BS EN 62041:2010

BSI Standards Publication

Safety of transformers, reactors, power supply units and combinations thereof — EMC requirements

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National foreword

This British Standard is the UK implementation of EN 62041:2010. It is identical to IEC 62041:2010. It supersedes BS EN 62041:2003, which will be withdrawn on 1 December 2013.

The UK participation in its preparation was entrusted to Technical Committee PEL/96, Small transformers.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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EUROPEAN STANDARD

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EN 62041

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ICS 29.180; 33.100

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English version

Safety of transformers, reactors, power supply units and combinations thereof - EMC requirements

(IEC 62041:2010)

Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et des combinaisons de ces éléments - Exigences CEM
(CEI 62041:2010)

Sicherheit von Transformatoren, Drosseln, Netzgeräten und entsprechenden Kombinationen - EMV-Anforderungen
(IEC 62041:2010)

This European Standard was approved by CENELEC on 2010-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 96/358/FDIS, future edition 2 of IEC 62041, prepared by IEC TC 96, Transformers, reactors, power supply units, and combinations thereof, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62041 on 2010-12-01.

This European Standard supersedes EN 62041:2003.

This EN 62041:2010 includes the following significant technical changes with respect to EN 62041:2003:

– the frequency range for tests according to EN 61000-4-3 has been extended above 1 GHz according to technologies used in this frequency area;

– the testing requirements according to EN 61000-4-11 have been amended significantly;

– the inclusion of a clause on tests in series production;

– the inclusion of a new clause on measurement uncertainly; and

– the inclusion of requirements on DC **power ports** and telecommunication **ports**.

It has the status of a product family EMC standard in accordance with IEC Guide 107:2009, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications.*

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62041:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60065	NOTE Harmonized as EN 60065.
IEC 60601-1	NOTE Harmonized as EN 60601-1.
IEC 60950-1	NOTE Harmonized as EN 60950-1.
IEC 61010-1	NOTE Harmonized as EN 61010-1.
IEC 61204-3	NOTE Harmonized as EN 61204-3.
IEC 61347-1	NOTE Harmonized as EN 61347-1.
IEC 62040-2	NOTE Harmonized as EN 62040-2.
CISPR 11	NOTE Harmonized as EN 55011.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 61000-3-2	-	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2	-
IEC 61000-3-3	-	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	EN 61000-3-3	-
IEC 61000-3-11	-	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	EN 61000-3-11	-
IEC 61000-3-12	-	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	EN 61000-3-12	-
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	-
IEC 61000-4-3	-	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	-
IEC 61000-4-4	-	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	-
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-

Publication	Year	Title	EN/HD	Year
IEC 61000-4-6	-	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	-
IEC 61000-4-11	-	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	-
IEC 61000-6-3	-	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments	EN 61000-6-3	-
IEC 61000-6-4	-	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	EN 61000-6-4	-
IEC 61558	Series	Safety of power transformers, power supplies, reactors and similar products	EN 61558	Series
CISPR 14-1	2005	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	EN 55014-1	2006
CISPR 16-1-2	2003	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances	EN 55016-1-2	2004
CISPR 16-2-1	2008	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements	EN 55016-2-1	2009
CISPR 16-2-3	-	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements	EN 55016-2-3	-
CISPR 22 (mod)	-	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022	-

CONTENTS

SAFETY OF TRANSFORMERS, REACTORS, POWER SUPPLY UNITS AND COMBINATIONS THEREOF –

EMC REQUIREMENTS

1 Scope

This international product family standard applies to **transformers**, **reactors, power supply** units and combinations thereof covered by the IEC 61558 series of standards. This standard deals with the electromagnetic compatibility requirements for emission and immunity within the frequency range 0 Hz - 400 GHz. No measurement needs to be performed at frequencies where no requirement is specified.

Transformers, **reactors, power supply** units and combinations thereof delivered with or incorporated in an appliance or equipment should follow the relevant EMC standard applicable to that appliance or equipment. However, this standard may be used as a guide to test the **transformers**, **reactors, power supply** units and combinations thereof separately before incorporating them in the appliance or equipment.

