# IEC 61204-3

Edition 3.0 2016-10
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside



## Low-voltage switch mode power supplies~~, d.c. output~~ – Part 3: Electromagnetic compatibility (EMC)

IEC 61204-3:2016-10 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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## FOREWORD

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International Standard IEC 61204-3 has been prepared by subcommittee 22E: Stabilized power supplies, of IEC technical committee 22: Power electronic systems and equipment.

IEC 61204-3 has the status of a product family standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

a) the title has been changed by deleting the wording "DC output-" from the title and adding "switch mode" in the title;
b) changes in the scope: 1.1.1 Equipment covered by this document;
c) update of the normative references to the latest editions or dated references;
d) change of wording or/and notes regarding the requirements of CENELEC Guide 24 and IEC Guide 107;
e) revision of the emission limits to align with the latest editions of the applicable normative references;
f) revision of the immunity requirements to align with the latest editions of the applicable normative references;
g) correction of typographical errors.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 22E/174/FDIS | 22E/176/RVD |

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61204 series, under the general title *Low-voltage power supplies, d.c. output,* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

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

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# LOW-VOLTAGE SWITCH MODE POWER SUPPLIES~~, d.c. OUTPUT~~ –

# Part 3: Electromagnetic compatibility (EMC)

## 1 Scope and object

### 1.1 Scope

#### 1.1.1 Equipment covered by this document

This part of IEC 61204 specifies the electromagnetic compatibility (EMC) requirements for ~~power supply units (PSUs) providing d.c. output(s) with or without auxiliary a.c. output(s), operating from a.c. or d.c. source voltages up to 600 V a.c. or 1 000 V d.c.~~ switch mode power supply (SMPS) units supplied by source voltages up to 1 000 V AC or 1 500 V DC providing AC and/or DC output(s), except inverter output(s) establishing AC mains (see exceptions under 1.1.3.)

NOTE 1 This document by definition covers DC/DC converters.

NOTE 2 Power supplies can provide accessory AC mains socket outlets, when such outputs are supplied from the AC mains.

NOTE 3 Ringing generators used in telecoms applications are covered by this document.

This product standard covers both stand alone and component power supply (PSU) units as defined in this document. It covers PSU units for use in or with IT equipment normally covered by IEC 60950-1~~:2001[1]~~ and/or IEC ~~60950-1:2005~~ 62368-1; PSU units for use in or with measurement, control and laboratory equipment normally covered by IEC 61010-1; PSU units for use in or with medical equipment – normally covered by IEC 60601-1; PSU units for use in or with audio, video and similar electronic apparatus – normally covered by IEC 60065 and/or IEC 62368-1. It also covers DC power and distribution equipment and DC/DC converters.

Where no standard exist, use of this document for other applications is not precluded.

#### 1.1.2 Additional requirements

Requirements additional to those specified in this document may be necessary for

- PSUs intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres);
- PSUs intended to be used in vehicles, on board ships or aircraft, or in tropical countries;
- PSUs intended for use where ingress of water is possible.

NOTE Attention is drawn to the fact that authorities in some countries impose additional requirements for health, environmental and similar reasons.

#### 1.1.3 Exclusions

This document does not apply to

- motor-generator sets;
- uninterruptible power supplies (UPS) to IEC 62040-1~~-1~~;

~~[1] This publication has been withdrawn and replaced by the second edition issued in 2005.~~

- PSUs covered by IEC 61558-1 (i.e. power supply units incorporating safety isolating transformers providing SELV or PELV output(s) in accordance with IEC 60364-4-41) and PSUs for use with household and other consumer products, except those covered by IEC 60065 and IEC 60950-1~~:2001~~ and/or IEC ~~60950-1:2005~~ 62368-1;
- transformers covered by IEC 61558-1;
- step-down converters covered by IEC 60146-1-1;
- PSUs and converters ~~for use with or in products covered by IEC 61347-2-2~~ intended for DC supplied bulb lamps, halogen lamps or LED lamps covered by CISPR 15.

### 1.1.4 Types of power supply

Two types of power supplies are covered by this document:

**a) stand alone (or end-product) power supplies**

Power supplies intended for free-standing operation (individual apparatus).

This part of IEC 61204 is applicable to PSUs developed as a unit with a direct function and sold on the market as a stand alone unit.

**b) component power supplies**

These can be divided into two categories:

**1) component power supplies considered as equivalent to stand alone power supplies (apparatus)**

This part of IEC 61204 is applicable to this category of component PSUs. These PSUs are considered to be apparatus with respect to their EMC requirements, for example those PSUs intended for use in installations or sold to the general public, cases where no further EMC tests are anticipated. This does not include PSUs sold as spares for repair which have been tested as part of an overall equipment.

**2) component power supplies intended for a professional installer**

This part of IEC 61204 is applicable to this category of power supplies only as an aid to specify relevant EMC requirements in order that various end-product standards may be met.

These are component power supplies that are intended for incorporation into a final product by a professional installer. These products may be sold to a professional installer or placed on the market for specialized distribution and use. ~~In neither case do they perform in themselves a direct function for the user of an end-product.~~ Further EMC tests of the assembly are assumed.

~~NOTE After incorporation into a final product, the emission values can be altered (e.g. because of modified earth connections).~~

### 1.1.5 Configurations and combinations of power supplies

#### 1.1.5.1 Modular PSUs

A PSU with a single primary circuit or module and separate output modules forming a single unit, synchronized or not, ~~shall~~ meets the requirements defined in this document as a single component or apparatus type of PSU.

#### 1.1.5.2 Power supply systems

An easily relocatable system containing several PSUs in parallel, in series or combination with a single input connection ~~shall comply~~ complies with this document as a single component or apparatus type of PSU. It is the responsibility of the system supplier to ensure EMC compliance with this document or with a specific EMC standard of the end product.

#### 1.1.5.3 Power supply installations

When a number of PSUs are used in an installation and are supplied by a distributed AC or DC network, then this is a power installation. This type of arrangement is not easily relocatable. Each individual PSU complies with this document and this is the responsibility of the PSU manufacturer who also provides information on the correct installation of his product. The EMC considerations of the final installation are the responsibility of the professional installer.

#### 1.1.5.4 Distributed power supplies

This is a power installation where the input AC or DC supply is distributed to individual power conversion units or modules which are installed locally to the circuitry to be supplied. This document applies to the individual products as appropriate. The EMC performance of the overall system or installation is the responsibility of the professional installer.

#### 1.1.5.5 Power supplies in parallel or in series

Where PSUs are sold to be connected in parallel or in series, their documentation shall include information relating to the expected EMC performance for such arrangements.

### 1.2 Object

The object of this part of IEC 61204 is to define EMC limits and test methods for PSUs. It includes limits for electromagnetic emissions which may cause interference to other electronic equipment (e.g. radio receivers, measuring and computer devices), as well as electromagnetic immunity limits for continuous and transient conducted and radiated disturbances including electrostatic discharges.

This part of IEC 61204 defines the minimum electromagnetic compatibility requirements for PSUs.

To comply with this part of IEC 61204, no additional EMC tests are required or necessary beyond those stated here.

## 2 Normative references

The following documents are referred to in the 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 60050-121, *International Electrotechnical Vocabulary – Part 121: Electromagnetism*

~~IEC 60050-131, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory*~~

IEC 60050-151, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic compatibility*

IEC 60050-551, *International Electrotechnical Vocabulary – Part 551: Power electronics*

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60146-1-1, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specifications of basic requirements*

~~IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*~~

IEC 60601-1, *Medical electrical equipment – Part 1: General requirements for basic safety and essential performance*

IEC 60950-1~~:2005~~, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-3-2:2014, *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 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

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

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

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity 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 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

~~IEC 61204, *Low-voltage power supply devices, d.c. output – Performance characteristics*[2]~~

~~IEC 61347-2-2, *Lamp controlgear – Part 2-2: Particular requirements for d.c. or a.c. supplied electronic step-down converters for filament lamps*~~

~~IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*~~

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

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

CISPR 16-1 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 16-1-2:~~2004~~ 2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus ~~– Ancillary equipment~~ – Coupling devices for conducted disturbance~~s~~ measurements*

CISPR 16-1-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-3: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Disturbance power*

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

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 terms and definitions given in IEC 60050-121, IEC 60050-151, IEC 60050-161, IEC 60050-551, IEC 60146-1-1 and the following apply.

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~~[2] Future IEC 61204-2.~~

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/obp

**3.1**
**environment**

**3.1.1**
**residential, commercial and light industrial environment**
environment encompassed by the generic standard IEC 61000-6-3

Note 1 to entry: An indication of the locations included by this environment is given in Annex G.

**3.1.2**
**industrial environment**
environment encompassed by the generic standard IEC 61000-6-4

Note 1 to entry: An indication of the locations included by this environment is given in Annex G.

**3.2**
**protection distance**
distance for an electronic or electrical apparatus beyond which the interference levels shall not impair the use of other electronic or electrical equipment, for example broadcast radio and television receivers

**3.3**
**distributed power system**
system of localized power converters supplied from a distributed power bus

**3.4**
**port**
particular interface of a product with the external electromagnetic environment

~~[IEC 60050-131:2002, 131-02-21 modified]~~

Note 1 to entry: Examples of ports are given in Figure 1:

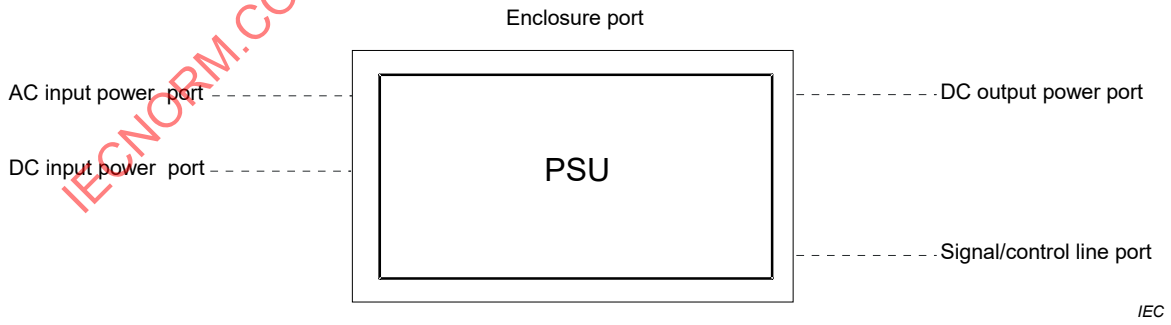



**Figure 1 – Examples of ports**

**3.4.1**
**enclosure port**
physical boundary of the PSU product through which and on which electromagnetic fields may radiate or impinge

**3.4.2**
**signal ~~or control line~~ port**
low energy level input or output port providing diagnostic or control information

**3.4.3**
**DC input power port**
external DC energy source connection point

**3.4.4**
**DC output power port**
external connection point for providing output DC energy

**3.4.5**
**AC input power port**
external AC energy source connection point

**3.5**
**power supply**
**PSU**
electrical or electronic device which transforms energy from an input source into a single or multiple output energy source

**3.5.1**
**component power supply**
modular PSU
sub-unit PSU
assemblies of electrical and/or electronic devices designed to provide or modify energy

Note 1 to entry: They are intended for incorporation into end-products by a professional installer. They are not intended for free-standing applications.

**3.5.2**
**stand alone power supply**
intended for use in laboratories, workshops and other areas in free-standing applications

Note 1 to entry: They are end-products, completely enclosed with full protection against electrostatic discharge and contact with hazardous parts which are accessible to the end-user. Typical examples include adjustable or fixed output bench-top units, plug-top units, free-standing and wall-mounted units.

**3.5.3**
**bench-top power supply**
supply intended for laboratory or similar use

Note 1 to entry: They are stand alone PSUs, sometimes with monitoring and measuring facilities.

**3.5.4**
**open card power supply**
frameless PSU
printed circuit board devoid of a metal mounting bracket

Note 1 to entry: It is a component PSU intended for use by a installer.

**3.5.5**
**open frame power supply**
supply that generally uses a printed circuit board mounted on a metal bracket for attachment to the professional installer's equipment chassis

Note 1 to entry: This bracket provides heat transfer for the cooling of power semiconductors. Optionally, a cover may be used for safety reasons and/or to reduce radiated interference.

**3.5.6**
**plug-in card power supply**
supply intended to be plugged into a subrack

Note 1 to entry: The design may be "open-card", "open-frame" or "cased". A plug-in card PSU is generally intended for use by a professional installer.

**3.5.7**
**cased power supply**
enclosed power supply
supply fully enclosed, cased or housed PSU

Note 1 to entry: The design uses the housing as a heat sink or employs fan(s) for forced air cooling.

**3.5.8**
**plug-top power supply**
direct plug-in power supply
power supply built into a mains voltage plug top

**3.5.9**
**uninterruptible power supply**
**UPS**
supply intended to provide a source of energy secure against mains failure

Note 1 to entry: This type of product would normally be free-standing.

**3.6**
**end-product**
finished unit which is designed to stand alone, useable by an end-user and having a direct function for the end-user

Note 1 to entry: It is intended to be placed on the market and/or taken into service as a single unit or as part of a system or installation.

**3.7**
**system**
localized group of interconnected products which is easily relocatable

Note 1 to entry: Typical examples of this would be a computer, including mouse, keyboard, printer and monitor, or a hi-fi system, TV and video recorder.

**3.8**
**installation**
collection of interconnected products which is not easily relocatable

Note 1 to entry: Typical examples of this include an industrial process installation or a power plant control installation.

~~**3.9**~~
~~**non-professional**~~
~~person or organization assumed to have little or no technical knowledge or facilities~~

**3.9**
**professional installer**
technically competent person or organization capable of correctly assembling/installing components and subassemblies into an end-product, or end-products into a system or installation, and, in so doing, fully complying with the technical and legal requirements of the end-product, system or installation

**3.10**
**full rated load**
maximum continuous or average power a product is marked to supply

**3.11**
**mains supply**

**3.11.1**
**industrial mains supply**
source of electrical energy provided solely for industrial use

**3.11.2**
**private mains supply**
localized source of electrical energy (e.g. generator or UPS) which is not directly connected to the public network

**3.11.3**
**public mains supply**
source of electrical energy provided for general public use in domestic, commercial or light industrial environments

**3.12**
**critical frequency of a PSU**
the frequency, the wavelength of which is equal to four times the longest side length of the PSU

**3.13**
**residual voltage**
<voltage dip> minimum value of RMS voltage recorded during a voltage dip or short interruption

Note 1 to entry: The residual voltage may be expressed as a value in volts, or as a percentage or per unit value relative to the reference voltage.

