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Electromagnetic compatibility requirements for power equipment in telecommunication facilities

Recommendation ITU-T K.152

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Electromagnetic compatibility requirements for power equipment in telecommunication facilities

Summary

Recommendation ITU-T K.152 specifies requirements for radiated and conducted emissions from power equipment installed in telecommunication facilities. Power equipment within the scope of this Recommendation includes rectifiers that supply direct current (DC) voltages of up to 400 V, power-conditioning systems (PCSs) including grid-connected power converters (GCPCs), uninterruptible power supplies (UPSs). The power equipment usually includes power conversion devices and may generate conducted and radiated electromagnetic disturbances and cause degradation of the performance of telecommunication systems that Recommendation ITU-T K.152 aims to prevent.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T K.152	2022-08-13	5	11.1002/1000/15022

Keywords

Conducted emission, immunity telecommunication facility, power conversion device, power equipment, radiated emission.

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Electromagnetic compatibility requirements for power equipment in telecommunication facilities

1 Scope

This Recommendation specifies emission and immunity requirements for power equipment that is installed inside or on the roof of telecommunication facilities.

This Recommendation applies to equipment including supply systems with embedded power conversion devices (e.g., direct current (DC) to alternating current (AC) inverters, DC to DC, AC to DC and AC to AC converters), power-conditioning systems (PCSs) including grid-connected power converters (GCPCs) and uninterruptible power supplies (UPSs).

Power devices integrated into equipment that directly provides telecommunication services are excluded from the scope of this Recommendation as they are covered by specific electromagnetic compatibility (EMC) Recommendations such as [b-ITU-T K.136] and [b-ITU-T K.137].

This Recommendation specifies measurement methods and limits for emission requirements and immunity requirement to ensure proper operation within the required reliability range. Guidance on any unintentional voltage or current at AC and DC power ports is also provided in this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T K.38] Recommendation ITU-T K.38 (1996), *Radiated emission test procedure for physically large systems*.

[ITU-T K.76] Recommendation ITU-T K.76 (2022), *EMC requirements for DC power ports of telecommunication network equipment in the frequency range below150 kHz)*.

[ITU-T L.1200] Recommendation ITU-T L.1200 (2012), *Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment.*

[IEC CISPR 11] IEC CISPR 11:2019, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement.*

[IEC CISPR 16-1-2] IEC CISPR 16-1-2:2017, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements.*

[IEC CISPR 16-1-4] IEC CISPR 16-1-4: 2020, *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*.

[IEC CISPR 16-2-1] IEC CISPR 16-2-1:2017, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*.

[IEC CISPR 16-2-3] IEC CISPR 16-2-3: 2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*.

[IEC CISPR 32] IEC CISPR 32:2019, *Electromagnetic compatibility of multimedia equipment – Emission requirements.*

[IEC 61000-3-2] IEC 61000-3-2:2020, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase).*

[IEC 61000-3-3] IEC 61000-3-3: 2021, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection.*

[IEC 61000-3-11] IEC 61000-3-11:2017, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤75 A and subject to conditional connection.*

[IEC 61000-3-12] IEC 61000-3-12:2021, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase.*

[IEC 61000-4-2] IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.*

[IEC 61000-4-3] IEC 61000-4-3:2020, *Electromagnetic compatibility (EMC) – Part 4-3 : Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.*

[IEC 61000-4-4] IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.*

[IEC 61000-4-5] IEC 61000-4-5: 2017, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.*

[IEC 61000-4-6] IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields.*

[IEC 61000-4-8] IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test.*

[IEC 61000-4-11] IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with Input current up to 16 A per phase.*

[IEC 61000-4-29] IEC 61000-4-29:2000, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests.*

[IEC 61000-4-34] IEC 61000-4-34:2009, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase.*

[IEC 62040-2] IEC 62040-2:2016, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements.*

[IEC 62040-3] IEC 62040-3:2021, *Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.*

[IEC TS 62578] IEC Technical Specification 62578:2015, *Power electronics systems and equipment – Operation conditions and characteristics of active infeed converter (AIC) applications including design recommendations for their emission values below 150 kHz.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 AC mains power port [IEC CISPR 11]: Port used to connect to the mains supply network.

3.1.2 active infeed converter (AIC) [IEC TS 62578]: Self-commutated electronic power converters of all technologies, topologies, voltages and sizes which are connected between the AC power supply system (lines) and a stiff DC-side (current source or voltage source) and which can convert electric power in both directions (generative or regenerative) and which can control the reactive power or the power factor.

Some of them can additionally control the harmonics to reduce the distortion of an applied voltage or current.

Basic topologies may be realized as a voltage source converter (VSC) or a current source converter (CSC).

3.1.3 artificial mains network (AMN) [IEC CISPR 11]: Network that provides a defined impedance to the EUT at radio frequencies, couples the disturbance voltage to the measuring receiver and decouples the test circuit from the supply mains.

3.1.4 continuous disturbance [b-ITU-T K.48]: Electromagnetic disturbance whose effects on a particular device or piece of equipment cannot be resolved into a succession of distinct effects.

3.1.5 DC artificial mains network (DC-AN) [IEC CISPR 11]: Artificial network that provides defined termination to the EUT's DC power port under test while also providing the necessary decoupling from conducted disturbances originating from the laboratory DC power source or from the load.

3.1.6 DC network power port [IEC CISPR 32]: Port, not powered by a dedicated AC/DC power converter and not supporting communication, that connects to a DC supply network.

3.1.7 DC power port [IEC CISPR 11]: Port used to connect to a low voltage DC power generating system or energy storage, or to another source/load.