This EMC standard covers performance only. Other operations of the **transformers**, **reactors** and **power supply** units (e.g. simulated faults in the electric circuitry for testing purposes or functional safety due to the effects of the electromagnetic phenomena, or evaluation of human being for exposure to electromagnetic fields (EMF)) have not been taken into consideration in this standard.

NOTE When **EUT** (Equipment under Test) is used, it covers **transformers**, **reactors, power supply** units and combinations thereof where applicable.

This standard does not apply to:

– uninterruptible **power supplies** (UPS) covered by IEC 62040 series;

– **power supply** units covered by IEC 61204-3,

  (i.e. DC-DC converters, DC power and distribution equipment and **power supply** units for use in applications covered by IEC 60950-1, IEC 61010-1, IEC 60601-1, IEC 60065 and IEC 62368-1);

– **power supplies** and converters for use with or in products covered by IEC 61347-1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 61000-3-3, *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, *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, *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, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

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

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

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

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

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61558 (all parts)*, Safety of power transformers, power supplies, reactors and similar products*

CISPR 14-1:2005, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 16-1-2:2003, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-2-1:2008, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

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

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms and definitions

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

3.1
environment 1
residential, commercial and light-industrial locations, both indoor and outdoor

NOTE 1 Locations which are characterised by being supplied directly from a **low voltage** from the **public mains network** are considered to be residential, commercial or light-industrial.

NOTE 2 The following list, although not comprehensive, gives an indication of location which are included:

– residential properties, e.g. houses, apartments, hotels, etc.;
– retail outlets, e.g. shops, supermarkets, etc.;
– business premises, e.g. offices, banks, etc.;
– areas of public entertainment, e.g. cinemas, public bars, dance halls, restaurants, etc.;
– outdoor locations, e.g. petrol stations, car parks, amusement and sports centres, etc.;
– light-industrial locations, e.g. workshops, laboratories, service centres, etc.

3.2
environment 2
industrial environments, both indoor and outdoor

NOTE Industrial locations are connected to a power network supplied from a high or medium **transformer** dedicated to the supply of an installation feeding manufacturing or similar plant, and in addition characterised by the existence of one or more of the following:

– industrial, scientific and medical (ISM) apparatus (as defined in CISPR 11);
– heavy inductive or capacitive loads are frequently switched;
– currents and associated magnetic fields are high.

3.3
equipment under test
EUT
it refers to **transformers**, **reactors, power supply** units and combinations thereof where applicable

3.4
port
particular interface of the specified **EUT** with the external electromagnetic environment (see Figure 1)

NOTE In some cases, different **ports** may be combined.

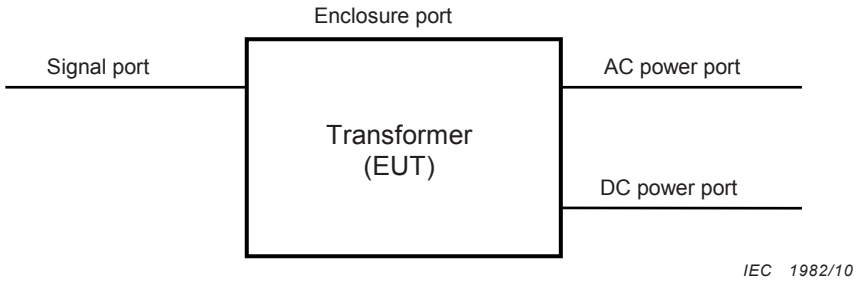

Figure 1 – Example of ports

3.5
enclosure port
physical boundary of the **EUT** which electromagnetic fields may radiate through or impinge on

3.6
cable port
port at which a conductor or a cable is connected to the **EUT**

NOTE Examples are signal and **power ports**.

3.7
signal port
port at which a conductor or cable intended to carry signals is connected to the **EUT**

NOTE Examples are analogue **inputs**, **outputs** and control lines, data busses, communication networks, etc.