**3.14**
**type test**
conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16]

## 4 Applicability of tests to different PSU technologies

Guidance on this issue is given in Annex A.

## 5 General requirements and test conditions

### 5.1 General requirements

The manufacturer of the PSU has a responsibility to provide information relating to the EMC performance, application, intended environment and installation guidelines for the product.

### 5.2 Test conditions

The tests shall be performed using the manufacturer's recommended wiring and installation instructions. There will be no connections other than those specified by the manufacturer.

The configuration, orientation and electrical test conditions of the PSU shall be representative of the worst case in-service conditions~~, if known~~. Otherwise, all measurements shall be performed at rated nominal input voltage, full rated load and ambient temperature between 15 °C and 35 °C. The PSU shall be at its normal operating temperature.

The load is presumed not to generate any electromagnetic ~~interference~~ disturbance. Load resistors may be cooled by a fan or cooling fluid.

All tests specified in this document are type tests only.

~~The equipment shall meet the requirements when measured by the test methods specified.~~

~~No additional EMC tests are required or necessary beyond those stated in this standard.~~

A PSU device is deemed to fulfill the requirements specified in this document if it complies with the defined functional and performance requirements using the test methods specified in this document.

Precautions shall be taken against the EUT (equipment under test) becoming dangerous or unsafe as a result of the immunity tests specified in this document.

# 6 Emission requirements

## 6.1 General

If the cable arrangements of the application are known, then those shall be used. If they are not known, the arrangements shall be chosen in accordance with 6.3 and 6.4. The ~~measuring conditions~~ cable arrangement implemented during the test shall be stated in the documentation.

## 6.2 Low frequency phenomena ($f \leq 9$ kHz; AC input only)

### 6.2.1 Commutation notches

In this subclause, only PSUs with commutation of the primary current are covered. PSUs of high power designed as line commutated converters may cause notches if connected to a high impedance source. Measurements or calculations are not mandatory. Information and recommendations are given in Annex B.

### 6.2.2 Current harmonics and interharmonics

The limits for PSUs connected to a public mains supply up to and including a rated input current of 16 A are given in IEC 61000-3-2. This requirement is applicable to apparatus and components considered as apparatus covered within the scope of IEC 61000-3-2.

NOTE Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase are given in IEC 61000-3-12.

Harmonic measurements, especially on PSUs, are sensitive to the voltage source. In many cases, the public mains supply may not be a suitable source for this purpose.

Therefore, one of the following methods shall be used.

a) Using a public mains supply in accordance with the related standard IEC 61000-3-2 or IEC 61000-3-12:
   – the limits for the harmonics of the voltage source shall be met with the PSU operating at full rated load.
b) Using an artificial supply in accordance with the related standard IEC 61000-3-2 or IEC 61000-3-12.
c) Calculation or simulation ~~if it takes into account~~ in accordance with the related standard IEC 61000-3-12:
   – usage of the voltage source as an ideal sine wave;

– notice the worst case internal impedance of the PSU in the frequency range from the line frequency up to the 40th harmonic.

For recommendations: see Annex C. Interharmonics may occur under specific load conditions which cannot be taken into account in this document; this system aspect is the responsibility of the user~~,~~ and/or installer.

### 6.2.3 Voltage fluctuations and flicker

The limits for PSUs connected to a public mains supply up to and including a rated input current of 16 A are given in IEC 61000-3-3. This requirement is applicable to apparatus and components considered as apparatus covered within the scope of IEC 61000-3-3, but it is not mandatory for PSUs used in countries where there are no regulations requiring voltage fluctuations and flicker limits.

For PSUs, only measurements or calculations for $d_{max}$ (maximum relative voltage change) are necessary.

~~NOTE~~ It is recommended to measure the amplitude and the duration of the inrush current and to calculate the RMS value in the first period after switching-on. Most PSUs have inrush current less than 10 ms which means that high inrush currents are still below the $d_{max}$ limit.

Fluctuations of the PSU input current may be caused by a time varying load on the PSU. This system aspect is the responsibility of the user~~,~~ and/or installer.

NOTE Limits for voltage fluctuations and flicker for PSUs connected to a public mains supply up to and including a rated input current of ≤75 A are given in IEC 61000-3-11.

## 6.3 High frequency conducted emission

### 6.3.1 General

The required AMN (artificial mains network) is as defined in 4.3 of CISPR 16-1-2:2014.

Measurements shall be performed in accordance with the method of CISPR 16-2-1.

Disposition of the EUT and its connection to the AMN are as defined in 7.4.1 of CISPR 16-2-1:2014.

Other CISPR publications supply additional test details relevant to a particular EUT as CISPR 11 for ISM application and CISPR 22 for ITE application.

### 6.3.2 High frequency conducted emission for input power ports

For AC input power ports, see Table H.1.

For DC input power ports, see Table H.2.

### 6.3.3 High frequency conducted emission for DC output power ports

For DC output power ports, see Table H.2.

## 6.4 High frequency radiated emission

### 6.4.1 General

Measurements shall be performed in accordance with the reference method of CISPR 16-2-3~~, "Radiated disturbance measurements"~~.

~~or~~

~~– CISPR 16-2-2, "Measurements of disturbance power".~~

~~The manufacturer must justify the choice of the interference power measurement in the documentation and test report, in case of dispute the test method of the manufacturer applies.~~

NOTE Measurement method CISPR 16-2-2 is a substitution only applicable for the frequency band 30 MHz to 300 MHz. Limits are listed in Table H.3.

### 6.4.2 Radiated disturbance measurements

The tests of radiation disturbance shall be performed in accordance with CISPR 16-2-3.

Load cables of unknown length shall be arranged horizontally, equally separated from each other and shall be 1 m in length.

The mains cable is arranged 1 m horizontally and then 0,8 m vertically to the ground where it is connected to the power source. Cables are unshielded, unless the PSU is supplied with a shielded cable.

Any other arrangement shall be justified and explained in the documentation.

The distance between the antenna and the PSU shall be 10 m if the limits of Table H.3 are applied.

~~At a measuring distance of~~ May be measured at 3 m distance~~,~~ using the limits ~~are~~ increased by 10 dB.

~~At a measuring distance of~~ May be measured at 30 m distance~~,~~ using the limits ~~are reduced~~ decreased by 10 dB.

### 6.4.3 Measurement of disturbance power

The measuring receiver shall have a quasi-peak detector and shall be in accordance with the requirements of CISPR 16-2-2. The absorbing clamp shall be designed and calibrated in accordance with CISPR 16-1-3.

NOTE The clamps generally refer to a 10 m radiated field measurement.

For measurement set-up and procedure, see Figure 2.

The PSU and the cable to be tested shall be placed on a non-metallic support of 0,8 m height and at least 0,8 m from all other metallic objects.

The cable under test is stretched in a straight line over a length of at least 5 m on a non-metallic support allowing the absorbing clamp to be moved along the cable under test. The clamp shall be placed around the cable in the correct orientation (current sensor on the side of the PSU).

All other cables are either disconnected (if the correct operation of the equipment can be maintained without the cables), or equipped with absorbing ferrite tubes (clamps) close to the PSU.

Each cable of the PSU shall be tested in turn. Cables which are longer than 5 m are tested as described above with 5 m of cable in the test set-up. The layout of the excess cable is not critical.

Cables which, in normal application, are restricted in length to less than 5 m are tested as follows:

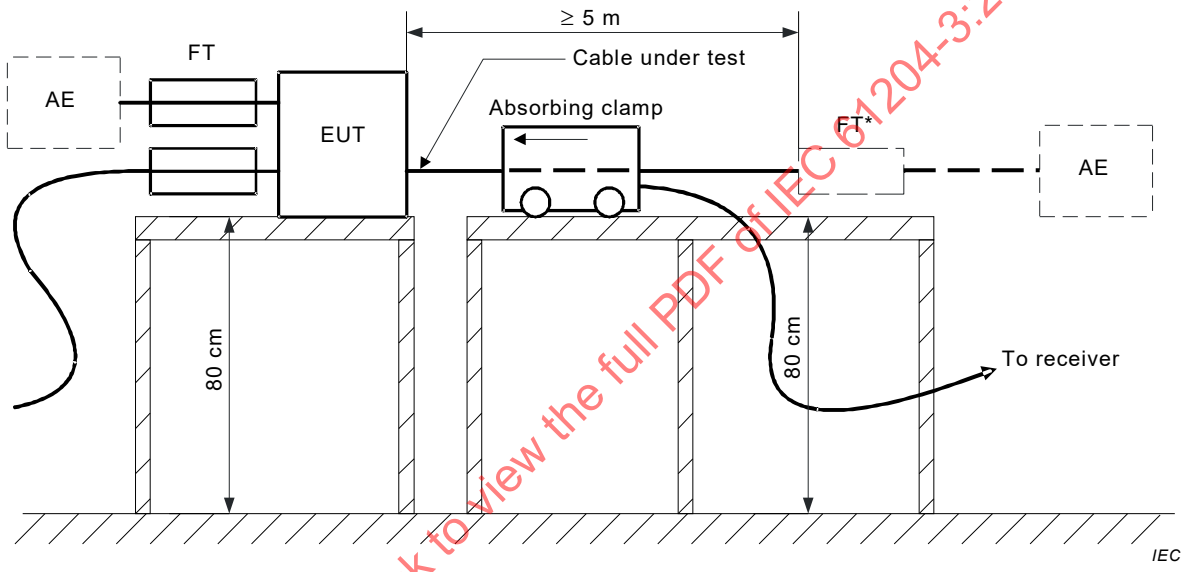
Cables with a restricted length:

- ≤ 0,25 m are not measured at all;
- $< s$ are lengthened to $s$;
- $> s$ are measured over the total length;

where $s$ is twice the length of the clamp.

The clamp shall be displaced along the cable under test, starting closest to the PSU up to a maximum of 5 m. The maximum reading is converted into disturbance power, using the clamp calibration factor. The displacement needed is from zero to a half-wavelength of the measured frequency. All maxima shall be below the limits given in Table H.3.

The disturbance power limits for the frequency are given in Table H.4




**Key**

EUT Equipment under test

AE Associated equipment

FT Ferrite tube (same type as absorbing clamp)

FT* Optional FT, for additional decoupling of the AE, when required

**Figure 2 – Test set-up for the measurement of disturbance power**

### 6.4.4 Restrictions for the application of interference power measurement

The measurement of interference power may be used instead of radiated field strength with the restriction that the longest side length of the box does not exceed $\lambda/4$ of the highest measured frequency. (In accordance with CISPR 16-1 series)

Most PSUs do not emit interference power above this critical frequency. (For calculation of the critical frequency of the PSU, see Annex E.)

Some PSUs can emit interference power above the critical frequency. This is especially so when logic circuitry with a clock frequency above 1 MHz is used.

The application of the high frequency power test method is therefore restricted to PSUs without shielded cables and:

– with a longest side length less than $\lambda/4$ of the highest frequency measured;
– with a clock frequency less than 1 MHz;
– with less than 5 outputs;
– which do not prevent the use of the clamp because of too large a diameter of the leads.

## 7 Immunity requirements

### 7.1 Performance criteria

The performance criteria (see Table 1) shall be used to check the acceptability of a PSU against external disturbances.

From the EMC point of view, any process including a PSU shall be operating as intended.

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

**Table 1 – Criteria to prove the performance of a PSU against EM disturbances**

| | Performance criteria | | |
|---|---|---|---|
| | **A** | **B** | **C** |
| **Basic specifications** | No loss of function or performance during and after the test | Temporary loss of function or performance during the test<br>Self-recoverable | Loss of function or performance<br>Not self-recoverable<br>Not damaged |
| **Remarks** | Operating as intended within specified tolerance | Degradation of performance shall be specified by the manufacturer<br>PSU shall continue to operate as intended after the test | Any resettable condition allowed including shut-down |

Performance criteria in the Tables 2 to 9 have been considered as minimum requirements.

~~These limits have been set to avoid imposing levels which may be unnecessary for the application. For some applications, it may be necessary for the customer and supplier to agree to higher levels.~~

See also Annex D for DC/DC converters.

### 7.2 Basic immunity requirements, high frequency disturbances

#### 7.2.1 General

The test ~~set-up is~~ levels are given in Tables 2 to 9, the test set-up ~~referring~~ refers to basic standards.

NOTE $T_r/T_h$ refers to rise time and impulse duration (50 % value), as described in IEC 61000-4-4.

For surge tests, apparatus with a DC power input port, intended for use with an AC/DC power adapter, shall be tested on the AC power input of the AC/DC power adapter specified by the manufacturer.

### 7.2.2 Immunity level for residential, commercial and light industrial environment

These levels are applied to PSUs which are intended to be used in residential, commercial or light industrial environments.

- Environment encompassed by the generic standard IEC ~~61000-6-3~~ 61000-6-1.
- An indication of the locations included by this environment is given in Annex G.

**Table 2 – Immunity – Enclosure port – Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **2-1** | Electrostatic discharge | Contact discharge<br>Air discharge | ±4<br>±8 | kV<br>kV | IEC 61000-4-2 | [a] | B |
| **2-2** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1000<br>3<br>80 | MHz<br>V/m<br>% | IEC 61000-4-3 | [b] [c] | A |
| **2-3** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | [b] [c] | A |
| **2-4** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | [b] [c] | A |
| **2-5** | Power frequency magnetic field immunity | Magnetic field at power frequencies | 50, 60<br>3 | Hz<br>A/m | IEC 61000-4-8 | [e] | A |

[a] In the case of an open frame PSU, the ESD test is impractical and need not be carried out.

[b] This level does not represent the field emitted by a transceiver in close proximity to the PSU.

[c] The test level specified is the RMS value of the unmodulated carrier.

[e] This test is only required if magnetic field sensitive components are used.

