

BS EN IEC 62041:2020 — **Tracked Changes**

compares BS EN IEC 62041:2020
with BS EN 62041:2010



BSI Standards Publication

Transformers, power supplies, reactors and similar products — EMC requirements

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- Text example 1** — indicates added text (in green)
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-  — indicates added graphic figure or table
-  — indicates removed graphic figure or table

About Tracked Changes

This document is a PDF containing a Tracked Changes version of BS EN IEC 62041, which compares BS EN IEC 62041:2020 with BS EN 62041:2010.

The original version of BS EN IEC 62041:2020, appended at the end of this document, should be considered the version of record for this publication.

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Amendments/corrigenda issued since publication

Date	Text affected
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National foreword

This British Standard is the UK implementation of ~~EN 62041:2010~~ **EN IEC 62041:2020**. It is identical to ~~IEC 62041:2010~~ **IEC 62041:2017**. It supersedes ~~BS EN 62041:2003~~ **BS EN 62041:2010**, which ~~will be~~ **is** withdrawn ~~on 1 December 2013~~.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.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on ~~28 February 2011~~ **29 February 2020**.

Amendments / **corrigenda issued since publication**

~~Amd. No.~~	Date	Text affected
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~~Safety of transformers, reactors, power supply units and
combinations thereof - EMC requirements~~ Transformers, power
supplies, reactors and similar products - EMC requirements
(~~IEC 62041:2010~~ IEC 62041:2017)

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

Transformateurs, alimentations, bobines
d'inductance et produits analogues - Exigences
CEM (IEC 62041:2017)

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

Transformatoren, Drosseln, Netzgeräte und entsprechende
Kombinationen - EMV-Anforderungen (IEC 62041:2017)

This European Standard was approved by CENELEC on ~~2010-12-01~~ 2019-12-11. 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~~ CEN-CENELEC Management Centre 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~~ CEN-CENELEC Management Centre has the same status as the official versions.

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

CEN-CENELEC Management Centre: ~~Avenue Marnix 17~~ Rue de la Science 23, B-~~1000~~ 1040 Brussels

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Ref. No. EN IEC 62041:2010 2020 E

~~Foreword~~ **European foreword**

The text of document ~~96/358/FDIS~~ **96/465/FDIS**, future edition ~~23~~ 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 IEC 62041: on 2010-12-01~~ **EN IEC 62041: 2020**.

~~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 uncertainty; 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 are fixed:

- latest date by which the ~~EN document~~ has to be implemented at national level by publication of an identical national standard or by endorsement (dop) ~~2011-09-01~~ **2020-09-11**
- latest date by which the national standards conflicting with the ~~EN document~~ have to be withdrawn (dow) ~~2013-12-01~~ **2022-12-11**

~~Annex ZA has been added by CENELEC.~~

This document supersedes EN 62041:2010 and all of its amendments and corrigenda (if any).