3.1.8 electromagnetic disturbance [b-IEC 60050-161]: Electromagnetic phenomenon that can degrade the performance of a device, equipment or system, or adversely affect living or inert matter.

3.1.9 electromagnetic interference (EMI) [IEC 60050-161]: Degradation in the performance of equipment, transmission channel or a system caused by an electromagnetic disturbance.

3.1.10 enclosure port [b-IEC 61000-6-6]: Physical boundary of the apparatus which electromagnetic fields may radiate through or impinge upon. The equipment case is normally considered the enclosure port.

3.1.11 grid connected power converter (GCPC) [IEC CISPR 11]: Power converter connected to an AC mains power distribution network or other AC mains installation and used in a power generating system.

NOTE – GCPC is popularly used in photovoltaic systems etc.

3.1.12 high power electronic system and equipment [IEC CISPR 11]: One or more semiconductor power converters with a combined rated power greater than 75 kVA, or an equipment containing such converters.

3.1.13 industrial, scientific and medical (ISM) applications (of radio frequency energy) [b-ITU RR 1]: Operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications.

3.1.14 minimum representative system: A system that contains the minimum number of units needed to perform all functions specified for the system.

NOTE – Paraphrased form clause 4.1 of [ITU-T K.38].

3.1.15 photovoltaic power generating system [IEC CISPR 11]: Electric power generating system which used the photovoltaic effect to convert solar power into electricity.

3.1.16 power supply [ITU-T K.48]: A power source to which telecommunication equipment is intended to be connected.

3.1.17 signal/control port [IEC CISPR 32]: Port intended for the interconnection of components of an EUT, or between an EUT and AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it).

3.1.18 telecommunication facility [b-ITU-T K.132]: A facility that mainly houses telecommunication equipment, such as telecommunication equipment rooms or remotely located telecommunication sites.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AC	Alternating Current
AE	Auxiliary Equipment
AIC	Active Infeed Converter
AMN	Artificial Mains Network
CDN	Coupling and Decoupling Network
CRT	Cathode Ray Tube
DC	Direct Current
DC-AN	Direct Current-Artificial Network
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference

EUT Equipment Under Test

GCPC Grid-Connected Power Converter

ICT Information and Communication Technology

PCS Power-Conditioning System

UPS Uninterruptible Power Supply

5 Conventions

This Recommendation uses the following convention:

U_T : Rated voltage of the equipment under test

6 Connection of equipment in a telecommunication centre

Figures 1 and 2 illustrate examples of the configuration of equipment and connection of power lines in telecommunication centres.

Figure 1 shows an example of a traditional telecommunication centre, where a −48 V DC power supply system is used for the telecommunication network. A conducted emission from GCPCs, air conditioners and lighting equipment enters the rectifier, and this may cause malfunction of the rectifier itself and of telecommunication equipment by conducted disturbance through the DC power line. The electromagnetic field emitted from the power line and the enclosure of the equipment may also cause interference in the telecommunication equipment. The emitted harmonic current to the AC power line may cause malfunction in the power distribution system external to the telecommunication facility.

Telecommunication equipment supporting an analogue subscriber line is sensitive to electrical noise below 20 kHz on a DC power line and emits audible noise on the analogue interface. A specific requirement in [ITU-T K.76] is applied to avoid the interference.

Figure 2 shows an example of a telecommunication centre where 400 V DC power supply systems are used for telecommunication network equipment. The interferences transmitted through power lines present a situation similar to the case of the −48 V DC power supply and electromagnetic fields are emitted from lines and enclosures in the same way. Therefore, the same kinds of requirements are applied to the equipment.

The requirement for interfaces feeding up to 400 V DC at the input to telecommunication equipment is shown in [ITU-T L.1200].