**Table 3 – Immunity – Ports for signal lines and control lines**
**Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **3-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±0,5<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | [a] Capacitive clamp used | B |
| **3-2** | Radio-frequency continuous conducted | Frequency<br>Amplitude<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | [b] | A |

[a] Applicable only to ports interfacing with cables, the total length of which, according to the manufacturer's functional specification may exceed 3 m.

[b] The test level specified is the RMS value of the unmodulated carrier.

The requirements given in Table 4 are not applicable to DC input power ports intended for connection to a battery, or to a rechargeable battery which ~~must~~ shall be disconnected from the equipment for recharging.

The stated limits may not be sufficient for some special applications, see Annex D.

**Table 4 – Immunity – DC input and output power ports**
**Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **4-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±0,5<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | [a] | B |
| **4-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±0,5<br>±0,5 | µs<br>kV<br>kV | IEC 61000-4-5 | | B |
| **4-3** | Radio-frequency continuous conducted | Frequency<br>Amplitude<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | [a, b, c] | A |

[a] The test is applicable to DC input power ports intended to be connected permanently to cables longer than 10 m.

[b] Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

[c] The test level specified is the RMS value of the unmodulated carrier.

**Table 5 – Immunity – AC input power ports – Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **5-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±1<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **5-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±2<br>±1 | µs<br>kV<br>kV | IEC 61000-4-5 | a | B |
| **5-3** | Voltage dips | Residual voltage | 0<br>during ½ cycle | % | IEC 61000-4-11 | | B |
| | | Residual voltage | 0<br>during 1 cycle | % | | | ~~C~~ B |
| | | Residual voltage | 70<br>during 25/30 cycles at 50/60 Hz | % | | c | C |
| **5-4** | Voltage interruptions | Residual voltage | 0<br>during 250/300 cycles at 50/60 Hz | % | IEC 61000-4-11 | d | C |
| **5-5** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | b | A |

a For products designed for installation class I according to IEC 60664-1, the surge limits may be reduced by 50 %.

b The test level specified is the RMS value of the unmodulated carrier.

c "25/30 cycles" means "25 cycles for 50 Hz test" and "30 cycles for 60 Hz test".

d "250/300 cycles" means "250 cycles for 50 Hz test" and "300 cycles for 60 Hz test".

### 7.2.3 Immunity level for industrial environment

These levels are applied to PSUs which are intended to be used in an industrial environment. In case of disturbances beyond the following levels, a solution has to be agreed between the customer and the supplier.

- Environment encompassed by the generic standard IEC ~~61000-6-4~~ 61000-6-2.
- An indication of the locations included by this environment is given in Annex G.

**Table 6 – Immunity – Enclosure port – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **6-1** | Electrostatic discharge | Contact discharge<br>Air discharge | ±4<br>±8 | kV<br>kV | IEC 61000-4-2 | a | B |
| **6-2** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1 000<br>10<br>80 | MHz<br>V/m<br>% | IEC 61000-4-3 | b c | A |
| **6-3** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b c | A |
| **6-4** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b c | A |
| **6-5** | Power frequency magnetic field immunity | Magnetic field at power frequencies | 50, 60<br>30 | Hz<br>A/m | IEC 61000-4-8 | d | A |

a In the case of an open frame PSU, the ESD test is impractical and need not be carried out.

b This level does not represent the field emitted by a transceiver in close proximity to the PSU.

c The test level specified is the RMS value of the unmodulated carrier.

d This test is only required if magnetic field sensitive components are used.

**Table 7 – Immunity – Ports for signal lines and control lines – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **7-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±1<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | a Capacitive clamp used | B |
| **7-2** | Radio-frequency common mode Amplitude modulated | Frequency<br>Amplitude<br>Modulation | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a<br>b | A |

a Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

b The test level specified is the RMS value of the unmodulated carrier.

The requirements given in Table 8 are not applicable to DC input power ports intended for connection to a battery, or to a rechargeable battery which ~~must~~ shall be disconnected from the equipment for recharging.

The stated limits may not be sufficient for some special applications, see Annex D.

**Table 8 – Immunity – DC input and output power ports – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **8-1** | Fast transients | Peak line-to-ground voltage | ±2 | kV | IEC 61000-4-4 | [a] | B |
| | | $T_r/T_h$ | 5/50 | ns | | | |
| | | Repetition frequency | 100 | kHz | | | |
| **8-2** | Surges | $T_r/T_h$ | 1,2/50 (8/20) | µs | IEC 61000-4-5 | [b] | B |
| | | Peak line-to-ground voltage | ±0,5 | kV | | | |
| | | Peak line-to-line voltage | ±0,5 | kV | | | |
| **8-3** | Radio-frequency continuous conducted | Frequency | 0,15 to 80 | MHz | IEC 61000-4-6 | [a, c, d] | A |
| | | Amplitude | 10 | V | | | |
| | | AM (1 kHz) | 80 | % | | | |

[a] The test is applicable to DC input power ports intended to be connected permanently to cables longer than 10 m.

[b] Applicable only to ports interfacing with cables the total length of which may exceed 30 m according to the manufacturer's functional specification.

[c] Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

[d] The test level specified is the RMS value of the unmodulated carrier.

**Table 9 – Immunity – AC input power ports – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | ~~Test set-up~~ Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **9-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±2<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **9-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±2<br>±1 | µs<br>kV<br>kV | IEC 61000-4-5 | a | B |
| **9-3** | Voltage dips | Residual voltage | 0 during ½ cycle | % | IEC 61000-4-11 | | B |
| | | Residual voltage | 0 during 1 cycle | % | | | B |
| | | Residual voltage | 40 during 10/12 cycles at 50/60 Hz | % | | c | C |
| | | Residual voltage | 70 during 25/30 cycles at 50/60 Hz | % | | d | C |
| | | Residual voltage | 80 during 250/300 cycles at 50/60 Hz | % | | e | C |
| **9-4** | Voltage interruptions | Residual voltage | 0 during 250/300 cycles at 50/60 Hz | % | IEC 61000-4-11 | e | C |
| **9-5** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM(1kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | b | A |

a In some industrial environments, higher limits may be required.

b The test level specified is the RMS value of the unmodulated carrier.

c "10/12 cycles" means "10 cycles for 50 Hz test" and "12 cycles for 60 Hz test".

d "25/30 cycles" means "25 cycles for 50 Hz test" and "30 cycles for 60 Hz test".

e "250/300 cycles" means "250 cycles for 50 Hz test" and "300 cycles for 60 Hz test".



## 8 Power supply families aspects

A power supply family consists of PSUs with similarities between members.

It is neither economic nor sensible to measure the EMC performance of all members of the family.

It is the responsibility of the manufacturer to decide which members of the family should be tested as being representative of the entire family. This decision shall be justified in the test report.

See also Annex F.

## 9 Statistical aspects

The limits in this document are set taking measurement uncertainties into account.

As a consequence, the measured value of one product sample shall be compared directly with the limits.

- One product sample means one piece.
- In case of ~~dispute~~ series production test, for conformance the 80/80 % rule stated in CISPR 16-1 series shall apply.

NOTE Uncertainty of measurement is a parameter, associated with the result of measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measure and in accordance with ISO/IEC ~~Guide 25~~ 17025 to the expression of uncertainty in measurement. Measurement uncertainty arises from random effects and from imperfect correction for systematic effects.

## 10 Safety aspects

EMC mitigation measures shall not violate the required electrical safety provisions; for example mains filters influence the touch current, and EMC screens can influence clearance or creepage distances.

~~Equipment shall not become dangerous or unsafe as a result of immunity tests defined in this standard. Therefore, type tests for EMC compliance shall be concluded before safety type tests are carried out or in parallel, as long as any changes to the equipment due to EMC testing are retested for compliance with product safety requirements.~~

After EMC testing it is necessary to ensure that the equipment continues to meet the requirements of its electrical safety product standard.

NOTE This document does not consider functional safety aspects. Such requirements are considered in accordance to IEC 61000-1-2.

## 11 Test report

The test results shall be documented in a test report.

The report shall give sufficient product identification and test data. It shall clearly, unambiguously and objectively present all relevant information of the tests such as load conditions, cable length, earthing, etc.

A functional description of the test set-up, including test equipment, cable layout and the modes of operation during the test shall be given.

A detailed definition and a justification of the chosen acceptance criteria shall be provided by the manufacturer and noted in the test report.

The report shall give the actual measured values for each test and relate them to the limit values.

# Annex A
(normative)

# Guidelines on the classification of PSUs

## A.1 General

Because many PSUs are used as part of larger units, referring to different EMC standards, a classification is necessary. This annex provides some examples of product classification, but it is the manufacturer's responsibility to determine the classification.

## A.2 Stand alone power supplies

The manufacturer is responsible for all relevant EMC tests to be applied to these PSUs. This category includes, for example:

- bench-top PSUs for laboratory or similar use;
- stand alone PSUs for industrial applications;
- plug top PSUs with switched mode control;
- industrial battery chargers;
- plug top PSUs with no internal high frequency generator;
- domestic battery chargers;
- communication power systems.

## A.3 Component power supplies

**a) Component power supplies considered as equivalent to "stand alone power supplies" (apparatus)**

These PSUs are intended for sale to an end-user or installer. The manufacturer is responsible for all relevant EMC tests to be applied to these PSUs. This category includes, for example:

– PSUs with integral mains and/or IT equipment connectors that are sold to the general public for upgrading PCs, for use with printers, etc.;

– PSUs intended to be used (with the addition of appropriate casing, wiring, etc.) in installations where the EMC performance will not be measured by the installer;

– a 24 V output PSU, within a safe box, intended for installation;

– PSUs for amateur electronics.

This category does not include PSUs sold to the general public or for use in installations, where these are spares for repair and have been tested as part of an overall equipment.

**b) Component power supplies intended for a professional assembler/installer**

This category includes, for example:

– most open card, cased and PCB-mounted PSUs (both plug in and wired);

– rack sub-assembly PSUs which are intended for use only by professional assemblers;

– PSUs sold as spares for repair where this PSU has been tested as part of the final product by a professional assembler.

Table A.1 gives an overview of the application of EMC standards to PSUs classified in accordance with Clauses A.2 and A.3.

**Table A.1 – Classification of power supplies and the relevant EMC standards**

| Power supply | | EMC standard |
|---|---|---|
| **A.2** | **Stand alone power supplies (apparatus)** | IEC 61204-3 |
| **A.3** | Component power supplies | IEC 61204-3 |
| | 1) Considered as equivalent to "stand alone power supplies (apparatus) | IEC 61204-3 used as an aid |
| | 2) Intended for a professional installer | IEC 61204-3 may be replaced by an end-product EMC standard~~, as agreed between the PSU manufacturer and installer or as required by the intended specific application~~ |

# Annex B
(informative)

## Commutation notches

The problem of commutation notches exists only for a very small percentage of PSUs, therefore no measurements or calculations are mandatory. In relevant cases, the manufacturer and the user have to agree the limit of the notches; this annex gives some common explanations of the problem.

The effect of commutation notches is well-known from line commutated converters of high power, especially if connected to voltage sources of high impedance. It is a system effect because it is dependent both on the internal line impedance and the converter characteristics. High power PSUs within the scope of this document may be designed as line commutated converters. The notch problem is much less severe because of the relatively low power compared with converters for drives or high power UPS.

Notches are defined in IEC 60146-1-1. They can be reduced by commutation impedances in series with the converter source connectors. The impedance needed depends on the internal impedance of the power source, the input impedance of the PSU and the limit of the notches at the source connectors.

Generally, line commutated PSUs are connected to an industrial mains supply where commutation notches of up to 40 % are usual. The limits of notches at a public mains supply ~~must~~ shall comply with the limits of the local supply authority.

The calculation of the commutation impedances is well-known and needs no further information.

# Annex C
(informative)

## Calculation and simulation of the input current harmonics

Generally, public mains supplies do not meet the requirements for testing the equipment against IEC 61000-3-2:2014, Annex A. In those cases, artificial voltage sources are necessary for the measurement of input current harmonics, the nominal power of which may need to be considerably higher than the rated power of the PSU because of the high peaks of input current and the requirement that the limits for harmonic currents shall be met with the PSU operating at full rated load.

Therefore, the calculation or simulation method related to standard IEC 61000-3-12 is commonly used for products of high power with input current >16 A and ≤75 A per phase.

If the internal input impedances of the PSU up to the 40th harmonic are known, simulation can be a reasonable solution to evaluate harmonics, even for low power PSUs.

If impedances are not exactly known, the worst case value is to be used. To avoid simulation errors, it is recommended that a batch test is performed for a typical case of a PSU family and that the results of the measurement are compared with the simulation.

In case of doubt, measurement is preferred.

# Annex D
(informative)

# Special considerations for DC/DC converters

## D.1 General

For some DC/DC converter applications, the definitions used in this document for "residential, commercial and light industrial environment" or "industrial environment" do not reflect the actual environment in which a DC/DC converter can be located.

## D.2 Emission

For DC/DC converters with an input voltage ≤ 60 V, which are used in distributed power systems and installations in special applications (e.g. telecom stations), the use of other limits may be necessary.

## D.3 Immunity

Higher immunity levels than specified in this document are recommended for DC/DC converters and which are:

- supplied by a generator (e.g. cars, ships), in a system with DC motor drives (e.g. fork-lifts, electric cars) or from high voltage converters (e.g. trains, streetcars);
- in industrial applications where the nominal DC input voltages are higher than 60 V;
- in power distribution systems in industrial applications (e.g. power plants, process industry).

The minimum immunity level for this class of DC/DC converters is defined in 7.2, Tables 2, 3, 4, 6, 7 and 8.

For a higher degree of immunity on the DC input, the levels of tables D.1, D.2 and D.3 are recommended for the following input categories:

a) nominal DC input voltage ≤ 100 V if fed from a generator, DC drives system or high voltage converter;

b) nominal DC input voltage > 100 V.

**Table D.1 – Immunity – DC input power ports – Input category a**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.1-1** | Fast transients | Peak line-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ± 2<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **D.1-2** | Surges | $T_r/T_h$<br>Peak line-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>± 1<br>± 0,5 | µs<br>kV<br>kV | IEC 61000-4-5 | | B |
| **D.1-3** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a, b | ~~B~~ A |
| a The test is applicable to DC input ports intended to be connected permanently to cables longer than 10 m.<br>b The test level specified is the RMS value of the unmodulated carrier. | | | | | | | |

Tests described in Table D.2 are applicable to DC power ports intended to be connected permanently to cables longer than 10 m.