3.8
power port
port at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of an **EUT** is connected

3.9
public mains network
power lines to which all categories of consumers have access to and that are operated by an electrical **power supply** and/or distribution organization for the purpose of supplying electrical energy

3.10
long distance lines
lines connected to a **signal port** and which inside a building are longer than 30 m, or which leave the building (including lines of outdoor installations)

3.11
low voltage
voltage having a value below a conventionally adopted limit

[IEC 60050-151:2001, 151-15-03]

4 Classification

EUT are classified according to the incorporation of components and **electronic circuits** as follows:

– category 0: **EUT** with or without passive protection component(s) and without **electronic circuits**;
– category 1: **EUT** with passive components, and without **electronic circuits**;
– category 2: **EUT** with **electronic circuits**.

NOTE 1 Examples of passive protection components are fuses, thermal links, **thermal cut-outs**, circuit-breakers, PTC's, NTC's and resistors.

NOTE 2 Examples of passive components are capacitors, inductors, diodes, LED's, relays, VDR's.

NOTE 3 Examples of **electronic circuits** are active semiconductors.

5 Test specifications

5.1 Immunity

5.1.1 Immunity against disturbances

EUT shall have sufficient immunity against disturbances from their surroundings.

Category 0 **EUT** are not sensitive to normal electromagnetic perturbations. Consequently, they are deemed to fulfil the immunity requirements without testing.

Category 1 **EUT** shall fulfil the following requirements:

– electrostatic discharge;

NOTE 1 Some passive components such as small capacitors (e.g. Y-type), diodes, LEDs or relays may be sensitive to electrostatic discharges.

– electrical fast transient/burst;

NOTE 2 Some passive components such as small capacitors (e.g. Y-type), diodes, LEDs, or relays may be sensitive to electrical fast transients.

– surge.

NOTE 3 Some passive components such as small capacitors (e.g. Y-type), diodes, LED or relays may be sensitive to surges.

For the requirements on a **port**-by-**port** basis, see 5.1.2.2 to 5.1.2.7 inclusive.

Category 2 **EUT** shall fulfil the following requirements:

– electrostatic discharge;
– electrical fast transient/burst;
– surge;
– conducted disturbances, inducted by radio-frequency fields;
– radiated, radio-frequency electromagnetic fields;
– **voltage** dips and short interruptions.

The requirements are given in 5.1.2.2 to 5.1.2.7 on a **port-**by-**port** basis.

The relevant **ports** of the **EUT** shall be subjected to the required test in accordance with the applicable subclauses. Tests shall be carried out only when the relevant **ports** exist.

Tests shall be conducted under the no-load condition at the **rated voltage** and the **rated frequency**, unless otherwise specified in the generic EMC standard as indicated in Clause 5. If **EUT** is not intended to operate under the no load condition, for some tests, a load may need to be applied for perturbation. In this case, the specification of the load shall be stated in the test report.

Tests shall be conducted sequentially. The sequence of testing is optional.

The necessity to conduct some of the tests may be determined in accordance with the electrical characteristics and the specific application of the particular **transformer**. In such cases the rationale for not conducting the tests shall be stated in the test report.

The description of the tests, the test generator, the test methods and the test set-up are specified in the generic EMC standard for testing in accordance with Clause 5.

The tests are carried out following the manufacturer’s documentation. This includes a functional description and explanation of performance criteria, during or as a consequence of the EMC testing. This shall be provided by the manufacturer and included in the test report, based on the following criteria. In case of no documentation, necessary conductors, the cross section, the type and the length of the conductors used shall be reported in the test report.

Performance criterion A: The **EUT** shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the **EUT** 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, either of these may be derived from the product description and documentation and what the user may reasonably expect from the **EUT** if used as intended.

Performance criterion B: The **EUT** shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the **EUT** is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is, however, allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the **EUT** if used as intended.

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

If, as a result of the application of the tests defined in this standard, the **transformer** becomes dangerous or unsafe (e.g., by an insulation breakdown), the **EUT** is deemed to have failed the tests.

5.1.2 Test levels

5.1.2.1 General

Levels for test stated in this standard correspond to typical condition for **environment 1** and **2**. However, if special conditions prevail for the use of the final product, the relevant values in the basic standard shall be applied and stated in the test report.

5.1.2.2 Electrostatic discharges

These tests are carried out according to IEC 61000-4-2, with test levels as given in Table 1.

