -40 dBm0 is impressed on the telecommunication line (signal level without the radio frequency disturbance). The resulting acoustic sound pressure level is measured using a microphone. The measured level shall be recorded as the reference level and used. The signal used to establish the reference level is switched off during the actual test. The measurement bandwidth shall be 100 Hz maximum.
During the test, the idle code shall be sent to the EUT in the assigned B-channel.
The background noise shall not exceed a level 15 dB below the reference level.
The demodulated differential mode noise*2) in the receive direction, measured in the way described for the reference level, shall not be greater than the values given in table 5.4.

*NOTE: 1) "A-law" and "μ-law" are both modulation laws applied to PCM coding for acoustic frequency signals. The former is used in Europe, and latter in North America and Japan. Please refer to ITU-T recommendation G. 711 for details.

2) The signal demodulated inside the EUT caused by the disturbance applied during the immunity testing and affects associated equipment connected to the EUT, are not considered.

Table 5.4 Maximum demodulated differential mode noise levels
(measurement method 2)

Frequency band (MHz)	Type of immunity test	Demodulated differential mode noise (dBm)
0.15 to 10	Conducted	Reference level-10 dB
10 to 30 (except 26.95 to 27.29)	Conducted	Reference level-10 dB to +10 dB See 2)
26.95 to 27.29	Conducted	Reference level
30 to 80	Conducted	Reference level+20 dB
80 to 1000 (except at 900 See 1))	Radiated	Reference level+10 dB
900 See 1)	Radiated	Reference level-10 dB
1) This requirement is not applicable for countries where no digital mobile services operating at 900 MHz exist. See note to table 5.1. 2) The limits change linearly with the logarithm of the frequency.		

b) Selected frequency test

The following shall be fulfilled at the spot frequencies specified in tables 1, 2, 3, and 4:

- the TTE shall be able to establish a call with telephony service;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call;
- where the TTE is intended to provide a data (non-voice) service, the time required for a transmission shall not, as a consequence of the application of the test, increase beyond that defined by the manufacturer.

For ISDN equipment for primary access only the following also applies:

The number of loss of frame alignments shall be less than 10 within a test period of 10 seconds. Where it can be clearly established that a voice call is maintained throughout the test it is not then required to evaluate the loss of frame alignment.

Performance criterion B

The following shall be fulfilled:

A call established prior to the application of the phenomena shall be maintained.

Requirements to be checked after the application of the phenomena:

- the TTE shall be able to establish a call;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call.

Performance criterion C

Requirements to be checked after the application of the phenomena:

- the TTE shall be able to establish a call;
- the TTE shall be able to receive a call;
- the TTE shall be able to clear a call.

5.3 Facsimile

5.3.1 Particular test conditions

The EUT shall be connected to a second EUT or simulator which permits a test pattern to be sent to and be received from the EUT. A test pattern selected from the relevant ITU-T recommendation is preferred but is not mandatory. The following requirements are in addition to the TTE performance requirements.

5.3.2 Particular performance criteria

Performance criterion A

The EUT shall operate normally during and after the test without:

- data transfer errors, for example no retries beyond the specified maximum;
- degradation of the printed image beyond the manufacturer's specification;
- color change beyond the manufacturer's specification;
- re-initiating a call.

Performance criterion B

As for performance criteria A, with the following exceptions, which are permitted during the application of the disturbance, provided that normal operation of the EUT is recoverable to the condition immediately before the application of the disturbance:

- degradation of the printed image beyond the manufacturer's specification;

Performance criterion C

Any degradation of performance is permitted, provided that normal operation is self-recoverable, or can be restored after the test by the use of operator controls, and provided that:

- any interruptions in the transmission are logged and the user notified;
- the EUT can re-establish a call;
- the EUT can receive a call;
- the EUT can clear a call.

6. Performance criteria for data processing equipment

The test shall be carried out using an exercising program, which can repeat the sequences for functions of equipment and, in case of failure, enable an operator to recognize the nature of failure by display or by operator's operation.

The test sequences shall be selected from the following below according to the functions defined by the manufacturer of the equipment to be tested, and the performance criterion A, B or C shall be selected according to the disturbance to be tested.

6.1 Read, write and storage of data

6.1.1 Particular test conditions

Data read and write cycles shall be repeated with internal storage devices such as semi-conductor memories, magnetic or optical desks or magnetic tape devices, and then the copied back data shall be compared with the original.

Read only memories (ROM) shall be read repeatedly and this data compared with the expected data.

6.1.2 Particular performance criteria

Performance criterion A

Storage devices shall maintain normal operation both in read/write and in stand-by conditions.

Performance criterion B

Failures which can be recovered by read and write retries are permissible (temporary delay in processing caused by this process is acceptable).

Normal operation of the EUT shall be restored after the test, self-recovery to the conditions immediately prior to the application of the test is accepted where this is a normal means of recovery. In these cases, operator response is permitted to re-initialize an operation.

Performance criterion C

Failures resulting in a delay in processing after the external disturbance is removed, but which can be recovered to normal operation by reset or reboot are permissible.

Failures resulting in a system abort which can be recovered to normal operation by reset or reboot are permissible.

6.2 Data display

6.2.1 Particular test conditions

Text or graphics shall be displayed on display devices such as CRT monitors and liquid crystal, plasma or LED displays.

6.2.2 Particular performance criteria

Performance criterion A

When seen from the normal viewing distance, the EUT shall operate with no change beyond the manufacturer's specification, in flicker, color, focus and jitter (except for the power frequency magnetic field test).

Power frequency magnetic field test

For CRT monitors, the following also applies:

The jitter shall be measured using a measuring microscope as specified in 6.6.14 of JIS Z 8513.