**Table D.2 – Immunity – DC input power ports – Input category b**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.2-1** | Fast transients | Peak line-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ± 4<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **D.2-2** | Surges | $T_r/T_h$<br>Peak line-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>± 2<br>± 1 | µs<br>kV<br>kV | IEC 61000-4-5 | a | B |
| **D.2-3** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | b | ~~B~~ A |
| a In some industrial environments higher limits may be required.<br>b The test level specified is the RMS value of the unmodulated carrier. | | | | | | | |

**Table D.3 – Immunity – Enclosure port – Input categories a and b**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.3-1** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1 000<br>10<br>80 | MHz<br>V/m<br>% | IEC 61000-4-3 | a<br>b | ~~B~~ A |
| **D.3-2** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |
| **D.3-3** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |

a This level does not represent the field emitted by a transceiver in close proximity to the PSU.

b The test level specified is the RMS value of the unmodulated carrier.

# Annex E
(informative)

# Critical frequency for high frequency power measurement

## ~~E.1~~ Calculation of the critical frequency of a PSU

The maximum test frequency for the absorbing clamp measurement, in accordance with CISPR 16-1 series, is defined, in this document, as the critical measuring frequency of the PSU.

CISPR 16-1 series requires that the longest side length of an EUT shall be:

$$l \leq \frac{\lambda_{\text{critical}}}{4}$$

with $\lambda_{\text{critical}} = \frac{c}{f_{\text{critical}}}$

then $f_{\text{critical}} = \frac{c}{4l}$

or $f_{\text{critical}} \cong \frac{75}{l}$ (MHz)

$f_{\text{measure}} = f_{\text{critical}}$

where

$l$ is the longest side length of the PSU, in metres;

$\lambda$ is the wavelength of the measuring frequency, in metres;

$c$ is the speed of light ($\cong 3 \times 10^8$ m/s).

# Annex F
(normative)

# Guidelines on power supply families

## F.1 General

This annex provides some assistance in judging the test philosophy of power supply families, but it is the manufacturer who will ultimately decide how many different representative products need to be tested.

A power supply family consists of a set of PSUs with similarities between its members. It may be possible to select one family member that is representative of all the other members in respect of EMC, but usually it would be necessary to test several PSUs.

The basis of the testing philosophy, including decisions, conclusions and a description of the products covered by the test plan, should be detailed in the test report or file.

Choice of family members to be tested is clearly dependent on the similarities between family members. Not all input/output combinations need to be tested, but it would be advisable to test all different input sections and all different output sections at least once.

## F.2 Emission

Items that may influence emission are:

- the type of enclosure,
- ventilation slots,
- connectors,
- input/output filter design,
- wiring lengths,
- layout and type,
- ground management,
- switching components,
- control of the switching components,
- magnetic components,
- different sources of the same component,
- the printed circuit board design.

## F.3 Immunity performance

Items that may influence the immunity performance are:

- the type of enclosure,
- ventilation slots,
- connectors,
- input/output filter design,
- magnetic components,
- wiring lengths,

- layout and type,
- ground management,
- control loops[3],
- printed circuit board design,
- decoupling.



3 The tests specified in IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-6 may affect the output regulation.

# Annex G
(informative)

# Summary of classification of environments and limits

## G.1 Residential, commercial and light industrial environment

Environment encompassed by the generic standard IEC 61000-6-1 and IEC 61000-6-3.

The following list, although not comprehensive, gives an indication of locations that are included:

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

## G.2 Industrial environment

Environment encompassed by the generic standard IEC 61000-6-2 and IEC 61000-6-4.

Industrial locations are in addition characterised by the existence of one or more of the following examples:

- industrial, scientific and medical (ISM) apparatus;
- heavy inductive or capacitive load are frequently switched;
- high currents and associated magnetic fields.

NOTE A PSU strictly designed for this environment ~~should carry~~ carries the following remark in its documentation:

**Warning: This is a product designed for an industrial environment. In a residential, commercial or light industrial environment it may cause radio interference. The user may be required to take adequate measures to reduce interference.**

The user, advised by the supplier, is responsible for the electromagnetic compatibility of the installed product in his environment.

## G.3 Special applications

This concerns the industrial environment only where equipment with high input current (> 25 A) is connected to an industrial mains supply, or a private mains supply, and where the protection distance is > 100 m.

Limits are under consideration.

In these applications, clear warning of the restricted use of the equipment shall be given in the documentation supplied with it.

Examples:

- internal radio interference tolerated by the user and external interference within acceptable limits (e.g. mains supply independent of public mains supply);
- safety requirements in conflict with EMC requirements in high power installations.

## G.4 Special considerations for DC/DC converters

See Annex D.

# Annex H
(normative)

## Emission limits

These limits have been copied without alteration, from IEC 61000-6-3, IEC 61000-6-4 and CISPR 14-1.

**Table H.1 – Limits of mains terminal disturbance voltage (AC input port)**

| | **Stand alone power supplies designed for a residential, commercial and light-industrial environment**<br>**See 3.1.1** | | **Stand alone power supplies designed for an industrial environment**<br>**See 3.1.2** | |
|---|---|---|---|---|
| **Frequency**<br>MHz | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) |
| 0,15 to 0,5 | 66 to 56 [a] | 56 to 46 [a] | 79 | 66 |
| 0,5 to 5 | 56 | 46 | 73 | 60 |
| 5 to 30 | 60 | 50 | 73 | 60 |
| [a] Limit decreasing linearly with logarithm of frequency. | | | | |
| NOTE For DC input, see Annex D. | | | | |

**Table H.2 – Limits of mains terminal disturbance voltage (DC input and DC output power port)**

| | **Stand alone power supplies designed for a residential, commercial and light-industrial environment**<br>**See 3.1.1** | | **Stand alone power supplies designed for an industrial environment**<br>**See 3.1.2** | |
|---|---|---|---|---|
| **Frequency**<br>MHz | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) |
| 0,15 to 0,5 | 79 | 66 | Not mandatory | Not mandatory |
| 0,5 to 5 | 73 | 60 | | |
| 5 to 30 | 73 | 60 | | |
| Applicable only to ports intended for connection to<br>– a local DC power network<br>or<br>– a remote local battery<br>by connecting cable exceeding a length of 30 m. | | | | |

**Table H.3 – Limits for electromagnetic radiation/interference power disturbance (all field strength limits refer to quasi-peak measurements)**

| | Stand alone power supplies designed for a residential, commercial and light-industrial environment<br><br>See 3.1.1 | | Stand alone power supplies designed for an industrial environment<br><br>See 3.1.2 | |
|---|---|---|---|---|
| **Frequency band**<br>MHz | **Quasi-peak**<br>dB(μV/m) | **Distance**<br>m | **Quasi-peak**<br>dB(μV/m) | **Distance**<br>m |
| 30 to 230 | 30 | 10 | 40 | 10 |
| 230 to 1 000 | 37 | 10 | 47 | 10 |
| | | | | |
| **Frequency band** [a]<br>GHz | **Peak/Average**<br>dB(μV/m) | **Distance**<br>m | **Peak/Average**<br>dB(μV/m) | **Distance**<br>m |
| 1 to 3 | 70/50 | 3 | 76/56 | 3 |
| 3 to 6 | 74/54 | 3 | 80/60 | 3 |
| [a] Measurements only applicable if internal clock frequencies above 108 MHz are used. | | | | |

Alternatives to the 10 m field strength measurement:

- 30 m = 10 m limits – 10 dB;
- 3 m = 10 m limits + 10 dB.

NOTE ~~This is not recommended for PSUs with a side length exceeding $\lambda/4$ of the highest measured frequency.~~ Additional guidance on the test method can be found in CISPR 16-2-3.

**Table H.4 – Disturbance power limits for the frequency range 30 MHz to 300 MHz**

| **Frequency**<br>MHz | **Quasi-peak**<br>dB(pW) | **Average** [a]<br>dB(pW) |
|---|---|---|
| 30 to 300 | 45 to 55 | 35 to 45 |
| [a] If the limit for the measurement with the average detector is met when using a receiver with quasi-peak detector, the equipment under test may be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out. | | |

## Bibliography

IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

IEC 60050-131, *International Electrotechnical Vocabulary – Part 131: Circuit theory*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

~~IEC 60950-1:2001, *Information technology equipment – Safety – Part 1: General requirements*~~

IEC 61000-1-2, *Electromagnetic compatibility (EMC) – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

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 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 62040-1, *Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS*

ISO/IEC ~~Guide 25~~ 17025, *General requirements for the competence of testing and calibration laboratories*

CENELEC Guide 24, *Electromagnetic Compatibility (EMC) Standardization for Product Committees concerned with apparatus*

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

CISPR 15, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

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

# IEC 61204-3

Edition 3.0 2016-10

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Low-voltage switch mode power supplies –**
**Part 3: Electromagnetic compatibility (EMC)**

**Alimentations à découpage basse tension –**
**Partie 3: Compatibilité électromagnétique (CEM)**



IEC 61204-3:2016-10(en-fr)

# CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# LOW-VOLTAGE SWITCH MODE POWER SUPPLIES –

# Part 3: Electromagnetic compatibility (EMC)

## 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 61204-3 has been prepared by subcommittee 22E: Stabilized power supplies, of IEC technical committee 22: Power electronic systems and equipment.

IEC 61204-3 has the status of a product family standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

a) the title has been changed by deleting the wording "DC output-" from the title and adding "switch mode" in the title;
b) changes in the scope: 1.1.1 Equipment covered by this document;
c) update of the normative references to the latest editions or dated references;

d) change of wording or/and notes regarding the requirements of CENELEC Guide 24 and IEC Guide 107;

e) revision of the emission limits to align with the latest editions of the applicable normative references;

f) revision of the immunity requirements to align with the latest editions of the applicable normative references;

g) correction of typographical errors.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 22E/174/FDIS | 22E/176/RVD |

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61204 series, under the general title *Low-voltage power supplies, d.c. output,* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

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

# LOW-VOLTAGE SWITCH MODE POWER SUPPLIES –

# Part 3: Electromagnetic compatibility (EMC)

## 1 Scope and object

### 1.1 Scope

#### 1.1.1 Equipment covered by this document

This part of IEC 61204 specifies the electromagnetic compatibility (EMC) requirements for switch mode power supply (SMPS) units supplied by source voltages up to 1 000 V AC or 1 500 V DC providing AC and/or DC output(s), except inverter output(s) establishing AC mains (see exceptions under 1.1.3.)

NOTE 1 This document by definition covers DC/DC converters.

NOTE 2 Power supplies can provide accessory AC mains socket outlets, when such outputs are supplied from the AC mains.

NOTE 3 Ringing generators used in telecoms applications are covered by this document.

This product standard covers both stand alone and component power supply (PSU) units as defined in this document. It covers PSU units for use in or with IT equipment normally covered by IEC 60950-1 and/or IEC 62368-1; PSU units for use in or with measurement, control and laboratory equipment normally covered by IEC 61010-1; PSU units for use in or with medical equipment – normally covered by IEC 60601-1; PSU units for use in or with audio, video and similar electronic apparatus – normally covered by IEC 60065 and/or IEC 62368-1. It also covers DC power and distribution equipment and DC/DC converters.

Where no standard exist, use of this document for other applications is not precluded.

#### 1.1.2 Additional requirements

Requirements additional to those specified in this document may be necessary for

- PSUs intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres);
- PSUs intended to be used in vehicles, on board ships or aircraft, or in tropical countries;
- PSUs intended for use where ingress of water is possible.

NOTE Attention is drawn to the fact that authorities in some countries impose additional requirements for health, environmental and similar reasons.

#### 1.1.3 Exclusions

This document does not apply to

- motor-generator sets;
- uninterruptible power supplies (UPS) to IEC 62040-1;
- PSUs covered by IEC 61558-1 (i.e. power supply units incorporating safety isolating transformers providing SELV or PELV output(s) in accordance with IEC 60364-4-41) and PSUs for use with household and other consumer products, except those covered by IEC 60065 and IEC 60950-1 and/or IEC 62368-1;
- transformers covered by IEC 61558-1;

- step-down converters covered by IEC 60146-1-1;
- PSUs and converters intended for DC supplied bulb lamps, halogen lamps or LED lamps covered by CISPR 15.

### 1.1.4 Types of power supply

Two types of power supplies are covered by this document:

**a) stand alone (or end-product) power supplies**

Power supplies intended for free-standing operation (individual apparatus).

This part of IEC 61204 is applicable to PSUs developed as a unit with a direct function and sold on the market as a stand alone unit.

**b) component power supplies**

These can be divided into two categories:

**1) component power supplies considered as equivalent to stand alone power supplies (apparatus)**

This part of IEC 61204 is applicable to this category of component PSUs. These PSUs are considered to be apparatus with respect to their EMC requirements, for example those PSUs intended for use in installations or sold to the general public, cases where no further EMC tests are anticipated. This does not include PSUs sold as spares for repair which have been tested as part of an overall equipment.

**2) component power supplies intended for a professional installer**

This part of IEC 61204 is applicable to this category of power supplies only as an aid to specify relevant EMC requirements in order that various end-product standards may be met.

These are component power supplies that are intended for incorporation into a final product by a professional installer. These products may be sold to a professional installer or placed on the market for specialized distribution and use. Further EMC tests of the assembly are assumed.

### 1.1.5 Configurations and combinations of power supplies

#### 1.1.5.1 Modular PSUs

A PSU with a single primary circuit or module and separate output modules forming a single unit, synchronized or not, meets the requirements defined in this document as a single component or apparatus type of PSU.

#### 1.1.5.2 Power supply systems

An easily relocatable system containing several PSUs in parallel, in series or combination with a single input connection complies with this document as a single component or apparatus type of PSU. It is the responsibility of the system supplier to ensure EMC compliance with this document or with a specific EMC standard of the end product.

#### 1.1.5.3 Power supply installations

When a number of PSUs are used in an installation and are supplied by a distributed AC or DC network, then this is a power installation. This type of arrangement is not easily relocatable. Each individual PSU complies with this document and this is the responsibility of the PSU manufacturer who also provides information on the correct installation of his product. The EMC considerations of the final installation are the responsibility of the professional installer.