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

Endorsement notice

The text of the International Standard ~~IEC 62041: 2010~~ **IEC 62041: 2017** 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 61000-4-20:2010	NOTE Harmonized as EN 61000-4-20:2010 (not modified)
IEC 61010-1	NOTE Harmonized as EN 61010-1
IEC 61204-3	NOTE Harmonized as EN 61204-3
IEC 61347-1 (series)	NOTE Harmonized as EN 61347-1 (series)
IEC 62040-2 (series)	NOTE Harmonized as EN 62040-2 (series)
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~~ referred to in the ~~application~~ text in such a way that some or all of their content constitutes requirements 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 1 ~~When~~ ~~Where~~ an ~~international publication~~ International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 60050-161	-	International Electrotechnical Vocabulary. Chapter 161: - Electromagnetic compatibility		-
IEC 61000-3-2	-	Electromagnetic compatibility (EMC) – Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN IEC 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 IEC 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	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5:EN 61000-4-5 Testing and measurement techniques - Surge immunity test	-	-
IEC 61000-4-6	-	Electromagnetic compatibility (EMC) - Part 4-6:EN 61000-4-6 Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	-	-
IEC 61000-4-11	-	Electromagnetic compatibility (EMC) - Part 4-11:EN 61000-4-11 Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	-	-
IEC 61000-4-34	-	Electromagnetic compatibility (EMC) - Part 4-34:EN 61000-4-34 Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase	-	-
IEC 61000-6-1	-	Electromagnetic compatibility (EMC) - Part 6-1:EN IEC 61000-6-1 Generic standards - Immunity standard for residential, commercial and light-industrial environments	-	-
IEC 61000-6-2	-	Electromagnetic compatibility (EMC) - Part 6-2:EN IEC 61000-6-2 Generic standards - Immunity standard for industrial environments	-	-
IEC 61000-6-3	-	Electromagnetic compatibility (EMC) - Part 6-3:EN 61000-6-3 Generic standards - Emission standard for residential, commercial and light-industrial environments	-	-
IEC 61000-6-4	-	Electromagnetic compatibility (EMC) -- Part 6-4:EN 61000-6-4 Generic standards - Emission standard for industrial environments	-	-
IEC 61558	~~Series~~ series	Safety of power transformers, power supplies, EN IEC 61558 reactors and similar products	IEC 61558	~~Series~~ series
CISPR 14-1	~~2005~~ 2016	Electromagnetic compatibility - Requirements for EN 55014-1 household appliances, electric tools and similar apparatus - Part 1: Emission	EN 55014-1	~~2006~~ 2017
~~CISPR 16-1-2~~ CISPR 16-1-1	~~2003~~ 2015	Specification for radio disturbance and immunity EN 55016-1-2- measuring apparatus and methods - Part 1-2-1: Radio disturbance and immunity measuring apparatus - ~~Ancillary equipment - Conducted disturbances~~ Measuring apparatus	EN 55016-1-2- EN 55016-1-2	~~2004-~~ 2014
~~CISPR 16-2-1~~ CISPR 16-1-2	~~2008~~ 2014	Specification for radio disturbance and immunity EN 55016-2-1 measuring apparatus and methods - Part 1-2-1: EN 55016-1-2 ~~Methods of measurement of disturbances: Radio disturbance and immunity - Conducted measuring apparatus - Coupling devices for conducted disturbance measurements~~	EN 55016-2-1 EN 55016-1-2	~~2009~~ 2014
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	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 16-1-4	2010	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	EN 55016-1-4	2010
CISPR 16-2-1	2014	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	2014
CISPR 16-2-3	2016	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	2017
CISPR 16-4-2	-	Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty	EN 55016-4-2	-
CISPR 32	2015	Electromagnetic compatibility of multimedia equipment - Emission requirements	EN 55032	2015



IEC 62041

Edition 3.0 2017-08

**INTERNATIONAL
STANDARD**

**NORME
INTERNATIONALE**

**Transformers, power supplies, reactors and similar products – EMC
requirements**

**Transformateurs, alimentations, bobines d'inductance et produits analogues –
Exigences CEM**

**INTERNATIONAL
ELECTROTECHNICAL
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**COMMISSION
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CONTENTS

FOREWORD	x
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviations	3
3.1 Terms and definitions	3
3.2 Abbreviations	5
4 General considerations	6
4.1 Categories	6
4.2 Measurement uncertainty	7
4.3 Routine tests (production tests)	8
5 Product documentation	8
6 Applicability	8
7 Test equipment	9
8 Conditions during testing	8
9 Measurement procedures	9
9.1 Emission	9
9.2 Immunity	9
10 Performance criteria	10
11 Requirements	17
11.1 Immunity	17
11.2 Emission	18
Annex A (informative) Tables for immunity and emission limits	19
Bibliography	32
Figure 1 – Ports covered by Table A.1 to Table A.16	4
Table 1 – Additional acceptance limit for statistical determination	7
Table 2 – Values of kE according to CISPR TR 16-4-3:2004, Table C.1	8
Table 3 – Uncertainties for emission tests	8
Table A.1 – Immunity requirements for enclosure ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-1	19
Table A.2 – Immunity requirements for enclosure ports for equipment intended for use in industrial environments according to IEC 61000-6-2	19
Table A.3 – Immunity requirements for signal ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-1	20
Table A.4 – Immunity requirements for signal ports for equipment intended for use in industrial environments according to IEC 61000-6-2	20
Table A.5 – Immunity requirements at input and output DC power ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-1	21
Table A.6 – Immunity requirements at input and output DC power ports for equipment intended for use in industrial environments according to IEC 61000-6-2	22
Table A.7 – Immunity requirements at input and output AC power ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-1	23

Table A.8 – Immunity requirements at input and output AC power ports for equipment intended for use in industrial environments according to IEC 61000-6-2	24
Table A.9 – Requirements for radiated emissions for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-3	25
Table A.10 – Requirements for radiated emissions ports for equipment intended for use in industrial environments according to IEC 61000-6-4	27
Table A.11 – Requirements for conducted emissions from AC mains power ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-3	29
Table A.12 – Requirements for conducted emissions from AC mains power ports according to IEC 61000-6-4	29
Table A.13 – Requirements for conducted emissions from AC mains power ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-3	30
Table A.14 – Requirements for conducted emissions from AC mains power ports for equipment intended for use in industrial environments according to IEC 61000-6-4	30
Table A.15 – Requirements for conducted emissions from signal ports for equipment intended for use in residential, commercial and light-industrial environments according to IEC 61000-6-3	31
Table A.16 – Requirements for conducted emissions from signal ports for equipment intended for use in industrial environments according to IEC 61000-6-4	31

INTERNATIONAL ELECTROTECHNICAL COMMISSION**TRANSFORMERS, POWER SUPPLIES, REACTORS AND SIMILAR
PRODUCTS – EMC requirements****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International standard IEC 62041 has been prepared by Technical Committee 96: Transformers, reactors, power supply units and combinations thereof.