The jitter (in mm) shall not exceed the following value when the CRT monitor is immersed in a continuous magnetic field of 1 A/m (r.m.s) at one of the power frequencies 50 or 60 Hz.

$$\frac{(\text{character height in mm}+0.3)\times 2.5}{33.3}$$

Alternatively, a field of 50 A/m may be applied, and a transparent graduated mask used to assess the jitter. In that case, the jitter shall not exceed 50 times the value in the above formula.

NOTE- This test level is used to simplify the measurement of jitter. Lesser values of the test level may be used if non-linearity is experienced, due to, for example, saturation of screening material.

The EUT shall be tested in two positions, both perpendicular to the magnetic field.

Performance criterion B

Screen disturbances during the application of the test are permissible.

Performance criterion C

Failures which are not self-covered after removal of the external disturbance, but which can be recovered to normal operation by reset or reboot are permissible.

6.3 Data input

6.3.1 Particular test conditions

Data shall be acquired with input devices such as keyboard, mouse, magnetic card reader, optical character reader, image scanner, input pen or miscellaneous sensors.

Though continuous input is preferable, testing in the stand-by condition is permitted for equipment, which requires operator's attendance for operation.

When the EUT is a mass data input device, such as a character reader or scanner, then the central processing unit shall run a program, which reads an appropriate test chart continuously for the duration of the test. Read data inputs are displayed, printed directly, or stored for later evaluation.

6.3.2 Particular performance criteria

Performance criterion A

Unintended input from input device is not allowed.

Input devices shall maintain the specified quality image data.

Performance criterion B

Keyboard/mouse "lock up" is not allowed.

For equipment with manually inputted data which can be confirmed by reading the display, errors, which can be recognized by the operator and easily corrected are permissible.

Performance criterion C

Failures resulting in a delay in processing after the external disturbance is removed, but which can be recovered to normal operation by reset or reboot are permissible.

Failures resulting in a system abort which can be recovered to normal operation by reset or reboot are permissible.

6.4 Data printing

6.4.1 Particular test conditions

Data shall be printed by printers or plotters. For equipment, which has several operation modes, test shall be selected in the most typical operation mode.

6.4.2 Particular performance criteria

Performance criterion A

Printers shall maintain the specified printing quality and normal operation.

Performance criterion B

No degradation of the printing quality beyond the manufacturer's specification (such as distortion of character(s) or missing pixels) is permissible.

Performance criterion C

Printing errors or omission of character(s), which require reprinting, are permissible.

Input/output failure, which can be recovered, to normal operation by reset or reboot are also permissible.

6.5 Data processing

6.5.1 Particular test conditions

Data processing, such as computation, data conversion, storage or transfer shall be performed, and the results of processing shall be compared with results in normal operation.

6.5.2 Particular performance criteria

Performance criterion A

Failures which do not influence the specified operation within the product specification, and which do not prevent automatic recovery are permissible.

Performance criterion B

Failures, which are recovered automatically but cause temporary delay in processing, are permissible.

Performance criterion C

Failures resulting in a delay in processing after the external disturbance is removed, but which can be recovered to normal operation by reset or reboot are permissible.

Failures resulting in a system abort, which can be recovered to normal operation by reset or reboot, are permissible.

Failures, which are followed by alarms and can be recovered to normal operation by the operator's intervention are permissible.

7. Performance criteria for local area networks (LAN)

7.1 Particular test conditions

A minimum test configuration consists of two pieces of terminal equipment interconnected with manufacture specified physical cable. Associated equipment necessary to the function of the LAN shall be included in the test configuration. Unused ports shall be treated according to the manufacture's instructions.

The system shall be capable of delivering and receiving data at the specified nominal transmission rate.

The LAN equipment executes a program, which exercise the LAN functions. As a minimum, the functions below shall be assessed.

7.2 Particular performance criteria

Performance criterion A

During and after the test, the EUT shall operate without:

- error rate beyond the figure defined by the manufacturer;
- requests for retry beyond the figure defined by the manufacturer;
- speed of data transmission rate beyond the figure defined by the manufacturer;
- protocol error,
- loss of link.

Performance criterion B

Error rate, request for retry and speed of data transmission rate may be degraded during the application of the test.

Degradation of the performance as described in criteria A is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test. In these cases, operator response is permitted to re-initiate an operation.

Performance criterion C

Degradation of the performance as described in criteria A and B is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test or can be restored after the test by the operator.

8. Performance criteria for printers

8.1 Particular test conditions

Data shall be printed with printers or plotters. No standard image is required, but the use of a text containing more than three character fonts and at least one grid of lines is recommended. Character pitch and line spacing should be small. If the dot density can be selected, the highest density shall be chosen. Tests shall be carried out with the EUT in the printing mode.

8.2 Particular performance criteria

Performance criterion A

The EUT shall operate without degradation of performance during and after the application of the disturbance. For example, there shall be no:

- loss or corruption of data during input/output operations;
- degradation of the printed image beyond the manufacturer's specification;
- change in output mode or character font;
- perceptible change in dot-pitch;
- unintended line or page feed.

Performance criterion B

As for performance criterion A, with the following exceptions:

- degradation of the printed image beyond the manufacturer's specification is allowed;
- misalignment of the grid lines is allowed;
- unintended line feed is allowed.

After the disturbance is removed, normal operation of the EUT is self-recoverable to the condition immediately before the application of the test; this may involve an operator response to re-initiate the operation.

Performance criterion C

Degradation of the performance as described in criteria A and B is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test or can be restored after the test by the operator.