#### 1.1.5.4 Distributed power supplies

This is a power installation where the input AC or DC supply is distributed to individual power conversion units or modules which are installed locally to the circuitry to be supplied. This document applies to the individual products as appropriate. The EMC performance of the overall system or installation is the responsibility of the professional installer.

#### 1.1.5.5 Power supplies in parallel or in series

Where PSUs are sold to be connected in parallel or in series, their documentation shall include information relating to the expected EMC performance for such arrangements.

### 1.2 Object

The object of this part of IEC 61204 is to define EMC limits and test methods for PSUs. It includes limits for electromagnetic emissions which may cause interference to other electronic equipment (e.g. radio receivers, measuring and computer devices), as well as electromagnetic immunity limits for continuous and transient conducted and radiated disturbances including electrostatic discharges.

This part of IEC 61204 defines the minimum electromagnetic compatibility requirements for PSUs.

To comply with this part of IEC 61204, no additional EMC tests are required or necessary beyond those stated here.

## 2 Normative references

The following documents are referred to in the 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 60050-121, *International Electrotechnical Vocabulary – Part 121: Electromagnetism*

IEC 60050-151, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic compatibility*

IEC 60050-551, *International Electrotechnical Vocabulary – Part 551: Power electronics*

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60146-1-1, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

IEC 60601-1, *Medical electrical equipment – Part 1: General requirements for basic safety and essential performance*

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-3-2:2014, *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 61000-3-12, *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 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

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

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

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity 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 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 16-1 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

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 16-1-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-3: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Disturbance power*

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 16-2-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-2: Methods of measurement of disturbances and immunity – Measurement of disturbance power*

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*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-121, IEC 60050-151, IEC 60050-161, IEC 60050-551, IEC 60146-1-1 and the following apply.

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/obp

**3.1**
**environment**

**3.1.1**
**residential, commercial and light industrial environment**
environment encompassed by the generic standard IEC 61000-6-3

Note 1 to entry: An indication of the locations included by this environment is given in Annex G.

**3.1.2**
**industrial environment**
environment encompassed by the generic standard IEC 61000-6-4

Note 1 to entry: An indication of the locations included by this environment is given in Annex G.

**3.2**
**protection distance**
distance for an electronic or electrical apparatus beyond which the interference levels shall not impair the use of other electronic or electrical equipment, for example broadcast radio and television receivers

**3.3**
**distributed power system**
system of localized power converters supplied from a distributed power bus

**3.4**
**port**
particular interface of a product with the external electromagnetic environment

Note 1 to entry: Examples of ports are given in Figure 1.

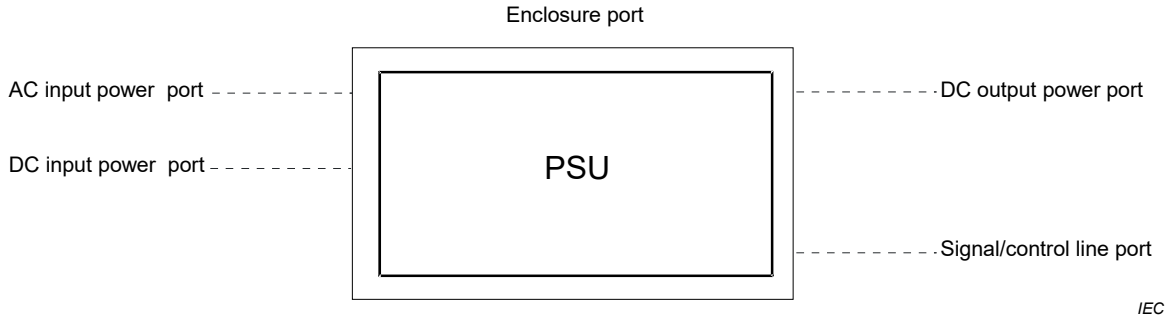



**Figure 1 – Examples of ports**

**3.4.1**
**enclosure port**
physical boundary of the PSU product through which and on which electromagnetic fields may radiate or impinge

**3.4.2**
**signal port**
low energy level input or output port providing diagnostic or control information

**3.4.3**
**DC input power port**
external DC energy source connection point

**3.4.4**
**DC output power port**
external connection point for providing output DC energy

**3.4.5**
**AC input power port**
external AC energy source connection point

**3.5**
**power supply**
**PSU**
electrical or electronic device which transforms energy from an input source into a single or multiple output energy source

**3.5.1**
**component power supply**
modular PSU
sub-unit PSU
assemblies of electrical and/or electronic devices designed to provide or modify energy

Note 1 to entry: They are intended for incorporation into end-products by a professional installer. They are not intended for free-standing applications.

**3.5.2**
**stand alone power supply**
intended for use in laboratories, workshops and other areas in free-standing applications

Note 1 to entry: They are end-products, completely enclosed with full protection against electrostatic discharge and contact with hazardous parts which are accessible to the end-user. Typical examples include adjustable or fixed output bench-top units, plug-top units, free-standing and wall-mounted units.

**3.5.3**
**bench-top power supply**
supply intended for laboratory or similar use

Note 1 to entry: They are stand alone PSUs, sometimes with monitoring and measuring facilities.

**3.5.4**
**open card power supply**
frameless PSU
printed circuit board devoid of a metal mounting bracket

Note 1 to entry: It is a component PSU intended for use by a installer.

**3.5.5**
**open frame power supply**
supply that generally uses a printed circuit board mounted on a metal bracket for attachment to the professional installer's equipment chassis

Note 1 to entry: This bracket provides heat transfer for the cooling of power semiconductors. Optionally, a cover may be used for safety reasons and/or to reduce radiated interference.

**3.5.6**
**plug-in card power supply**
supply intended to be plugged into a subrack

Note 1 to entry: The design may be "open-card", "open-frame" or "cased". A plug-in card PSU is generally intended for use by a professional installer.

**3.5.7**
**cased power supply**
enclosed power supply
supply fully enclosed, cased or housed PSU

Note 1 to entry: The design uses the housing as a heat sink or employs fan(s) for forced air cooling.

**3.5.8**
**plug-top power supply**
direct plug-in power supply
power supply built into a mains voltage plug top

**3.5.9**
**uninterruptible power supply**
**UPS**
supply intended to provide a source of energy secure against mains failure

Note 1 to entry: This type of product would normally be free-standing.

**3.6**
**end-product**
finished unit which is designed to stand alone, useable by an end-user and having a direct function for the end-user

Note 1 to entry: It is intended to be placed on the market and/or taken into service as a single unit or as part of a system or installation.

**3.7**
**system**
localized group of interconnected products which is easily relocatable

Note 1 to entry: Typical examples of this would be a computer, including mouse, keyboard, printer and monitor, or a hi-fi system, TV and video recorder.

**3.8**
**installation**
collection of interconnected products which is not easily relocatable

Note 1 to entry: Typical examples of this include an industrial process installation or a power plant control installation.

**3.9**
**professional installer**
technically competent person or organization capable of correctly assembling/installing components and subassemblies into an end-product, or end-products into a system or installation, and, in so doing, fully complying with the technical and legal requirements of the end-product, system or installation

**3.10**
**full rated load**
maximum continuous or average power a product is marked to supply

**3.11**
**mains supply**

**3.11.1**
**industrial mains supply**
source of electrical energy provided solely for industrial use

**3.11.2**
**private mains supply**
localized source of electrical energy (e.g. generator or UPS) which is not directly connected to the public network

**3.11.3**
**public mains supply**
source of electrical energy provided for general public use in domestic, commercial or light industrial environments

**3.12**
**critical frequency of a PSU**
the frequency, the wavelength of which is equal to four times the longest side length of the PSU

**3.13**
**residual voltage**
<voltage dip> minimum value of RMS voltage recorded during a voltage dip or short interruption

Note 1 to entry: The residual voltage may be expressed as a value in volts, or as a percentage or per unit value relative to the reference voltage.

**3.14**
**type test**
conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16]

## 4 Applicability of tests to different PSU technologies

Guidance on this issue is given in Annex A.

# 5 General requirements and test conditions

## 5.1 General requirements

The manufacturer of the PSU has a responsibility to provide information relating to the EMC performance, application, intended environment and installation guidelines for the product.

## 5.2 Test conditions

The tests shall be performed using the manufacturer's recommended wiring and installation instructions. There will be no connections other than those specified by the manufacturer.

The configuration, orientation and electrical test conditions of the PSU shall be representative of the worst case in-service conditions. Otherwise, all measurements shall be performed at rated nominal input voltage, full rated load and ambient temperature between 15 °C and 35 °C. The PSU shall be at its normal operating temperature.

The load is presumed not to generate any electromagnetic disturbance. Load resistors may be cooled by a fan or cooling fluid.

All tests specified in this document are type tests only.

A PSU device is deemed to fulfill the requirements specified in this document if it complies with the defined functional and performance requirements using the test methods specified in this document.

Precautions shall be taken against the EUT (equipment under test) becoming dangerous or unsafe as a result of the immunity tests specified in this document.



# 6 Emission requirements

## 6.1 General

If the cable arrangements of the application are known, then those shall be used. If they are not known, the arrangements shall be chosen in accordance with 6.3 and 6.4. The cable arrangement implemented during the test shall be stated in the documentation.

## 6.2 Low frequency phenomena ($f \leq 9$ kHz; AC input only)

### 6.2.1 Commutation notches

In this subclause, only PSUs with commutation of the primary current are covered. PSUs of high power designed as line commutated converters may cause notches if connected to a high impedance source. Measurements or calculations are not mandatory. Information and recommendations are given in Annex B.

### 6.2.2 Current harmonics and interharmonics

The limits for PSUs connected to a public mains supply up to and including a rated input current of 16 A are given in IEC 61000-3-2. This requirement is applicable to apparatus and components considered as apparatus covered within the scope of IEC 61000-3-2.

NOTE Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase are given in IEC 61000-3-12.

Harmonic measurements, especially on PSUs, are sensitive to the voltage source. In many cases, the public mains supply may not be a suitable source for this purpose.

Therefore, one of the following methods shall be used.

a) Using a public mains supply in accordance with the related standard IEC 61000-3-2 or IEC 61000-3-12:
   – the limits for the harmonics of the voltage source shall be met with the PSU operating at full rated load.
b) Using an artificial supply in accordance with the related standard IEC 61000-3-2 or IEC 61000-3-12.
c) Calculation or simulation in accordance with the related standard IEC 61000-3-12:
   – usage of the voltage source as an ideal sine wave;
   – notice the worst case internal impedance of the PSU in the frequency range from the line frequency up to the 40th harmonic.

For recommendations: see Annex C. Interharmonics may occur under specific load conditions which cannot be taken into account in this document; this system aspect is the responsibility of the user and/or installer.

### 6.2.3 Voltage fluctuations and flicker

The limits for PSUs connected to a public mains supply up to and including a rated input current of 16 A are given in IEC 61000-3-3. This requirement is applicable to apparatus and components considered as apparatus covered within the scope of IEC 61000-3-3, but it is not mandatory for PSUs used in countries where there are no regulations requiring voltage fluctuations and flicker limits.

For PSUs, only measurements or calculations for $d_{max}$ (maximum relative voltage change) are necessary.

It is recommended to measure the amplitude and the duration of the inrush current and to calculate the RMS value in the first period after switching-on. Most PSUs have inrush current less than 10 ms which means that high inrush currents are still below the $d_{max}$ limit.

Fluctuations of the PSU input current may be caused by a time varying load on the PSU. This system aspect is the responsibility of the user and/or installer.

NOTE Limits for voltage fluctuations and flicker for PSUs connected to a public mains supply up to and including a rated input current of ≤75 A are given in IEC 61000-3-11.

## 6.3 High frequency conducted emission

### 6.3.1 General

The required AMN (artificial mains network) is as defined in 4.3 of CISPR 16-1-2:2014.

Measurements shall be performed in accordance with the method of CISPR 16-2-1.

Disposition of the EUT and its connection to the AMN are as defined in 7.4.1 of CISPR 16-2-1:2014.

Other CISPR publications supply additional test details relevant to a particular EUT as CISPR 11 for ISM application and CISPR 22 for ITE application.

### 6.3.2 High frequency conducted emission for input power ports

For AC input power ports, see Table H.1.

For DC input power ports, see Table H.2.

### 6.3.3 High frequency conducted emission for DC output power ports

For DC output power ports, see Table H.2.

## 6.4 High frequency radiated emission

### 6.4.1 General

Measurements shall be performed in accordance with the reference method of CISPR 16-2-3.

NOTE Measurement method CISPR 16-2-2 is a substitution only applicable for the frequency band 30 MHz to 300 MHz. Limits are listed in Table H.3.

### 6.4.2 Radiated disturbance measurements

The tests of radiation disturbance shall be performed in accordance with CISPR 16-2-3.

Load cables of unknown length shall be arranged horizontally, equally separated from each other and shall be 1 m in length.

The mains cable is arranged 1 m horizontally and then 0,8 m vertically to the ground where it is connected to the power source. Cables are unshielded, unless the PSU is supplied with a shielded cable.

Any other arrangement shall be justified and explained in the documentation.

The distance between the antenna and the PSU shall be 10 m if the limits of Table H.3 are applied.

May be measured at 3 m distance using the limits increased by 10 dB.

May be measured at 30 m distance using the limits decreased by 10 dB.

### 6.4.3 Measurement of disturbance power

The measuring receiver shall have a quasi-peak detector and shall be in accordance with the requirements of CISPR 16-2-2. The absorbing clamp shall be designed and calibrated in accordance with CISPR 16-1-3.

NOTE The clamps generally refer to a 10 m radiated field measurement.

For measurement set-up and procedure, see Figure 2.

The PSU and the cable to be tested shall be placed on a non-metallic support of 0,8 m height and at least 0,8 m from all other metallic objects.

The cable under test is stretched in a straight line over a length of at least 5 m on a non-metallic support allowing the absorbing clamp to be moved along the cable under test. The clamp shall be placed around the cable in the correct orientation (current sensor on the side of the PSU).

All other cables are either disconnected (if the correct operation of the equipment can be maintained without the cables), or equipped with absorbing ferrite tubes (clamps) close to the PSU.

Each cable of the PSU shall be tested in turn. Cables which are longer than 5 m are tested as described above with 5 m of cable in the test set-up. The layout of the excess cable is not critical.