Except for metallic parts for which a contact discharge test is made, only air discharge test is required.

Ten positive and ten negative pulses shall be applied to each selected point. The time interval between each successive single discharge is 1 s.

Table 1 – Electrostatic discharges – Test levels at enclosure

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Air discharge	8 kV	3	8 kV	3
Contact discharge	4 kV	2	4 kV	2

The device shall comply with performance criterion B.

5.1.2.3 Radiated, radio frequency electromagnetic field

These tests are carried out according to IEC 61000-4-3, with test levels as given in Table 2.

Table 2 – Radiated, radio frequency electromagnetic field – Test levels at enclosure

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Frequency range	80 MHz to 1 000 MHz		80 MHz to 1 000 MHz	
Test level	3 V/m (unmodulated)	2	10 V/m (unmodulated)	3
Modulation	1 kHz, 80 % AM, sine wave		1 kHz, 80 % AM, sine wave	
Frequency range	1,4 GHz to 2,0 GHz	2	1,4 GHz to 2,0 GHz	2
Test level	3 V/m (unmodulated)		3 V/m (unmodulated)	
Modulation	1 kHz, 80 % AM, sine wave		1 kHz, 80 % AM, sine wave	
Frequency range	2,0 GHz to 2,7 GHz	1	2,0 GHz to 2,7 GHz	1
Test level	1 V/m (unmodulated)		1 V/m (unmodulated)	
Modulation	1 kHz, 80 % AM, sine wave		1 kHz, 80 % AM, sine wave	

The tests are normally performed without gaps in the frequency range 80 MHz to 1 000 MHz. For testing frequencies above 1 000 MHz is to reach an agreement with the customer.

The device shall comply with performance criterion A.

5.1.2.4 Electrical fast transient/burst

These tests are carried out according to IEC 61000-4-4, with test levels as given in Tables 3 to 5. The device shall comply with performance criterion B.

Electrical fast transients are applied with a positive polarity and a negative polarity for not less than 1 minute each.

Table 3 – Electrical fast transient/burst – Test levels at signal port

Characteristics	Environment 1			Environment 2		
	Test values		Level	Test values		Level
EUT Category [a]	1	2		1	2	
Test level [b]	0,5 kV	0,5 kV	2	1,0 kV	1,0 kV	3
Rise time/hold time	5/50 ns	5/50 ns		5/50 ns	5/50 ns	
Repetition Frequency	5 kHz	100 kHz		5 kHz	100 kHz	

[a] referring to 5.1.1 no testing required for category 0 **EUT.**

[b] open circuit test **voltage.**

For this test, the capacitive coupling clamp is to be used. Applicable only to **ports** interfacing with cables whose total length according to manufacturer's functional specification may exceed 3 m.

NOTE 1 Use of 5 kHz repetition rates is traditional; however, 100 kHz is closer to reality.

Table 4 – Electrical fast transient/burst – Test levels at input and output DC power ports

Characteristics	Environment 1			Environment 2		
	Test values		Level	Test values		Level
EUT Category [a]	1	2	2	1	2	3
Test level [b]	0,5 kV	0,5 kV		1,0 kV	1,0 kV	
Rise time/hold time	5/50 ns	5/50 ns		5/50 ns	5/50 ns	
Repetition Frequency	5 kHz	100 kHz		5 kHz	100 kHz	

[a] referring to 5.1.1 no testing required for category 0 **EUT.**

[b] open circuit test **voltage.**

Not applicable to **input ports** intended for connection to a battery or a rechargeable which must be removed or disconnected from the **EUT** for recharging. **EUT** with a DC power **input port** intended for use with an AC – DC power adaptor shall be tested on an AC power **input** of the AC – DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC – DC power adaptor. The test is applicable to DC power **input ports** intended to be connected permanently to cables longer than 3 m.

NOTE 2 Use of 5 kHz repetition rates is traditional; however, 100 kHz is closer to reality.