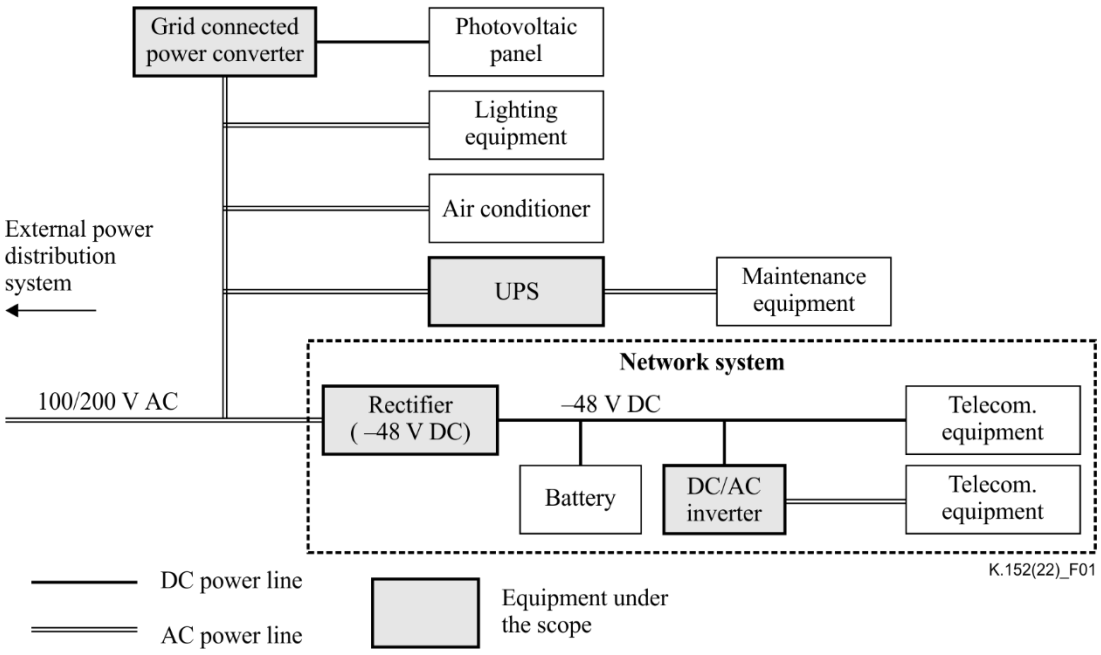


Figure 1 – An example of a −48 V DC power supply system

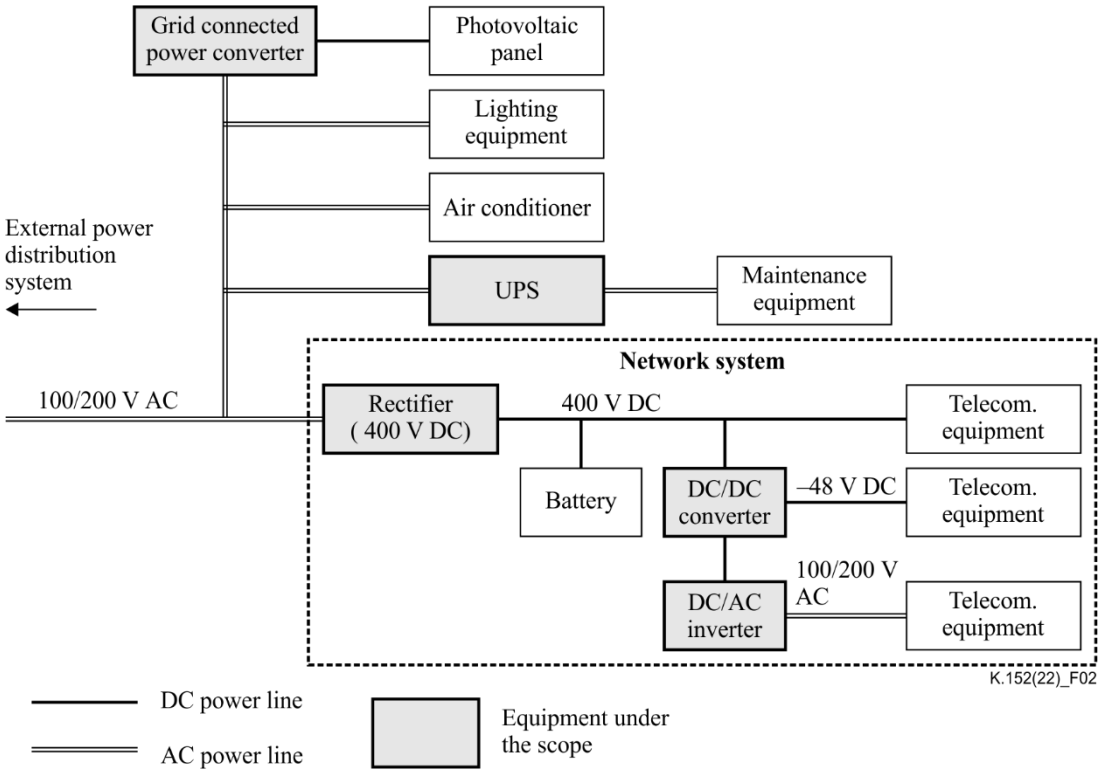


Figure 2 – An example of a 400 V DC power supply system

7 Test methods and limits

7.1 Emissions from 9 kHz to 6 GHz

Basically, both conducted and radiated emission for power systems needed for the operation of telecommunication systems should be tested in accordance with [IEC CISPR 32] and [IEC TS 62578].

If the equipment under test (EUT) is part of a system or can be connected to associated equipment, the EUT shall be tested while connected to the minimum representative configuration necessary to exercise the ports in a similar manner to that described in [IEC CISPR 11] or [IEC CISPR 32].

Test for photovoltaic equipment should be conducted according to configurations specified in [IEC CISPR 11]. Conducted emission measurement at power input and output ports should be made using the artificial mains network (AMN) at each port, if available, as detailed in [IEC CISPR 32]. In order to demonstrate compliance of physically large systems with radiated emission tests, [ITU-T K.38] applies. A minimum system that is representative of those installed in terms of function (which includes at least one of each functional unit type) and electromagnetic radiation characteristics is specified in [ITU-T K.38].

7.1.1 Conducted emission at AC and DC power input ports

Conducted emissions above 150 kHz at an AC power input port (mains) should be measured in accordance with clause A.3 of [IEC CISPR 32], and those below 150 kHz with [IEC CISPR 16-2-1] using the AMN. EUT, local auxiliary equipment (AE) and associated cabling should be arranged in accordance with Annex D of [IEC CISPR 32]. Conducted emission at DC power input ports should be measured using DC-AN. Table 1 shows measurement methods and limits of conducted emission at AC and DC mains ports. The conducted emission limit requirements below 150 kHz are tentative; they are not, at the time of publication, normative. These limits will be aligned with those of IEC or CISPR when available.

Detailed aspects of emissions from AICs are described in [IEC TS 62578].