This third edition cancels and replaces the second edition published in 2010. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- the inclusion of a clause on tests in series production;
- the inclusion of a new clause on measurement uncertainty, and
- the status of a harmonized standard for this third edition.

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.

This bilingual version (2018-01) corresponds to the monolingual English version, published in 2017-08.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
96/465/FDIS	96/467/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2. This standard is to be used in conjunction with the IEC 61558 series.

In this standard, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type.

In the text of this publication, the words in **bold** are defined in Clause 3 of this document and in the IEC 61558 series.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE The attention of the National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months or not later than 3 years from the date of publication.

The transitional period is no longer than 3 years after the publication of this standard.

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

TRANSFORMERS, POWER SUPPLIES, REACTORS AND SIMILAR PRODUCTS – EMC requirements

1 Scope

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

For associated transformers, associated reactors and associated power supply units either supplied with or incorporated into an appliance or equipment, the relevant EMC standard for that appliance or equipment applies.

This ~~EMC standard~~ document covers ~~performance~~ normal operating conditions 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~~ document.

Requirements are specified for each port considered. If requirements are different, the most severe takes precedence.

This document may also be used as a guide to test transformers, reactors and power supply units separately before these are incorporated into an appliance or equipment.

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

This ~~standard~~ document does not apply to:

- uninterruptible power supplies (UPS) covered by IEC 62040 ~~series~~ all parts;
- power supply units covered by ~~IEC 61204-3~~ IEC 61204, (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~~ IEC 60065);
- power supplies and converters for use with or in products covered by ~~IEC 61347-1~~ IEC 61347 (all parts).

2 Normative references

The following ~~referenced~~ documents are ~~indispensable for~~ referred to in the ~~application~~ text in such a way that some or all of their content constitutes requirements 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 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

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

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

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~~ CISPR 14-1:2016, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

~~CISPR 16-1-2:2003~~ **CISPR 16-1-1:2015**, Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – ~~Ancillary equipment – Conducted disturbances~~ **Measuring apparatus**

~~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~~

CISPR 16-1-2:2014, 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

CISPR 16-1-4:2010, Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements

CISPR 16-1-4:2010/AMD1:2012

CISPR 16-2-1:2014, Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements

CISPR 16-2-3:2016, Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements

CISPR 16-4-2, Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Measurement instrumentation uncertainty

CISPR 32:2015, Electromagnetic compatibility of multimedia equipment – Emission requirements

3 Terms ~~and~~, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the ~~following~~ terms and definitions **given in IEC 60050-161 and the following** 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/ohp>

3.3.1.1

equipment under test EUT

it refers to transformers, reactors and power supply units and combinations thereof where applicable

3.4.1.2

port

particular interface of the specified EUT with the external electromagnetic environment (see Figure 1).

Note 1 to entry: Examples of ports of interest are shown in Figure 1. The enclosure port is the physical boundary of the equipment (e.g. enclosure). The enclosure port provides for radiated and electrostatic discharge (ESD) energy transfer, whereas the other ports provide for conducted energy transfer, either by direct injection or by induction.

NOTE Note 2 to entry: In some cases, different ports may be combined.