Table 5 – Electrical fast transient/burst – Test levels at input and output AC power ports

Characteristics	Environment 1			Environment 2		
	Test values		Level	Test values		Level
EUT Category [a]	1	2	2	1	2	3
Test level [b]	1,0 kV	1,0 kV		2,0 kV	2,0 kV	
Rise time/hold time	5/50 ns	5/50 ns		5/50 ns	5/50 ns	
Repetition Frequency	5 kHz	100 kHz		5 kHz	100 kHz	

[a] referring to 5.1.1 no testing required for category 0 **EUT.**

[b] open circuit test **voltage.**

NOTE 3 Use of 5 kHz repetition rates is traditional; however, 100 kHz is closer to reality.

5.1.2.5 Conducted disturbances, inducted by radio-frequency fields

These tests are carried out according to IEC 61000-4-6, with test values/level as given in Table 6. The device shall comply with performance criterion A.

Table 6 – Conducted disturbances, inducted by radio-frequency fields – Test levels at signal ports[a] and input and output at DC and AC power ports

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Frequency range	0,15 MHz to 80 MHz		0,15 MHz to 80 MHz	
Test level	3 V rms (unmodulated)	2	10 V rms (unmodulated) [b]	3
Modulation	1 kHz, 80 % AM, sine wave		1 kHz, 80 % AM, sine wave	
The test level can also be defined as the equivalent current into a 150 Ω load.				
[a] Applicable only to **ports** interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.				
[b] Except for the ITU broadcast frequency band 47 MHz to 68 MHz, where the level shall be 3 V.				

5.1.2.6 Surge

These tests are carried out according to IEC 61000-4-5, with test values/level as given in Tables 7 to 9 and the device shall comply with performance criterion B.

Table 7 – Surge – Test levels at signal ports

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Wave shape Test level line-to-ground	no requirements		1,2/50 µs 1 kV (open circuit test **voltage**)	2

Applicable only to **ports** interfacing with cables whose total length according to the manufacturer's functional specification may exceed 30 m.

Where normal functioning cannot be achieved because of the impact of the CDN on the **EUT**, this test is not required.

Five positive and five negative pulses shall be applied (total 10 pulses) of the **signal port**.

Table 8 – Surge – Test levels at input and output DC power ports

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Wave shape Test level line-to-line Test level line-to-ground	1,2/50 µs 0,5 kV (open circuit test **voltage**) 0,5 kV (open circuit test **voltage**)	 1 1	1,2/50 µs 0,5 kV (open circuit test **voltage**) 0,5 kV (open circuit test **voltage**)	 1 1

Not applicable to **input ports** intended for connection to a battery or a rechargeable, which must be removed or disconnected from the **EUT** for recharging. **EUT** with a DC power **input port** intended for use with an AC – DC power adaptor shall be tested on an AC power **input** of the AC – DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC – DC power adaptor. DC **ports** which are not intended to be connected to a DC distribution network are treated as **signal ports**.

Five positive and five negative pulses shall be applied (total 10 pulses) of the DC **voltage**.

**Table 9 – Surge –
Test levels at input and output AC power ports**

Characteristics	Environment 1		Environment 2	
	Test values	Level	Test values	Level
Wave shape Test level line-to-line Test level line-to-ground	1,2/50 µs 1 kV (open circuit test **voltage**) 2 kV (open circuit test **voltage**)	 2 3	1,2/50 µs 1 kV (open circuit test **voltage**) 2 kV (open circuit test **voltage**)	 2 3

Five positive and five negative pulses shall be applied at the peak value and zero crossing points (total 30 pulses) of the AC **voltage** wave.

5.1.2.7 Voltage dips and short interruptions

These tests are carried out according to IEC 61000-4-11, with test values as given in Table 10.

**Table 10 – Voltage dips –
Test levels at input AC power ports**

Characteristics	Environment 1		Environment 2	
	Test values	Performance criterion	Test values	Performance criterion
Residual **voltage** % cycle	0 0,5	B	0 1	B[a]
Residual **voltage** % cycle	0 1	B	40 10/12 at 50/60 Hz	C[a]
Residual **voltage** % cycle	70 25/30 at 50/60 Hz	C	70 25/30 at 50/60 Hz	C[a]
Voltage shift at zero crossing [a] For electronic power converters, the operation of protective devices is allowed.				