Table 1 – Measurement methods and limits of conducted emission at AC and DC mains ports

Coupling device	Frequency	Quasi-peak limit (dBµV)	Average limit (dBµV)	Basic standard	Validation method
AC mains power input ports					
AMN	9 kHz to 50 kHz (Note 1, Note 2)	138 to 127.5 (120.5 to 110) Note 3	125 to 114.5	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	50 kHz to 150 kHz (Note 1, Note 2)	127.5 to 100 (104 to 80) Note 3	114.5 to 87		
	0.15 MHz to 0.5 MHz	79	66	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	0.5 MHz to 30 MHz	73	60		
DC mains power input ports					
DC-AN	9 kHz to 50 kHz (Note 1, Note 2, Note 4)	148 to 137.5	135 to 124.5	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	50 kHz to 150 kHz (Note 1, Note 2, Note 4)	137.5 to 110	124.5 to 97		
	0.15 MHz to 0.5 MHz (Note 2)	89	76	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]

Table 1 – Measurement methods and limits of conducted emission at AC and DC mains ports

Coupling device	Frequency	Quasi-peak limit (dBμV)	Average limit (dBμV)	Basic standard	Validation method
	0.5 MHz to 30 MHz (Note 2)	83	70		
NOTE 1 – The limit shall decrease linearly with the logarithm of the frequency in the range of 9 kHz to 150 kHz. NOTE 2 – The value is determined assuming that the emission is from a current source and considering the impedance difference of AMN, according to [IEC CISPR 16-1-2] and DC-AN according to CISPR 16-1-2, i.e., 50 Ω and 150 Ω. NOTE 3 – These limits are derived from [IEC TS 62578]. Limits in parenthesis are not normative but they should be considered for power units directly connected to Low Voltage public network, where smart meters can be present, and without transformer on the AC power input and without a UPS). NOTE 4 – These limits are not normative and can be requested by telecom operators when power units are connected to the DC power network where information and communication technology (ICT) equipment can be connected. Furthermore, in the case of power units connected to the DC power network where the connected ICT equipment has analogue subscriber ports, the requirement in clause 8.2 applies.					

7.1.2 Conducted emission at AC and DC power output ports

Conducted emissions at an AC power output port (mains) should be measured using an AMN. Those at a DC power input port should be measured using a DC-AN.

The measurement method and limit can be applied to a port that is intended for connection to a cable longer than 3 m. Table 2 shows measurement methods and limits of conducted emissions at AC and DC power output ports.

Table 2 – Measurement methods and limits of conducted emission from AC and DC power output ports

Coupling device	Frequency	Quasi-peak limit (dBμV)	Average limit (dBμV)	Basic standard	Validation method
AC mains power output ports					
AMN	9 kHz to 50 kHz (Note 1)	138 to 127.5	125 to 114.5	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	50 kHz to 150 kHz (Note 1)	127.5 to 100	114.5 to 87		
	0.15 MHz to 0.5 MHz	79	66	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	0.5 MHz to 30 MHz	73	60		
DC mains power output ports					
DC-AN	9 kHz to 50 kHz (Note 1, Note 2, Note 3)	148 to 137.5	135 to 124.5	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	50 kHz to 150 kHz	137.5 to 110	124.5 to 97		

Table 2 – Measurement methods and limits of conducted emission from AC and DC power output ports

Coupling device	Frequency	Quasi-peak limit (dBμV)	Average limit (dBμV)	Basic standard	Validation method
	(Note 1, Note 2, Note 3)				
	0.15 MHz to 0.5 MHz (Note 2)	89	76	Clause 7 of [IEC CISPR 16-2-1]	Clause 4 of [IEC CISPR 16-1-2]
	0.5 MHz to 30 MHz (Note 2)	83	70		
NOTE 1 – The limit shall decrease linearly with the logarithm of the frequency in the range of 9 kHz to 150 kHz. NOTE 2 – The value is determined assuming that the emission is from a current source and considering the impedance difference of AMN, according to [IEC CISPR 16-1-2], and DC-AN according to [IEC CISPR 16-1-2], i.e., 50 Ω and 150 Ω. NOTE 3 – These limits are not normative and can be requested by telecom operator when power units are intended to feed ICT equipment. Furthermore, if ICT equipment has analogue subscriber ports, the requirement of clause 8.2 applies.					

7.1.3 Conducted emission at signal ports

Conducted emissions at a signal port such as an interface to control equipment should be measured in accordance with Annex C and clause A.3 of [IEC CISPR 32] using the asymmetrical artificial network (AAN). EUT, local AE and associated cabling should be arranged in accordance with Annex D and clause C.4.1.1 of [IEC CISPR 32].

The measurement methods and limits can be applied to a port that is intended to be connected to a cable longer than 3 m. Table 3 shows measurement methods and limits of conducted emission from signal ports.

Table 3 – Measurement methods and limits of conducted emission from signal ports

Coupling device	Frequency (MHz)	Quasi-peak limit (dBμV)	Average limit (dBμV)	Basic standard	Validation method
Signal ports					
AAN	0.15 to 0.5	79	66	Clause 7 of [IEC CISPR 16-2-1]	Clause 7 of [IEC CISPR 16-1-2] Table C.2. of [IEC CISPR 32]
	0.5 to 30	73	60		

7.1.4 Conducted emission specifically from GCPC

Conducted emissions at AC and DC power input ports should be measured in accordance with clause 7.6.10 of [IEC CISPR 11]. The test setup for GCPC shall be in accordance with Annex J of [IEC CISPR 11]. Table 4 shows measurement methods and limits of conducted emission from GCPC.