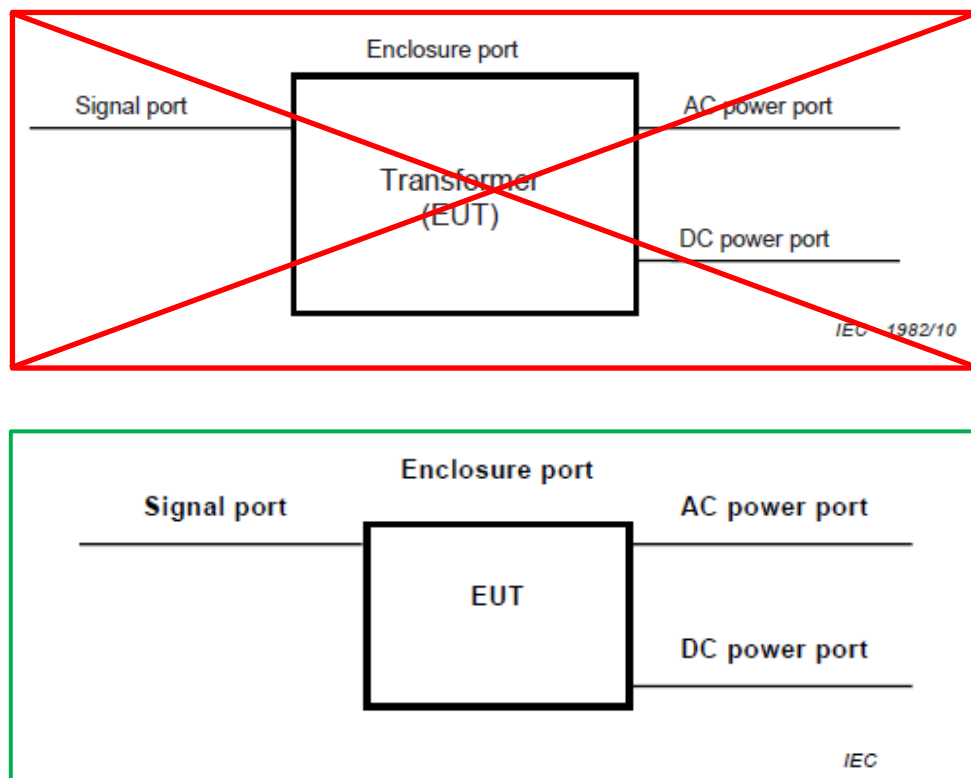


Figure 1 - ~~Example of ports~~ Ports covered by Table A.1 to Table A.16

3.53.1.3**enclosure port**

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

3.63.1.4**cable port**

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

NOTE Note 1 to entry: Examples are signal, **control** and **power ports**.

3.73.1.5**signal port**

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

NOTE Note 1 to entry: Examples are analogue inputs, outputs and control lines, data busses, communication networks, etc.

3.83.1.6**power port**

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

3.93.1.7**public mains network**

power electricity lines to which all categories of consumers have access ~~to~~ and ~~that~~ which are operated by ~~an~~ **electrical power** supply ~~and/or~~ distribution ~~organization~~ **undertaking** 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)~~

3.113.1.8**low voltage**

voltage having a value below a conventionally adopted limit

Note 1 to entry: For the distribution of AC electric power, the upper limit is generally accepted to be 1 000 V

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

3.2 Abbreviations

AC	Alternating Current
AM	Amplitude Modulation
DC	Direct Current
EUT	Equipment Under Test
FAR	Fully Anechoic Room
ISN	Impedance Stabilization Network
LV	Low Voltage
OATS	Open Area Test Site
SAC	Semi Anechoic Chamber
TEM	Transverse Electromagnetic Mode

4 Classification

4 General considerations

4.1 Categories

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

- category 0: EUT with or without passive protection ~~component(s)~~ components 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.~~

4.2 Measurement uncertainty

Compliance testing with the limits described in this document shall be carried out statistically according to [Table 1](#). Emission tests shall be executed in accordance with [Annex A](#) by using at least 5 samples. In case of exceptional conditions, the sum of test samples can be reduced to 3 or 4 samples.

The requirements are fulfilled, if the measured emissions of all individual samples are in compliance with the limits and the gap to the limit is not smaller than specified in [Table 1](#).

Table 1 – Additional acceptance limit for statistical determination

Sample size	3	4	5	6
Additional acceptance limit (dB)	3,8	2,5	1,5	0,7

This procedure shall not be used to show the non-compliance of the product.

NOTE This procedure is based on CISPR TR 16-4-3.

Compliance is constituted by

$$x_{\max} + k_E \times \sigma_{\max} < L$$

where

$x_{\max}$ is the highest (unfavourable) value of all samples of the sample size;

k_E is the coefficient taken from the [Table 2](#) in view of sample size;

$\sigma_{\max}$ is the conservative standard regression of product group;

L is the permissible limit.

Table 2 – Values of kE according to CISPR TR 16-4-3:2004, Table C.1

Sample size	3	4	5	6
Coefficient kE	0,63	0,4	0,24	0,12

IEC/CISPR/TR 16-4-3 recommends $\sigma_{\max} = 6$ dB for conducted emissions. For radiated emissions the same value of $\sigma_{\max}$ can be used. Values shown in [Table 1](#) constitute a simple multiplication of kE and $\sigma_{\max} = 6$ dB.

[Table 1](#) is only valid for sample sizes up to 6. If more samples are used to check compliance, a different procedure may be used (binominal distribution without additional gap to the limit).