Cables which, in normal application, are restricted in length to less than 5 m are tested as follows:

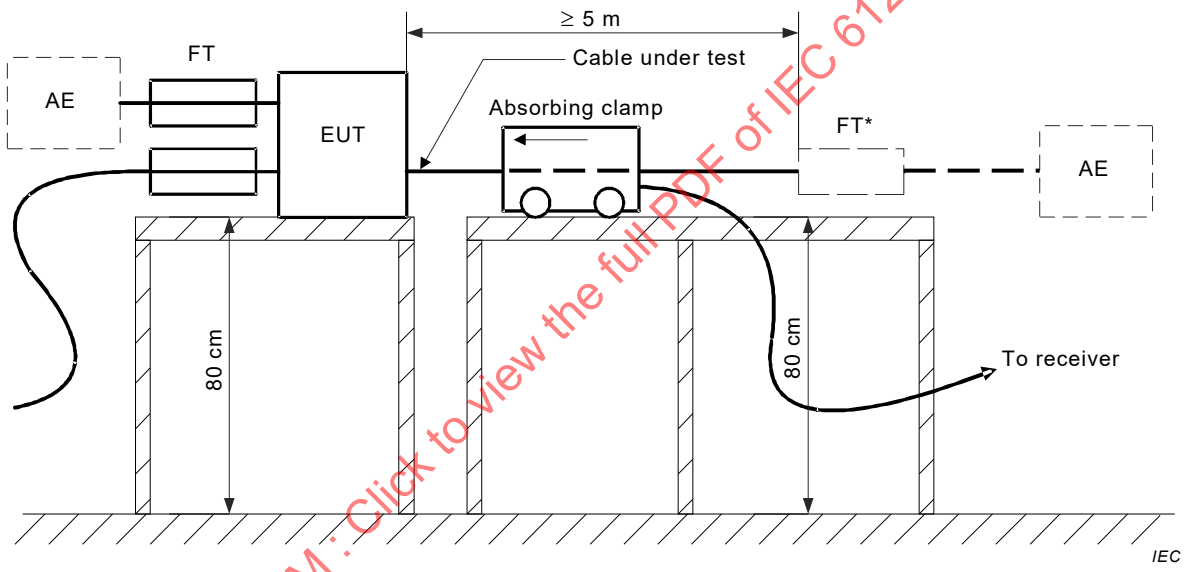
Cables with a restricted length:

- ≤ 0,25 m are not measured at all;
- < $s$ are lengthened to $s$;
- > $s$ are measured over the total length;

where $s$ is twice the length of the clamp.

The clamp shall be displaced along the cable under test, starting closest to the PSU up to a maximum of 5 m. The maximum reading is converted into disturbance power, using the clamp calibration factor. The displacement needed is from zero to a half-wavelength of the measured frequency. All maxima shall be below the limits given in Table H.3.

The disturbance power limits for the frequency are given in Table H.4




**Key**

EUT Equipment under test

AE Associated equipment

FT Ferrite tube (same type as absorbing clamp)

FT* Optional FT, for additional decoupling of the AE, when required

**Figure 2 – Test set-up for the measurement of disturbance power**

### 6.4.4 Restrictions for the application of interference power measurement

The measurement of interference power may be used instead of radiated field strength with the restriction that the longest side length of the box does not exceed $\lambda/4$ of the highest measured frequency. (In accordance with CISPR 16-1 series)

Most PSUs do not emit interference power above this critical frequency. (For calculation of the critical frequency of the PSU, see Annex E.)

Some PSUs can emit interference power above the critical frequency. This is especially so when logic circuitry with a clock frequency above 1 MHz is used.

The application of the high frequency power test method is therefore restricted to PSUs without shielded cables and:

– with a longest side length less than $\lambda/4$ of the highest frequency measured;
– with a clock frequency less than 1 MHz;
– with less than 5 outputs;
– which do not prevent the use of the clamp because of too large a diameter of the leads.

## 7 Immunity requirements

### 7.1 Performance criteria

The performance criteria (see Table 1) shall be used to check the acceptability of a PSU against external disturbances.

From the EMC point of view, any process including a PSU shall be operating as intended.

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

**Table 1 – Criteria to prove the performance of a PSU against EM disturbances**

| | Performance criteria | | |
|---|---|---|---|
| | **A** | **B** | **C** |
| **Basic specifications** | No loss of function or performance during and after the test | Temporary loss of function or performance during the test<br>Self-recoverable | Loss of function or performance<br>Not self-recoverable<br>Not damaged |
| **Remarks** | Operating as intended within specified tolerance | Degradation of performance shall be specified by the manufacturer<br>PSU shall continue to operate as intended after the test | Any resettable condition allowed including shut-down |

Performance criteria in the Tables 2 to 9 have been considered as minimum requirements.

See also Annex D for DC/DC converters.

### 7.2 Basic immunity requirements, high frequency disturbances

#### 7.2.1 General

The test levels are given in Tables 2 to 9, the test set-up refers to basic standards.

NOTE $T_r/T_h$ refers to rise time and impulse duration (50 % value), as described in IEC 61000-4-4.

For surge tests, apparatus with a DC power input port, intended for use with an AC/DC power adapter, shall be tested on the AC power input of the AC/DC power adapter specified by the manufacturer.

#### 7.2.2 Immunity level for residential, commercial and light industrial environment

These levels are applied to PSUs which are intended to be used in residential, commercial or light industrial environments.

- Environment encompassed by the generic standard IEC 61000-6-1.
- An indication of the locations included by this environment is given in Annex G.

**Table 2 – Immunity – Enclosure port –**
**Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **2-1** | Electrostatic discharge | Contact discharge<br>Air discharge | ±4<br>±8 | kV<br>kV | IEC 61000-4-2 | a | B |
| **2-2** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1000<br>3<br>80 | MHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |
| **2-3** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |
| **2-4** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |
| **2-5** | Power frequency magnetic field immunity | Magnetic field at power frequencies | 50, 60<br>3 | Hz<br>A/m | IEC 61000-4-8 | e | A |

a In the case of an open frame PSU, the ESD test is impractical and need not be carried out.

b This level does not represent the field emitted by a transceiver in close proximity to the PSU.

c The test level specified is the RMS value of the unmodulated carrier.

e This test is only required if magnetic field sensitive components are used.

**Table 3 – Immunity – Ports for signal lines and control lines**
**Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **3-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±0,5<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000 -4-4 | a<br>Capacitive clamp used | B |
| **3-2** | Radio-frequency continuous conducted | Frequency<br>Amplitude<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000 -4-6 | b | A |

a Applicable only to ports interfacing with cables, the total length of which, according to the manufacturer's functional specification may exceed 3 m.

b The test level specified is the RMS value of the unmodulated carrier.

The requirements given in Table 4 are not applicable to DC input power ports intended for connection to a battery, or to a rechargeable battery which shall be disconnected from the equipment for recharging.

The stated limits may not be sufficient for some special applications, see Annex D.

**Table 4 – Immunity – DC input and output power ports**
**Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **4-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±0,5<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | a | B |
| **4-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±0,5<br>±0,5 | µs<br>kV<br>kV | IEC 61000-4-5 | | B |
| **4-3** | Radio-frequency continuous conducted | Frequency<br>Amplitude<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a, b, c | A |

a The test is applicable to DC input power ports intended to be connected permanently to cables longer than 10 m.

b Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

c The test level specified is the RMS value of the unmodulated carrier.

**Table 5 – Immunity – AC input power ports – Residential, commercial and light industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **5-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±1<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **5-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±2<br>±1 | µs<br>kV<br>kV | IEC 61000-4-5 | [a] | B |
| **5-3** | Voltage dips | Residual voltage | 0<br>during ½ cycle | % | IEC 61000-4-11 | | B |
| | | Residual voltage | 0<br>during 1 cycle | % | | | B |
| | | Residual voltage | 70<br>during 25/30 cycles at 50/60 Hz | % | | [c] | C |
| **5-4** | Voltage interruptions | Residual voltage | 0<br>during 250/300 cycles at 50/60 Hz | % | IEC 61000-4-11 | [d] | C |
| **5-5** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>3<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | [b] | A |

[a] For products designed for installation class I according to IEC 60664-1, the surge limits may be reduced by 50 %.

[b] The test level specified is the RMS value of the unmodulated carrier.

[c] "25/30 cycles" means "25 cycles for 50 Hz test" and "30 cycles for 60 Hz test".

[d] "250/300 cycles" means "250 cycles for 50 Hz test" and "300 cycles for 60 Hz test".



### 7.2.3 Immunity level for industrial environment

These levels are applied to PSUs which are intended to be used in an industrial environment. In case of disturbances beyond the following levels, a solution has to be agreed between the customer and the supplier.

- Environment encompassed by the generic standard IEC 61000-6-2.
- An indication of the locations included by this environment is given in Annex G.

**Table 6 – Immunity – Enclosure port – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **6-1** | Electrostatic discharge | Contact discharge<br>Air discharge | ±4<br>±8 | kV<br>kV | IEC 6100 0-4-2 | a | B |
| **6-2** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1 000<br>10<br>80 | MHz<br>V/m<br>% | IEC 6100 0-4-3 | b<br>c | A |
| **6-3** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 6100 0-4-3 | b<br>c | A |
| **6-4** | Radio-frequency electromagnetic field Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 6100 0-4-3 | b<br>c | A |
| **6-5** | Power frequency magnetic field immunity | Magnetic field at power frequencies | 50, 60<br>30 | Hz<br>A/m | IEC 6100 0-4-8 | d | A |

a In the case of an open frame PSU, the ESD test is impractical and need not be carried out.

b This level does not represent the field emitted by a transceiver in close proximity to the PSU.

c The test level specified is the RMS value of the unmodulated carrier.

d This test is only required if magnetic field sensitive components are used.

**Table 7 – Immunity – Ports for signal lines and control lines – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **7-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±1<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | a<br>Capacitive clamp used | B |
| **7-2** | Radio-frequency common mode Amplitude modulated | Frequency<br>Amplitude<br>Modulation | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a<br>b | A |

a Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

b The test level specified is the RMS value of the unmodulated carrier.

The requirements given in Table 8 are not applicable to DC input power ports intended for connection to a battery, or to a rechargeable battery which shall be disconnected from the equipment for recharging.

The stated limits may not be sufficient for some special applications, see Annex D.

**Table 8 – Immunity – DC input and output power ports – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **8-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±2<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | a | B |
| **8-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±0,5<br>±0,5 | µs<br>kV<br>kV | IEC 61000-4-5 | b | B |
| **8-3** | Radio-frequency continuous conducted | Frequency<br>Amplitude<br>AM (1 kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a, c, d | A |

a The test is applicable to DC input power ports intended to be connected permanently to cables longer than 10 m.

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

c Applicable only to ports interfacing with cables the total length of which may exceed 3 m according to the manufacturer's functional specification.

d The test level specified is the RMS value of the unmodulated carrier.

**Table 9 – Immunity – AC input power ports – Industrial environment**

| | Environmental phenomenon | Test item | Test specification | Unit | Basic standard | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **9-1** | Fast transients | Peak line-to-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ±2<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **9-2** | Surges | $T_r/T_h$<br>Peak line-to-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>±2<br>±1 | µs<br>kV<br>kV | IEC 61000-4-5 | a | B |
| **9-3** | Voltage dips | Residual voltage | 0 during ½ cycle | % | IEC 61000-4-11 | | B |
| | | Residual voltage | 0 during 1 cycle | % | | | B |
| | | Residual voltage | 40 during 10/12 cycles at 50/60 Hz | % | | c | C |
| | | Residual voltage | 70 during 25/30 cycles at 50/60 Hz | % | | d | C |
| | | Residual voltage | 80 during 250/300 cycles at 50/60 Hz | % | | e | C |
| **9-4** | Voltage interruptions | Residual voltage | 0 during 250/300 cycles at 50/60 Hz | % | IEC 61000-4-11 | e | C |
| **9-5** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM(1kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | b | A |

a In some industrial environments, higher limits may be required.

b The test level specified is the RMS value of the unmodulated carrier.

c "10/12 cycles" means "10 cycles for 50 Hz test" and "12 cycles for 60 Hz test".

d "25/30 cycles" means "25 cycles for 50 Hz test" and "30 cycles for 60 Hz test".

e "250/300 cycles" means "250 cycles for 50 Hz test" and "300 cycles for 60 Hz test".



## 8 Power supply families aspects

A power supply family consists of PSUs with similarities between members.

It is neither economic nor sensible to measure the EMC performance of all members of the family.

It is the responsibility of the manufacturer to decide which members of the family should be tested as being representative of the entire family. This decision shall be justified in the test report.

See also Annex F.

## 9 Statistical aspects

The limits in this document are set taking measurement uncertainties into account.

As a consequence, the measured value of one product sample shall be compared directly with the limits.

- One product sample means one piece.
- In case of series production test, for conformance the 80/80 % rule stated in CISPR 16-1 series shall apply.

NOTE Uncertainty of measurement is a parameter, associated with the result of measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measure and in accordance with ISO/IEC 17025 to the expression of uncertainty in measurement. Measurement uncertainty arises from random effects and from imperfect correction for systematic effects.

## 10 Safety aspects

EMC mitigation measures shall not violate the required electrical safety provisions; for example mains filters influence the touch current, and EMC screens can influence clearance or creepage distances.

After EMC testing it is necessary to ensure that the equipment continues to meet the requirements of its electrical safety product standard.

NOTE This document does not consider functional safety aspects. Such requirements are considered in accordance to IEC 61000-1-2.

## 11 Test report

The test results shall be documented in a test report.

The report shall give sufficient product identification and test data. It shall clearly, unambiguously and objectively present all relevant information of the tests such as load conditions, cable length, earthing, etc.

A functional description of the test set-up, including test equipment, cable layout and the modes of operation during the test shall be given.

A detailed definition and a justification of the chosen acceptance criteria shall be provided by the manufacturer and noted in the test report.

The report shall give the actual measured values for each test and relate them to the limit values.

# Annex A
(normative)

# Guidelines on the classification of PSUs

## A.1 General

Because many PSUs are used as part of larger units, referring to different EMC standards, a classification is necessary. This annex provides some examples of product classification, but it is the manufacturer's responsibility to determine the classification.