Table 4 – Measurement method and limits of conducted emission from GCPC

Coupling device	Frequency (MHz)	Quasi-peak limit (dBμV)	Average limit (dBμV)	Basic standard	Validation method
AC mains ports					
AMN	0.15 to 0.5	79	66	Annex J of [IEC CISPR 11]	
	0.5 to 30	73	60		
DC power generator port					
DC-AN	0.15 to 0.5	97 to 89	84 to 76	Annex J of [IEC CISPR 11]	
	0.5 to 30	89	76		

7.1.5 Radiated emission from enclosure port

Test methods for radiated emission are based on [IEC CISPR 32]. Refer to [IEC CISPR 11] for measurement of radiated emissions from specific features of electrical systems. Table 5 shows measurement methods and limits of radiated emission from enclosure ports.

Table 5 – Measurement methods and limits of radiated emission from enclosure ports

Frequency (MHz)	Measurement facility	Validation method	Measurement procedure	Quasi-peak limit (dB μV/m)	Average limit (dB μV/m)	Peak limit (dB μV/m)
30 to 230	Semi-anechoic chamber or open area test site 10 m distance	Clause 5.3 of [IEC CISPR 16-1-4]	Clause 7.3 of [IEC CISPR 16-2-3]	40	–	–
230 to 1 000				47	–	–
1 000 to 3 000	Free space open area test site 3 m distance	Clause 8.3 of [IEC CISPR 16-1-4]	Clause 7.6.6 of [IEC CISPR 16-2-3]	–	60	80
3 000 to 6 000				–	60	80

7.2 Immunity

7.2.1 General

Test levels for power equipment are shown in Table 6. The EUT is required to fulfil the compliance criteria when tested at levels lower than those specified.

Radiated immunity tests should be applied up to 6 GHz considering that high-frequency bands, for example, 3.5 GHz for cellular mobile systems and 5.8 GHz for wireless fidelity have been used. The test should be conducted in accordance with [IEC 61000-4-3].

Conducted immunity tests should be applied to one port at a time and performed on power input and output ports, as well as on all signal ports to which cables are permanently connected in usual use. For a single EUT with multiple power ports intended to be connected to the same power source, conducted immunity tests can be applied to all ports at the same time. If in normal installation practice

multi-pair cables (e.g., 64 × balanced pairs) and composite cables (e.g., a combination of fibre and copper) are used, they may be tested as one port.

For multi-pair cables, conducted immunity tests where a multi-pair coupling and decoupling network (CDN) does not exist should be applied to a single pair using an appropriate CDN. The remaining pairs should be tested one by one, or current- or electromagnetic-clamp method could be used for multi-pair cables according to [IEC 61000-4-6].

The EUT and all signal ports should comply with the given compliance criteria during and after performance of a surge test to power port. The tested port should be checked against the compliance criteria after performance of a surge test to signal port. If requested, it is allowed to test equipment with primary protection installed, and the test conditions should be recorded in the test report.

The basic-level requirements in Table 6 have been selected to ensure an adequate level of immunity for power equipment with normal reliability; if a high reliability is preferred, the enhanced level requirements in Table 6 can be selected. The levels do not, however, cover extreme phenomena that may occur with a low probability at any environmental location. Special cases may arise when the levels of disturbance exceed the immunity test levels specified in Table 6. In these conditions, special mitigation measures or protection may have to be implemented.

Table 6 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
		Basic level	Enhanced level			
Enclosure port						
Electrostatic discharge	kV	4 (contact) 4 (air)	6 (contact) 8 (air)	[IEC 61000-4-2]	B	
Radio-frequency electromagnetic field	MHz V/m %AM (1 kHz)	80 ~ 690 3 80	80 ~ 690 10 80	[IEC 61000-4-3]	A	
		690 ~ 6 000 10 80	690 ~ 6 000 20 80			
Power-frequency magnetic field	Hz A/m (r.m.s.)	–	50 3	[IEC 61000-4-8]	A	(Note 15) (Note 16)
Outdoor telecommunication ports (Note 1)						
Electrical fast transients or bursts	kV (rise time/time to half-value, T_r/T_h) ns repetition rate kHz	0.5 5/50 5	1 5/50 5	[IEC 61000-4-4]	B	(Note 3)
Radio-frequency conducted continuous	MHz V %AM (1 kHz)	0.15 ~ 80 3 80	0.15 ~ 80 10 80	[IEC 61000-4-6]	A	(Note 4) (Note 13)

Table 6 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
		Basic level	Enhanced level			
Surges	(T_r/T_h) μs kV kV	1.2/50 0.5 (line to line) 1 (line to ground)	1.2/50 0.5 (line to line) 1 (line to ground)	[IEC 61000-4-5]	B	(Note 5) (Note 7)
		10/700 1 (line to ground)	10/700 0.5 (line to line) 1 (line to ground)			(Note 14)
Indoor telecommunication ports						
Electrical fast transients/bursts	kV (T_r/T_h) ns repetition rate kHz	0.5 5/50 5	1 5/50 5	[IEC 61000-4-4]	B	(Note 2) (Note 3)
Radio-frequency conducted continuous	MHz V %AM (1 kHz)	0.15 ~ 80 3 80	0.15 ~ 80 10 80	[IEC 61000-4-6]	A	(Note 2) (Note 4) (Note 13)
Surges	(T_r/T_h) μs kV	1.2/50 (8/20) 0.5 (line to ground)	1.2/50 (8/20) 0.5 (line to ground)	[IEC 61000-4-5]	B	(Note 5) (Note 6)
AC power port						
Electrical fast transients/Bursts	kV (T_r/T_h) ns kHz	1 5/50 5	2 5/50 5	[IEC 61000-4-4]	B	
Radio-frequency conducted continuous	MHz V %AM (1 kHz)	0.15 ~ 80 3 80	0.15 ~ 80 10 80	[IEC 61000-4-6]	A	(Note 4) (Note 13)
Surges	(T_r/T_h) μs kV kV	1.2/50 (8/20) 0.5 (line to line) 1 (line to ground)	1.2/50 (8/20) 1 (line to line) 2 (line to ground)	[IEC 61000-4-5]	B B	