4.3 Routine tests (production tests)

The assessment of compliance with the requirements of this document shall be carried out by normative tests. The uncertainty of measurement shall be taken into account.

Wherever possible, the measurement uncertainty shall be covered in accordance with CISPR 16-4-2.

NOTE 1 Measurements conducted at the place of installation, the share of place is not taken into account.

Measurements carried out at distances smaller than 10 m, higher uncertainty may need to be used.

Table 3 – Uncertainties for emission tests

Test	Uncertainty dB
Conducted emissions (150 kHz to 30 MHz) using a 50Ω/50μH ISN ^a	3,44
Radiated emissions (30 MHz to 200 MHz) – Horizontal polarisation – 10 m ^b	5,05
Radiated emissions (30 MHz to 200 MHz) – Vertical polarisation – 10 m ^b	5,03
Radiated emissions (200 MHz to 1 GHz) – Horizontal polarisation – 10 m ^c	5,21
Radiated emissions (200 MHz to 1 GHz) – Vertical polarisation – 10 m ^c	5,22
^a Impedance stabilisation network (ISN).	
^b Uncertainty for the use of biconical antennas.	
^c Uncertainty for the use of logarithmical-periodical antennas.	

5 Product documentation

The user documentation and/or manual shall contain details of any special measures required to be taken by the purchaser or user to ensure the EMC compliance of the EUT with the requirements of this publication. One example would be the need to use shielded or special cables.

6 Applicability

The application of tests for evaluation of immunity depends on the particular apparatus, its configuration, its **ports**, its technology and its operating conditions.

Tests shall be applied to the relevant **ports** of the **EUT** according to Table A.1 to Table A.16. Tests shall only be carried out where the relevant **ports** exist.

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

7 Test equipment

The description of the measurement, the measurement instrumentation, the measurement methods and the measurement set up to be used is given in Tables A.1 to A.16.

8 Conditions during testing

If the apparatus is part of a system, or can be connected to auxiliary apparatus, the apparatus shall be tested while connected to the minimum representative configuration of auxiliary apparatus necessary to exercise the **ports** in a similar manner to that described in CISPR 32.

In cases where manufacturer's specification requires external filtering and/or shielding devices or measures that are clearly specified in the user's manual, the measurement requirements of this document shall be applied with the specified devices or measures in place.

The configuration and mode of operation during the measurements shall be precisely noted in the test report. If the apparatus has a large number of similar **ports** or **ports** with many similar connections, a sufficient number shall be selected to simulate actual operating conditions and to ensure that all different types of determination are covered.

The measurements shall be carried out at one single set of parameters within the operating ranges of temperature, humidity and atmospheric pressure specified for the product and at the rated supply voltage, unless otherwise indicated in the basic standard.

Where applicable, additional information on **EUT** configuration can be found in CISPR 16-2 (all parts) and CISPR 32.

9 Measurement procedures

9.1 Emission

The **equipment under test (EUT)** shall be tested in the operating mode producing the largest emission in the frequency band being investigated, e.g. based on limited pre-tests and consistent with normal applications. The configuration of the test sample shall be varied to achieve maximum emission consistent with typical applications and installation practice.

The emission requirements for **EUT** covered by this document are given on a **port** by **port** basis. These requirements are stated in Tables A.9 to A.16.

Measurements shall be conducted in a well-defined and reproducible manner. The measurements may be performed in any order.

9.2 Immunity

The **equipment under test (EUT)** shall be tested in the expected most susceptible operating mode e.g. identified by performing limited pre-tests. This mode shall be consistent with normal applications. The configuration of the test sample shall be varied to archive maximum susceptibility with typical applications and installation practice.

The immunity test requirements for **EUT** covered by this document 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 individually as single tests in sequence. The tests may be performed in any order. If requirements are in conflict the most severe takes precedence.

The description of the test, relevant generator, appropriate methods, and the set up to be used are given in basic standards, which are referred to in Tables A.1 to A.8.

The contents of these basic standards are not repeated here, however modifications or additional information and test levels needed for the practical application of the tests are given in this document.

10 Performance criteria

The variety and the diversity of the EUT within the scope of this document makes it difficult to define precise criteria for the evaluation of the immunity test results.

If, as a result of the application of the tests defined in this document, the apparatus becomes dangerous or unsafe, the apparatus shall be deemed to have failed the test.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on one of the following criteria for each test as specified in Tables A.1 to A.8.

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

~~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	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 .						

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		Level	Environment 2		Level
	Test values			Test values		
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		Level	Environment 2		Level
	Test values			Test values		
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.