## A.2 Stand alone power supplies

The manufacturer is responsible for all relevant EMC tests to be applied to these PSUs. This category includes, for example:

- bench-top PSUs for laboratory or similar use;
- stand alone PSUs for industrial applications;
- plug top PSUs with switched mode control;
- industrial battery chargers;
- plug top PSUs with no internal high frequency generator;
- domestic battery chargers;
- communication power systems.

## A.3 Component power supplies

**a) Component power supplies considered as equivalent to "stand alone power supplies" (apparatus)**

These PSUs are intended for sale to an end-user or installer. The manufacturer is responsible for all relevant EMC tests to be applied to these PSUs. This category includes, for example:

– PSUs with integral mains and/or IT equipment connectors that are sold to the general public for upgrading PCs, for use with printers, etc.;

– PSUs intended to be used (with the addition of appropriate casing, wiring, etc.) in installations where the EMC performance will not be measured by the installer;

– a 24 V output PSU, within a safe box, intended for installation;

– PSUs for amateur electronics.

This category does not include PSUs sold to the general public or for use in installations, where these are spares for repair and have been tested as part of an overall equipment.

**b) Component power supplies intended for a professional assembler/installer**

This category includes, for example:

– most open card, cased and PCB-mounted PSUs (both plug in and wired);

– rack sub-assembly PSUs which are intended for use only by professional assemblers;

– PSUs sold as spares for repair where this PSU has been tested as part of the final product by a professional assembler.

Table A.1 gives an overview of the application of EMC standards to PSUs classified in accordance with Clauses A.2 and A.3.

**Table A.1 – Classification of power supplies and the relevant EMC standards**

| Power supply | | EMC standard |
|---|---|---|
| **A.2** | **Stand alone power supplies (apparatus)** | IEC 61204-3 |
| **A.3** | Component power supplies | IEC 61204-3 |
| | 1) Considered as equivalent to "stand alone power supplies (apparatus) | IEC 61204-3 used as an aid |
| | 2) Intended for a professional installer | IEC 61204-3 may be replaced by an end-product EMC standard, |

# Annex B
(informative)

## Commutation notches

The problem of commutation notches exists only for a very small percentage of PSUs, therefore no measurements or calculations are mandatory. In relevant cases, the manufacturer and the user have to agree the limit of the notches; this annex gives some common explanations of the problem.

The effect of commutation notches is well-known from line commutated converters of high power, especially if connected to voltage sources of high impedance. It is a system effect because it is dependent both on the internal line impedance and the converter characteristics. High power PSUs within the scope of this document may be designed as line commutated converters. The notch problem is much less severe because of the relatively low power compared with converters for drives or high power UPS.

Notches are defined in IEC 60146-1-1. They can be reduced by commutation impedances in series with the converter source connectors. The impedance needed depends on the internal impedance of the power source, the input impedance of the PSU and the limit of the notches at the source connectors.

Generally, line commutated PSUs are connected to an industrial mains supply where commutation notches of up to 40 % are usual. The limits of notches at a public mains supply shall comply with the limits of the local supply authority.

The calculation of the commutation impedances is well-known and needs no further information.

# Annex C
(informative)

## Calculation and simulation of the input current harmonics

Generally, public mains supplies do not meet the requirements for testing the equipment against IEC 61000-3-2:2014, Annex A. In those cases, artificial voltage sources are necessary for the measurement of input current harmonics, the nominal power of which may need to be considerably higher than the rated power of the PSU because of the high peaks of input current and the requirement that the limits for harmonic currents shall be met with the PSU operating at full rated load.

Therefore, the calculation or simulation method related to standard IEC 61000-3-12 is commonly used for products of high power with input current >16 A and ≤75 A per phase.

If the internal input impedances of the PSU up to the 40th harmonic are known, simulation can be a reasonable solution to evaluate harmonics, even for low power PSUs.

If impedances are not exactly known, the worst case value is to be used. To avoid simulation errors, it is recommended that a batch test is performed for a typical case of a PSU family and that the results of the measurement are compared with the simulation.

In case of doubt, measurement is preferred.

# Annex D
(informative)

# Special considerations for DC/DC converters

## D.1 General

For some DC/DC converter applications, the definitions used in this document for "residential, commercial and light industrial environment" or "industrial environment" do not reflect the actual environment in which a DC/DC converter can be located.

## D.2 Emission

For DC/DC converters with an input voltage ≤ 60 V, which are used in distributed power systems and installations in special applications (e.g. telecom stations), the use of other limits may be necessary.

## D.3 Immunity

Higher immunity levels than specified in this document are recommended for DC/DC converters and which are:

- supplied by a generator (e.g. cars, ships), in a system with DC motor drives (e.g. fork-lifts, electric cars) or from high voltage converters (e.g. trains, streetcars);
- in industrial applications where the nominal DC input voltages are higher than 60 V;
- in power distribution systems in industrial applications (e.g. power plants, process industry).

The minimum immunity level for this class of DC/DC converters is defined in 7.2, Tables 2, 3, 4, 6, 7 and 8.

For a higher degree of immunity on the DC input, the levels of tables D.1, D.2 and D.3 are recommended for the following input categories:

a) nominal DC input voltage ≤ 100 V if fed from a generator, DC drives system or high voltage converter;

b) nominal DC input voltage > 100 V.

**Table D.1 – Immunity – DC input power ports – Input category a**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.1-1** | Fast transients | Peak line-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ± 2<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **D.1-2** | Surges | $T_r/T_h$<br>Peak line-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>± 1<br>± 0,5 | µs<br>kV<br>kV | IEC 61000-4-5 | | B |
| **D.1-3** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | a, b | A |
| [a] The test is applicable to DC input ports intended to be connected permanently to cables longer than 10 m.<br>[b] The test level specified is the RMS value of the unmodulated carrier. | | | | | | | |

Tests described in Table D.2 are applicable to DC power ports intended to be connected permanently to cables longer than 10 m.

**Table D.2 – Immunity – DC input power ports – Input category b**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.2-1** | Fast transients | Peak line-ground voltage<br>$T_r/T_h$<br>Repetition frequency | ± 4<br>5/50<br>100 | kV<br>ns<br>kHz | IEC 61000-4-4 | | B |
| **D.2-2** | Surges | $T_r/T_h$<br>Peak line-ground voltage<br>Peak line-to-line voltage | 1,2/50 (8/20)<br>± 2<br>± 1 | µs<br>kV<br>kV | IEC 61000-4-5 | a | B |
| **D.2-3** | Radio-frequency continuous conducted | Frequency<br>Voltage<br>AM (1 kHz) | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% | IEC 61000-4-6 | b | A |
| [a] In some industrial environments higher limits may be required.<br>[b] The test level specified is the RMS value of the unmodulated carrier. | | | | | | | |

**Table D.3 – Immunity – Enclosure port – Input categories a and b**

| | Environmental phenomenon | Test item | Test specification | Unit | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| **D.3-1** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 80 to 1 000<br>10<br>80 | MHz<br>V/m<br>% | IEC 61000-4-3 | a<br>b | A |
| **D.3-2** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 1,4 to 2<br>3<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |
| **D.3-3** | Radio-frequency electromagnetic field<br>Amplitude modulated | Frequency<br>Field strength<br>AM 1 kHz | 2 to 2,7<br>1<br>80 | GHz<br>V/m<br>% | IEC 61000-4-3 | b<br>c | A |

a This level does not represent the field emitted by a transceiver in close proximity to the PSU.

b The test level specified is the RMS value of the unmodulated carrier.

# Annex E
(informative)

## Critical frequency for high frequency power measurement

### Calculation of the critical frequency of a PSU

The maximum test frequency for the absorbing clamp measurement, in accordance with CISPR 16-1 series, is defined, in this document, as the critical measuring frequency of the PSU.

CISPR 16-1 series requires that the longest side length of an EUT shall be:

$$l \leq \frac{\lambda_{\text{critical}}}{4}$$

with $\lambda_{\text{critical}} = \frac{c}{f_{\text{critical}}}$

then $f_{\text{critical}} = \frac{c}{4l}$

or $f_{\text{critical}} \cong \frac{75}{l}$ (MHz)

$f_{\text{measure}} = f_{\text{critical}}$

where

$l$ is the longest side length of the PSU, in metres;

$\lambda$ is the wavelength of the measuring frequency, in metres;

$c$ is the speed of light ($\cong 3 \times 10^8$ m/s).

# Annex F
(normative)

# Guidelines on power supply families

## F.1 General

This annex provides some assistance in judging the test philosophy of power supply families, but it is the manufacturer who will ultimately decide how many different representative products need to be tested.

A power supply family consists of a set of PSUs with similarities between its members. It may be possible to select one family member that is representative of all the other members in respect of EMC, but usually it would be necessary to test several PSUs.

The basis of the testing philosophy, including decisions, conclusions and a description of the products covered by the test plan, should be detailed in the test report or file.

Choice of family members to be tested is clearly dependent on the similarities between family members. Not all input/output combinations need to be tested, but it would be advisable to test all different input sections and all different output sections at least once.

## F.2 Emission

Items that may influence emission are:

- the type of enclosure,
- ventilation slots,
- connectors,
- input/output filter design,
- wiring lengths,
- layout and type,
- ground management,
- switching components,
- control of the switching components,
- magnetic components,
- different sources of the same component,
- the printed circuit board design.

## F.3 Immunity performance

Items that may influence the immunity performance are:

- the type of enclosure,
- ventilation slots,
- connectors,
- input/output filter design,
- magnetic components,
- wiring lengths,

- layout and type,
- ground management,
- control loops[1],
- printed circuit board design,
- decoupling.



[1] The tests specified in IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-6 may affect the output regulation.

# Annex G
(informative)

# Summary of classification of environments and limits

## G.1 Residential, commercial and light industrial environment

Environment encompassed by the generic standard IEC 61000-6-1 and IEC 61000-6-3.

The following list, although not comprehensive, gives an indication of locations that are included:

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

## G.2 Industrial environment

Environment encompassed by the generic standard IEC 61000-6-2 and IEC 61000-6-4.

Industrial locations are in addition characterised by the existence of one or more of the following examples:

- industrial, scientific and medical (ISM) apparatus;
- heavy inductive or capacitive load are frequently switched;
- high currents and associated magnetic fields.

NOTE A PSU strictly designed for this environment carries the following remark in its documentation:

**Warning: This is a product designed for an industrial environment. In a residential, commercial or light industrial environment it may cause radio interference. The user may be required to take adequate measures to reduce interference.**

The user, advised by the supplier, is responsible for the electromagnetic compatibility of the installed product in his environment.

## G.3 Special applications

This concerns the industrial environment only where equipment with high input current (> 25 A) is connected to an industrial mains supply, or a private mains supply, and where the protection distance is > 100 m.

Limits are under consideration.

In these applications, clear warning of the restricted use of the equipment shall be given in the documentation supplied with it.

Examples:

- internal radio interference tolerated by the user and external interference within acceptable limits (e.g. mains supply independent of public mains supply);
- safety requirements in conflict with EMC requirements in high power installations.

## G.4 Special considerations for DC/DC converters

See Annex D.

# Annex H
(normative)

## Emission limits

These limits have been copied without alteration, from IEC 61000-6-3, IEC 61000-6-4 and CISPR 14-1.

**Table H.1 – Limits of mains terminal disturbance voltage (AC input port)**

| | **Stand alone power supplies designed for a residential, commercial and light-industrial environment**<br>**See 3.1.1** | | **Stand alone power supplies designed for an industrial environment**<br>**See 3.1.2** | |
|---|---|---|---|---|
| **Frequency**<br>MHz | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) |
| 0,15 to 0,5 | 66 to 56 [a] | 56 to 46 [a] | 79 | 66 |
| 0,5 to 5 | 56 | 46 | 73 | 60 |
| 5 to 30 | 60 | 50 | 73 | 60 |
| [a] Limit decreasing linearly with logarithm of frequency. | | | | |
| NOTE For DC input, see Annex D. | | | | |

**Table H.2 – Limits of mains terminal disturbance voltage (DC input and DC output power port)**

| | **Stand alone power supplies designed for a residential, commercial and light-industrial environment**<br>**See 3.1.1** | | **Stand alone power supplies designed for an industrial environment**<br>**See 3.1.2** | |
|---|---|---|---|---|
| **Frequency**<br>MHz | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) | **Quasi-peak**<br>dB(μV) | **Average**<br>dB(μV) |
| 0,15 to 0,5 | 79 | 66 | Not mandatory | Not mandatory |
| 0,5 to 5 | 73 | 60 | | |
| 5 to 30 | 73 | 60 | | |
| Applicable only to ports intended for connection to<br>– a local DC power network<br>or<br>– a remote local battery<br>by connecting cable exceeding a length of 30 m. | | | | |

**Table H.3 – Limits for electromagnetic radiation/interference power disturbance (all field strength limits refer to quasi-peak measurements)**

| | Stand alone power supplies designed for a residential, commercial and light-industrial environment<br><br>See 3.1.1 | | Stand alone power supplies designed for an industrial environment<br><br>See 3.1.2 | |
|---|---|---|---|---|
| **Frequency band**<br>MHz | **Quasi-peak**<br>dB(μV/m) | **Distance**<br>m | **Quasi-peak**<br>dB(μV/m) | **Distance**<br>m |
| 30 to 230 | 30 | 10 | 40 | 10 |
| 230 to 1 000 | 37 | 10 | 47 | 10 |
| | | | | |
| **Frequency band** [a]<br>GHz | **Peak/Average**<br>dB(μV/m) | **Distance**<br>m | **Peak/Average**<br>dB(μV/m) | **Distance**<br>m |
| 1 to 3 | 70/50 | 3 | 76/56 | 3 |
| 3 to 6 | 74/54 | 3 | 80/60 | 3 |
| [a] Measurements only applicable if internal clock frequencies above 108 MHz are used. | | | | |

Alternatives to the 10 m field strength measurement:

- 30 m = 10 m limits – 10 dB;
- 3 m = 10 m limits + 10 dB.

NOTE Additional guidance on the test method can be found in CISPR 16-2-3.