Table 6 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
		Basic level	Enhanced level			
Voltage dips and interruption	% reduction cycle period	–	> 95 1	[IEC 61000-4-11]	B	(Note 8)
		–	30 25/30 at 50 Hz/60 Hz		C	
		–	> 95 at 50 Hz/60 Hz		C	
	% reduction cycle period	–	> 95 0.5	[IEC 61000-4-34]	B	(Note 11)
		–	30 25/30 at 50 Hz/60 Hz		C	
		–	> 95 250/300 at 50 Hz/60 Hz		C	
DC power port (output, input)						
Fast transients	kV (T_r/T_h) ns repetition rate kHz	0.5 5/50 5	1 5/50 5	[IEC 61000-4-4]	B	(Note 2) (Note 3)
Radiofrequency conducted continuous	MHz V %AM (1 kHz)	0.15 ~ 80 3 80	0.15~80 10 80	[IEC 61000-4-6]	A	(Note 2) (Note 4) (Note 13)
Surges	(T_r/T_h) µs kV kV	–	1.2/50 (8/20) 0.5 (line to line) 1 (line to ground)	[IEC 61000-4-5]	B B	
Voltage dips, Voltage interruption, Voltage Variation		Residual voltage %U_T	Duration time s	[IEC 61000-4-29]	–	
	Voltage inter-ruption	0	0.004		A	(Note 17)
			0.01		C (Note 9) (Note 10) (Note 12)	
			0.1			
	Voltage Variation	From 0 to 90	1		C	(Note 18)
		From 110 to 125	1			
	Abnormal Voltage	From 100 to 90	2		A	
		From 100 to 110	2			

Table 6 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
		Basic level	Enhanced level			
NOTE 1 – Outdoor lines carrying DC power with superimposed signals should be treated as outdoor signal lines. NOTE 2 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 3 m. NOTE 3 – The repetition rate for any type of digital subscriber line port should be 100 kHz. Re-testing of equipment tested according to the earlier version of the basic standard with the repetition rate of 5 kHz is not required. NOTE 4 – The test level can be determined as equivalent current into 150 Ω. NOTE 5 – This test may not be applied for unscreened cable when an appropriate CDN does not exist. NOTE 6 – Only applies when the overall cable length between the EUT and another item of active equipment is greater than 30 m. NOTE 7 – This test applies to symmetrical or unsymmetrical metrical screened cables and to coaxial cables. NOTE 8 – This test applies to equipment having a rated input current not exceeding 16 A per phase. NOTE 9 – 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 should be taken into account. More detailed information about the service interruption should be provided by the manufacturer on the request of the operator. NOTE 10 – To prevent system malfunctioning, additional arrangements concerning the power supply system may be necessary. E.g., dual feeding system; high ohmic distribution system; independent power distribution. NOTE 11 – This test applies to equipment having a rated input current more than 16 A per phase. NOTE 12 – This test is applicable only in equipment in which the battery back-up is not permanently connected to the DC distribution system. NOTE 13 – The test for enhanced level is 10 V, except for the ITU-T broadcast frequency band: 47 MHz to 68 MHz, where the test level should be 3 V. NOTE 14 – This test applies to symmetrical and unsymmetrical unscreened cables. NOTE 15 – This test applicable only to equipment containing devices susceptible to magnetic fields, such as cathode ray tube (CRT) monitors, Hall elements, electrodynamic microphones, magnetic field sensors. NOTE 16 – For CRTs the acceptable jitter depends upon the character size and is computed for a test level of 1 A/m as follows: Jitter (mm)= (3×character height in mm + 1)/40 As jitter is linearly proportional to the magnetic field strength, tests can be carried out at other test levels extrapolating the maximum jitter level appropriately. NOTE 17 – The test should be carried out at both high and low output impedance of test generator. NOTE 18 – The test simulates a change in the DC voltage from the nominal value to a lower value or to a higher value.						

7.3 Operational conditions

All measurements should be made in the operating mode that produces the largest emissions consistent with normal use. The operating conditions and power consumption level of the EUT shall be selected to maximize the emission level. The EUT load should be adjusted within the normal operating range in order to maximize emissions.

If the emission spectrum changes depending on the operation mode, measurement should be conducted in more than one mode, so as not to overlook the maximum emission at different frequencies.

Concerning devices for power supply systems and PCSs, the following conditions shall apply:

- the load on the EUT terminating the power output should be resistive unless otherwise specified in the agreement between operator and manufacturer;
- the test shall be carried out at the nominal input voltage;