**Table 11 – Voltage interruptions –
Test levels at input AC power ports**

Characteristics	Environment 1		Environment 2	
	Test values	Performance criterion	Test values	Performance criterion
Residual **voltage** % cycle	0 250/300 at 50/60 Hz	C	0 250/300 at 50/60 Hz	C[a]
Voltage shift at zero crossing [a] For electronic power converters, the operation of protective devices is allowed.				

5.2 Emission

EUT shall not introduce perturbations in such a way that they disturb the surroundings.

5.2.1 Categories

5.2.1.1 Category 0 **EUT** having a **working voltage** not exceeding 700 V do not generate electromagnetic perturbations with a considerable level and as a consequence are deemed to fulfil the emission requirements without testing.

Category 0 **EUT** having a **working voltage** exceeding 700 V are considered to generate electromagnetic perturbations with a considerable level. Consequently the following tests, given in 5.2.2.3 and 5.2.2.4, shall be carried out:

– conducted radio disturbances (refer to Tables 13, 14, 15 where applicable);
– radiated radio disturbances (refer to Table 16).

NOTE 700 V is the **voltage** value at which the influence from partial discharge is to be considered.

5.2.1.2 Category 1 **EUT** having a **working voltage** not exceeding 700 V shall fulfil the following tests given in 5.2.2.2 and 5.2.2.3:

– harmonics and flicker (refer to Table 12);
– conducted radio disturbances (refer to Tables 13, 14, 15 where applicable).

Category 1 **EUT** having a **working voltage** exceeding 700 V shall fulfil the following test given in 5.2.2.4:

– radiated radio disturbances (refer to Table 16).

NOTE 700 V is the **voltage** value at which the influence from partial discharge is to be considered.

5.2.1.3 Category 2 **EUT** shall fulfil the following tests given in 5.2.2.2, 5.2.2.3 and 5.2.2.4:

– harmonics and flicker (refer to Table 12);
– conducted radio disturbances (refer to Tables 13, 14, 15, where applicable);
– radiated radio disturbances (refer to Table 16).

Tests shall be performed at full load condition with rated **voltage** at **rated frequency** at **output power factor** 1, unless otherwise specified in the generic EMC standard mentioned for the testing of Clause 5 or stated by the manufacturer in the instruction sheet.

5.2.2 Test levels

5.2.2.1 General

Tests and test levels are carried out according to the following generic IEC standards:

– IEC 61000-6-3 for **environment 1**;
– IEC 61000-6-4 for **environment 2**.

Requirements and remarks given in these IEC standards shall be fulfilled.

5.2.2.2 Harmonics and flicker

Table 12 – Harmonics and flicker –
Test levels at low voltage AC mains ports

Frequency range KHz	**Environment 1 Limits**	**Basic standards**	**Environment 2 Limits**	**Basic standards**
0 – 2	given in basic standard	IEC 61000-3-2 IEC 61000-3-3 IEC 61000-3-11 IEC 61000-3-12	no requirements	
Applicability note: If the **transformer** is covered by the scope of IEC 61000-3-11, this may be used instead of IEC 61000-3-3.				

5.2.2.3 Conducted radio disturbances

Table 13 – Conducted radio disturbances – Test levels at signal ports (telecommunications/network ports)

Frequency range MHz	**Environment 1 Limits**	**Basic Standard**	**Environment 2 Limits**	**Basic Standard**
0,15 – 0,5	84 dB(μV) – 74 dB(μV) quasi peak 74 dB(μV) – 64 dB(μV) average 40 dB(μV) – 30 dB(μV) quasi peak 30 dB(μV) – 20 dB(μV) average	CISPR 22	97 dB(μV) – 87 dB(μV) quasi peak 84 dB(μV) – 74 dB(μV) average 53 dB(μV) – 43 dB(μV) quasi peak 40 dB(μV) – 30 dB(μV) average	CISPR 22
0,5 – 30	74 dB(μV) quasi peak 64 dB(μV) average 30 dB(μV) quasi peak 20 dB(μV) average	CISPR 22	87 dB(μV) quasi peak 74 dB(μV) average 43 dB(μV) quasi peak 30 dB(μV) average	CISPR 22
Applicability note: 1) At transitional frequencies, the lower limit applies (**Environment 1**). 2) The limits decrease linearly with the logarithm of the frequency in the range of 0,15 MHz to 0,5 MHz. 3) The current and **voltage** disturbance limits are derived for use with an impedance stabilisation network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication **port** under test (conversion factor is 20 $\log_{10}$ 150 / I = 44 dB).				