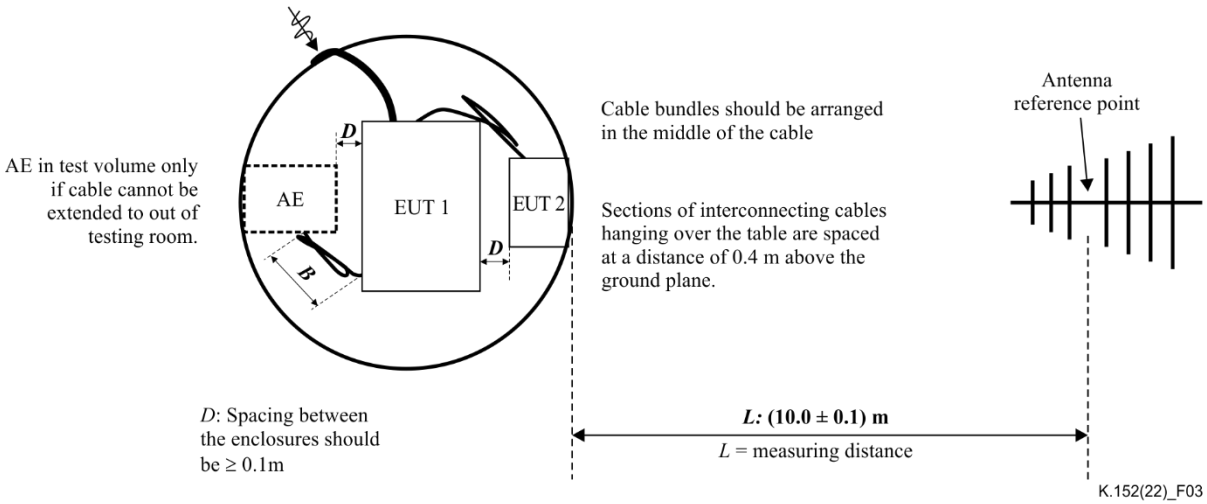
- the measurement shall be conducted in consideration of whether the AC mains are on or off;
- the signal or control ports should be correctly terminated either by the AE necessary to exercise the ports or by its nominal impedance.

7.4 Test configuration

Conducted emission is measured on the power input and output ports with AMN on both ports and on one signal/control interface of each type found on the equipment. The configuration of the EUT shall be precisely documented in the test reports.

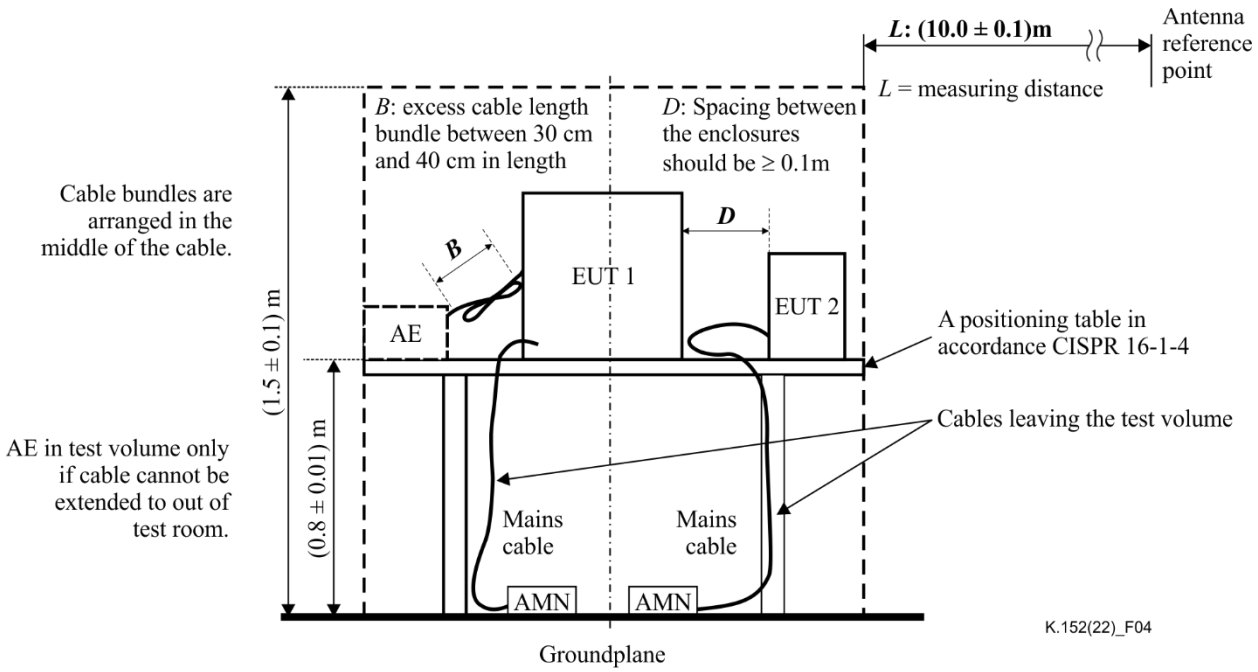
An example of a typical setup for measurement of radiated disturbances from table-top EUTs is provided in [IEC CISPR 11]. However, the use of a common mode absorption device is not recommended for the tests in this Recommendation (see Figures 3 and 4).

An example of a typical unified test setup for floor-standing equipment suitable for measurement of conducted as well as radiated disturbances is shown in Figure 5. Further examples of typical arrangements of the EUT and associated peripherals are given in [IEC CISPR 16-2-1] and [IEC CISPR 16-2-3].