Table 14 – Conducted radio disturbances – Test levels at DC power ports)

Frequency range MHz	**Environment 1 Limits**	**Basic Standard**	**Environment 2 Limits**	**Basic Standard**
0,15 – 0,5	79 dB(μV) quasi peak 66 dB(μV) average	CISPR 16-2-1, 7.4.1	no requirements	
0,5 – 30	73 dB(μV) quasi peak 60 dB(μV) average	CISPR 16-1-2, 4.3		
Applicability note: 1) At transitional frequencies, the lower limit applies.(**Environment 1**) 2) Applicable only to **ports** intended for connection to: – a local DC power network, or – a remote local battery by a connecting cable exceeding a length of 30 m.				

Table 15 – Conducted radio disturbances – Test levels at low voltage AC mains ports

Frequency range MHz	**Environment 1 Limits**	**Basic Standard**	**Environment 2 Limits**	**Basic Standard**
0,15 – 0,5	66 dB(μV) – 56 dB(μV) quasi peak 56 dB(μV) – 46 dB(μV) average	CISPR 16-2-1, 7.4.1	79 dB(μV) quasi peak 66 dB(μV) average	CISPR 16-2-1, 7.4.1
0,5 – 5	56 dB(μV) quasi peak 46 dB(μV) average	CISPR 16-1-2, 4.3	73 dB(μV) quasi peak 60 dB(μV) average	CISPR 16-1-2, 4.3
5 – 30	60 dB(μV) quasi peak 50 dB(μV) average	1), 2)		
0,15 – 30	See basic standard, Subclause 4.2	CISPR 14-1	3)	
Applicability note: 1) At transitional frequencies, the lower limit applies. 2) The limits decrease linearly with the logarithm of the frequency in the range of 0,15 MHz to 0,5 MHz. 3) Impulse noise (clicks) which occur less than five times per minute is not considered. For clicks appearing more often than 30 times per minute, the limits apply. For clicks appearing between 5 and 30 times per minute, a relaxation of the limits is allowed of 20 $\log_{30}$/N dB (where N is the number of clicks per minute). Criteria for separated clicks may be found in CISPR 14-1.				

5.2.2.4 Radiated radio disturbances

Table 16 – Radiated radio disturbances – Test levels at enclosure port

Frequency range MHz	**Environment 1 Limits**	**Basic Standard**	**Environment 2 Limits**	**Basic Standard**
30 – 230	30 dB(μV/m) quasi peak at 10 m	CISPR 16-2-3	40 dB(μV/m) quasi peak at 10 m	CISPR 16-2-3
230 – 1 000	37 dB(μV/m) quasi peak at 10 m	1), 2)	47 dB(μV/m) quasi peak at 10 m	1)
Applicability note: 1) If the internal emission source(s) is operating at a frequency below 9 kHz, then measurements need only to be performed up to 230 MHz. 2) At transitional frequencies, the lower limit applies. 3) Test should carried out at open area test site or semi-anechoic method (that may be measured at 3 m distance using the limits increased by 10 dB).				

6 Specification of environment

For all **EUT** except those of category 0 having a **working voltage** not exceeding 700 V, the manufacturer shall state in the instruction sheet if the **EUT** is to be used in **environment 1** or 2. This information may be stated separately for immunity and emission.

For **EUT** with emission only allowed for use in **environment 2**, a warning in the instruction sheet shall be given explaining that the use of the **transformer** in **environment 1** may cause radio interference. In this case, additional attenuation methods may be required.

NOTE From the point of view of immunity, the level of severity for **environment 2** covers that required for **environment 1**. From the point of view of emission, the level of severity for **environment 1** covers that required for **environment 2**.

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