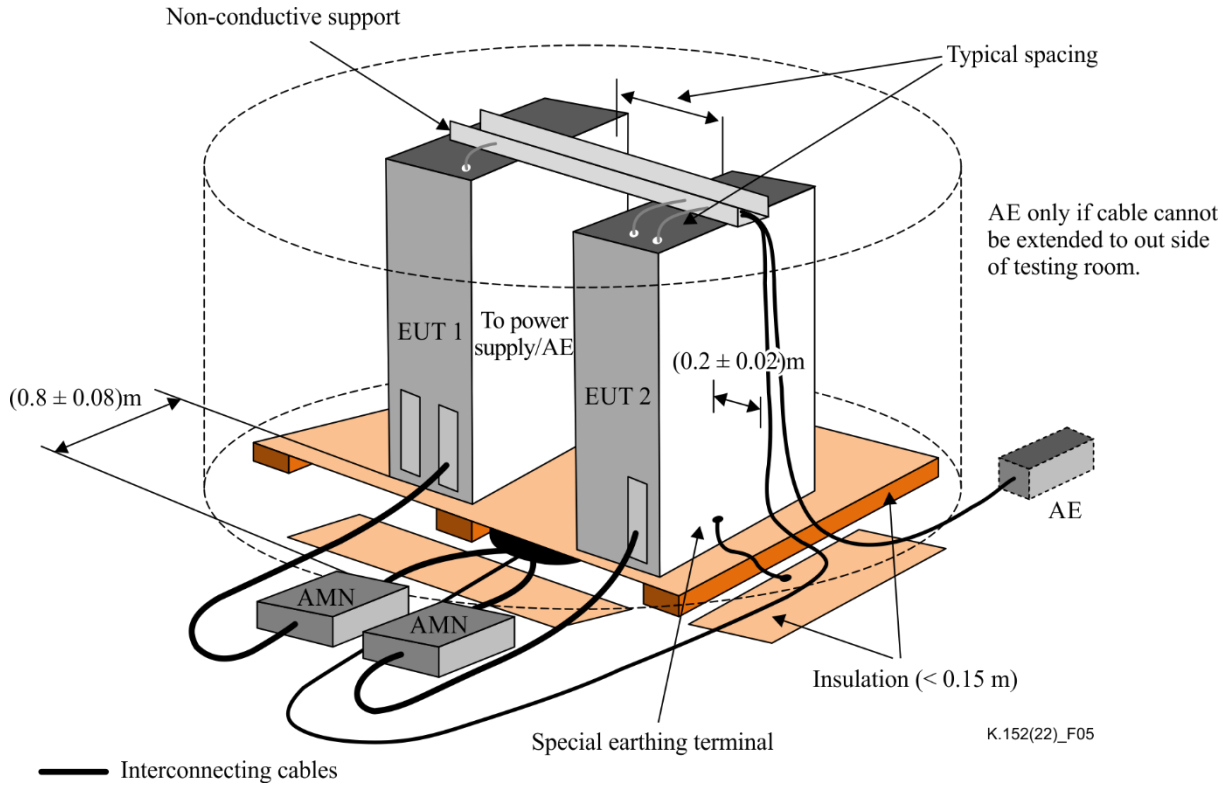
Modified from Fig. 3a of [IEC CISPR 11]

Figure 3 – Example of a typical setup for measurement of radiated disturbances at a 10 m separation distance



Modified from Fig. 3b of [IEC CISPR 11]

Figure 4 – Example of a typical setup for measurement of radiated disturbances from a table-top EUT



Modified from Fig. 4 of [IEC CISPR 11]

Figure 5 – Example of a typical setup for measurement of conducted or radiated disturbances from a floor-standing EUT

8 Guidance on noise other than emissions from 9 kHz to 6 GHz

The issues described in clauses 8.1. to 8.3 must be considered when electrical equipment installed in a telecommunication centre is designed or selected from the market. This clause provides guidance on the noise or unintended voltages other than emissions from 9 kHz to 6 GHz.

8.1 Requirements for harmonic currents and voltage change on AC input ports

Harmonic currents on AC mains input ports can influence power distribution systems connected to the equipment. See the requirement in [IEC 61000-3-2] or [IEC 61000-3-12] for high power equipment.

See the requirements in [IEC 61000-3-3] or [IEC 61000-3-11] for voltage fluctuations on the AC mains port.

8.2 Noise on DC output port

Equipment having analogue ports, e.g., a plain old telephone service interface, is sensitive to noise voltages below 20 kHz. Therefore, it is necessary to limit noise voltages below 20 kHz in the −48 V DC output of rectifiers or DC/DC converters used in power supplies for telecommunication equipment. The quality of DC output, including noise voltages below 20 kHz, can be determined, using [ITU-T K.76] when applicable.

Regarding 400 V DC rectifiers, requirements other than those for electromagnetic disturbances can be found in [ITU-T L.1200].

8.3 Noise on AC output ports

UPSs shall meet the EMC requirements in [IEC 62040-2]. However, the requirement in this Recommendation takes precedence in the case of deviation from the requirements in [IEC 62040-2].

UPSs with a non-sinusoidal output voltage are not appropriate for operation of telecommunication equipment. The output specifications in [IEC 62040-3] should be considered when selecting UPSs to be installed in telecommunication centres. The output voltage performance classification of wave shape should be "S", as specified in clause 5.3.4 of [IEC 62040-3].

Bibliography

[b-ITU-T K.48] Recommendation ITU-T K.48 (2006), *EMC requirements for telecommunication equipment – Product family Recommendation.*

[b-ITU-T K.132] Recommendation ITU-T K.132 (2018), *Electromagnetic compatibility requirements of electromagnetic disturbances from lighting equipment located in telecommunication facilities.*

[b-ITU-T K.136] Recommendation ITU-T K.136 (2018), *Electromagnetic compatibility requirements for radio telecommunication equipment*.

[b-ITU-T K.137] Recommendation ITU-T K.137 (2022), *Electromagnetic compatibility requirements and measurement methods for wireline telecommunication network equipment*.

[b-ITU RR 1] ITU (2012). *Radio regulations*, Vol.1: *Articles*. Geneva: International Telecommunication Union. 435 pp.

[b-IEC 60050-161] IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility.*

[b-IEC 61000-6-6] IEC 61000-6-6:2003, *Electromagnetic compatibility (EMC) – Part 6-6: Generic standards – HEMP immunity for indoor equipment.*

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