**Table H.4 – Disturbance power limits for the frequency range 30 MHz to 300 MHz**

| **Frequency**<br>MHz | **Quasi-peak**<br>dB(pW) | **Average** [a]<br>dB(pW) |
|---|---|---|
| 30 to 300 | 45 to 55 | 35 to 45 |
| [a] If the limit for the measurement with the average detector is met when using a receiver with quasi-peak detector, the equipment under test may be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out. | | |

# Bibliography

IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

IEC 60050-131, *International Electrotechnical Vocabulary – Part 131: Circuit theory*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61000-1-2, *Electromagnetic compatibility (EMC) – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

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 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 62040-1, *Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

CENELEC Guide 24, *Electromagnetic Compatibility (EMC) Standardization for Product Committees concerned with apparatus*

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

CISPR 15, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

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

# SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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# ALIMENTATIONS À DÉCOUPAGE BASSE TENSION –

## Partie 3: Compatibilité électromagnétique (CEM)

## AVANT-PROPOS

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La Norme internationale IEC 61204-3 a été établie par le sous-comité 22E: Alimentations stabilisées, du comité d'études 22: Systèmes et équipements électroniques de puissance.

L'IEC 61204-3 a le statut d'une norme de famille de produits.

Cette troisième édition annule et remplace la deuxième édition parue en 2011. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) modification du titre avec la suppression des termes "sortie continue" et l'ajout des termes "à découpage";

b) modifications dans le domaine d'application: 1.1.1 Matériel couvert par le présent document;

c) mise à jour des références normatives pour mentionner les dernières éditions ou les références datées;

d) modifications de la formulation et/ou des notes relatives aux exigences du Guide 24 du CENELEC et du Guide 107 de l'IEC;

e) révisions des limites relatives aux émissions pour les aligner avec celles des dernières versions des références normatives applicables;

f) révisions des exigences relatives à l'immunité pour les aligner avec celles des dernières versions des références normatives applicables;

g) correction d'ordre typographiques.

Le texte de cette norme est issu des documents suivants:

| FDIS | Rapport de vote |
|---|---|
| 22E/174/FDIS | 22E/176/RVD |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de ce document.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Les futures normes de cette série porteront dorénavant le nouveau titre général cité ci-dessus. Le titre des normes existant déjà dans cette série sera mis à jour lors de la prochaine édition.

Une liste de toutes les parties de la série IEC 61204, publiées sous le titre général *Alimentations basse tension, sortie continue,* peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. À cette date, la publication sera

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- amendée.

# ALIMENTATIONS À DÉCOUPAGE BASSE TENSION –

# Partie 3: Compatibilité électromagnétique (CEM)

## 1 Domaine d'application et objet

### 1.1 Domaine d'application

#### 1.1.1 Matériel couvert par le présent document

La présente partie de l'IEC 61204 spécifie les exigences de compatibilité électromagnétique (CEM) pour les alimentations à découpage (*switch mode power supply* – SMPS) alimentées par des sources ne dépassant pas 1 000 V en courant alternatif et 1 500 V en courant continu fournissant un courant alternatif et/ou continu, à l'exception de la ou des sorties de l'onduleur alimentant le réseau en courant alternatif (voir les exclusions en 1.1.3.).

NOTE 1 Par définition, le présent document couvre les convertisseurs courant continu/courant continu.

NOTE 2 Les alimentations peuvent fournir des socles (auxiliaires) de prise de courant réseau en courant alternatif lorsque ces sorties sont alimentées par le réseau en courant alternatif.

NOTE 3 Les générateurs sonores utilisés dans les applications de télécommunication sont couverts par le présent document.

Le présent document de produit couvre les alimentations (*power supply* – PSU) autonomes et composants, telles que définies dans le présent document. Elle couvre les alimentations destinées à être utilisées dans ou avec un appareil de traitement de l'information normalement couvertes par l'IEC 60950-1 et/ou l'IEC 62368-1; les alimentations destinées à être utilisées dans ou avec des appareils de mesurage, de régulation et de laboratoire normalement couvertes par l'IEC 61010-1; les alimentations destinées à être utilisées dans ou avec du matériel médical – normalement couvertes par l'IEC 60601-1; les alimentations destinées à être utilisées dans ou avec des appareils audio, vidéo et appareils électroniques analogues – normalement couvertes par l'IEC 60065 et/ou l'IEC 62368-1. Elle couvre également les équipements de puissance et de distribution en courant continu et les convertisseurs courant continu/courant continu.

En l'absence de norme, l'utilisation du présent document pour d'autres applications n'est pas exclue.

#### 1.1.2 Exigences complémentaires

Des exigences complémentaires à celles qui sont spécifiées dans le présent document peuvent être nécessaires pour

- les alimentations destinées à fonctionner dans des environnements particuliers (par exemple, en présence de températures extrêmes, de poussières, d'humidité ou de vibrations excessives, de gaz inflammables et d'atmosphères corrosives ou explosives);
- les alimentations destinées à être utilisées dans des véhicules, à bord de navires ou d'avions ou dans les pays tropicaux;
- les alimentations destinées à être utilisées dans des endroits propices à la pénétration de l'eau.

NOTE L'attention est attirée sur le fait que, dans certains pays, les autorités imposent des exigences complémentaires pour des raisons liées à la santé, à l'environnement ou pour des raisons similaires.

#### 1.1.3 Exclusions

Le présent document ne s'applique pas

- aux groupes convertisseurs;
- aux alimentations sans interruption (ASI) conformément à l'IEC 62040-1;
- aux alimentations couvertes par l'IEC 61558-1 (c'est-à-dire aux alimentations incorporant des transformateurs de sécurité qui fournissent des sorties TBTS ou TBTP conformément à l'IEC 60364-4-41) et aux alimentations destinées à être utilisées avec des produits à usage domestique ou autres produits de consommation, à l'exception de ceux couverts par l'IEC 60065 et l'IEC 60950-1 et/ou l'IEC 62368-1;
- aux transformateurs couverts par l'IEC 61558-1;
- aux convertisseurs abaisseurs couverts par l'IEC 60146-1-1;
- aux alimentations et aux convertisseurs destinés à être utilisés avec des ampoules alimentées en courant continu, des lampes halogènes ou des lampes LED couvertes par la CISPR 15.

### 1.1.4 Types d'alimentations

Deux types d'alimentations sont couverts par le présent document:

**a) alimentations autonomes (ou produits finaux)**

Alimentations qui sont destinées à fonctionner individuellement.

La présente partie de l'IEC 61204 s'applique aux alimentations conçues pour un emploi direct et vendues sur le marché en tant qu'appareils autonomes.

**b) alimentations-composants**

Elles peuvent être réparties selon les deux catégories suivantes:

**1) alimentations-composants considérées comme équivalentes à des alimentations autonomes (appareil)**

La présente partie de l'IEC 61204 s'applique à cette catégorie d'alimentations-composants. Pour ce qui concerne les exigences CEM, ces alimentations sont considérées comme des appareils. C'est le cas, par exemple, des alimentations destinées à être utilisées dans des installations ou à être vendues au public, dans les cas où aucun essai CEM supplémentaire n'est prévu. Cela n'inclut pas les alimentations vendues comme pièces de rechange qui ont été soumises à l'essai comme parties intégrantes d'un équipement global.

**2) alimentations-composants destinées à un installateur professionnel**

La présente partie de l'IEC 61204 s'applique à cette catégorie d'alimentations, uniquement en tant qu'aide à la spécification des exigences CEM applicables permettant de respecter différentes normes pour produit final.

Ces alimentations sont destinées à être incorporées en tant que composants dans un produit final par un installateur professionnel. Elles peuvent être vendues à un installateur professionnel ou mises sur le marché pour l'utilisation et la distribution spécialisées. Des essais CEM supplémentaires sont censés être réalisés sur l'ensemble.

### 1.1.5 Configurations et combinaisons d'alimentations

#### 1.1.5.1 Alimentations modulaires

Une alimentation, synchronisée ou non, avec un circuit ou module primaire unique et des modules de sortie séparés formant une seule unité, satisfait aux exigences définies dans le présent document en tant qu'alimentation de type composant seul ou appareil.

#### 1.1.5.2 Systèmes d'alimentations

Un système facile à déplacer contenant plusieurs alimentations en parallèle, en série ou combinées, avec une seule connexion d'entrée satisfait aux exigences définies dans le présent document en tant qu'alimentation de type composant seul ou appareil. Il est de la

responsabilité d'un fabricant de systèmes de s'assurer de la conformité CEM au présent document ou à une norme CEM spécifique de produit final.

#### 1.1.5.3 Installations d'alimentations

Lorsque plusieurs alimentations sont utilisées dans une installation et sont alimentées par un réseau distribué à courant alternatif ou à courant continu, il s'agit d'une installation de puissance. Ce type de dispositif n'est pas facile à déplacer. Chaque alimentation individuelle satisfait au présent document, le fabricant en est responsable et il fournit aussi les informations pour une installation correcte de son produit. Les performances CEM de l'installation finale sont sous la responsabilité de l'installateur professionnel.

#### 1.1.5.4 Alimentations distribuées

Il s'agit d'une installation de puissance dans laquelle l'alimentation d'entrée en courant alternatif ou en courant continu est distribuée à des unités individuelles de conversion de puissance ou à des modules qui sont placés à proximité des circuits à alimenter. Le présent document s'applique aux produits individuels. Les performances CEM de l'installation ou du système global(e) sont sous la responsabilité de l'installateur professionnel.

#### 1.1.5.5 Alimentations en parallèle ou en série

Lorsque des alimentations sont vendues pour être montées en parallèle ou en série, leur documentation doit inclure une information relative aux performances CEM attendues pour de telles dispositions.

### 1.2 Objet

L'objet de la présente partie de l'IEC 61204 est de définir les limites et les méthodes d'essai CEM pour les alimentations. Elle inclut d'une part les limites des émissions électromagnétiques qui peuvent causer des perturbations avec d'autres équipements électroniques (par exemple, les récepteurs radio, les appareils de mesure et les ordinateurs) et, d'autre part, les limites de l'immunité électromagnétique à l'égard des perturbations conduites et rayonnées, continues et transitoires, y compris les décharges électrostatiques.

La présente partie de l'IEC 61204 définit les exigences minimales de compatibilité électromagnétique pour les alimentations.

Pour satisfaire à la présente partie de l'IEC 61204, aucun essai CEM complémentaire n'est exigé ni nécessaire au-delà de ceux énoncés ici.

## 2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-121, *Vocabulaire Électrotechnique International – Partie 121: Électromagnétisme*

IEC 60050-151, *Vocabulaire Électrotechnique International – Partie 151: Dispositifs électriques et magnétiques*

IEC 60050-161, *Vocabulaire Électrotechnique International – Partie 161: Compatibilité électromagnétique*

IEC 60050-551, *Vocabulaire Électrotechnique International – Partie 551: Électronique de puissance*

IEC 60065, *Appareils audio, vidéo et appareils électroniques analogues – Exigences de sécurité*

IEC 60146-1-1, *Convertisseurs à semiconducteurs – Exigences générales et convertisseurs commutés par le réseau – Partie 1-1: Spécification des exigences de base*

IEC 60601-1, *Appareils électromédicaux – Partie 1: Exigences générales pour la sécurité de base et les performances essentielles*

IEC 60950-1, *Matériels de traitement de l'information – Sécurité – Partie 1: Exigences générales*

IEC 61000-3-2:2014, *Compatibilité électromagnétique (CEM) – Partie 3-2: Limites – Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤ 16 A par phase)*

IEC 61000-3-3, *Compatibilité électromagnétique (CEM) – Partie 3-3: Limites – Limitation des variations de tension, des fluctuations de tension et du papillotement dans les réseaux publics d'alimentation basse tension, pour les matériels ayant un courant assigné ≤ 16 A par phase et non soumis à un raccordement conditionnel*

IEC 61000-3-12, *Compatibilité électromagnétique (CEM) – Partie 3-12: Limites – Limites pour les courants harmoniques produits par les appareils connectés aux réseaux publics basse tension ayant un courant appelé > 16 A et ≤ 75 A par phase*

IEC 61000-4-2, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-4, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essais d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*

IEC 61000-4-6, *Compatibilité électromagnétique (CEM) – Partie 4-6: Techniques d'essai et de mesure – Immunité aux perturbations conduites, induites par les champs radioélectriques*

IEC 61000-4-8, *Compatibilité électromagnétique (CEM) – Partie 4-8: Techniques d'essai et de mesure – Essai d'immunité au champ magnétique à la fréquence du réseau*

IEC 61000-4-11, *Compatibilité électromagnétique (CEM) – Partie 4-11: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension*

IEC 61000-6-1, *Compatibilité électromagnétique (CEM) – Partie 6-1: Normes génériques – Immunité pour les environnements résidentiels, commerciaux et de l'industrie légère*

IEC 61000-6-2, *Compatibilité électromagnétique (CEM) – Partie 6-2: Normes génériques – Immunité pour les environnements industriels*

IEC 61000-6-3, *Compatibilité électromagnétique (CEM) – Partie 6-3: Normes génériques – Norme sur l'émission pour les environnements résidentiels, commerciaux et de l'industrie légère*

IEC 61000-6-4, *Compatibilité électromagnétique (CEM) – Partie 6-4: Normes génériques – Norme sur l'émission pour les environnements industriels*

IEC 61010-1, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 1: Exigences générales*

IEC 62368-1, *Équipements des technologies de l'audio/vidéo, de l'information et de la communication – Partie 1: Exigences de sécurité*

CISPR 11, *Appareils industriels, scientifiques et médicaux – Caractéristiques de perturbations radioélectriques – Limites et méthodes de mesure*

CISPR 16-1 (toutes les parties), *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques*

CISPR 16-1-2:2014, *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-2: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Dispositifs de couplage pour la mesure des perturbations conduites*

CISPR 16-1-3, *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-3: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Matériels auxiliaires – Puissance perturbatrice*

CISPR 16-2-1:2014, *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 2-1: Méthodes de mesure des perturbations et de l'immunité – Mesures des perturbations conduites*

CISPR 16-2-2, *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 2-2: Méthodes de mesure des perturbations et de l'immunité – Mesure de la puissance perturbatrice*

CISPR 16-2-3 *Spécification des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 2-3: Méthodes de mesure des perturbations et de l'immunité – Mesures des perturbations rayonnées*

## 3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 60050-121, l'IEC 60050-151, l'IEC 60050-161, IEC 60050-551 et l'IEC 60146-1-1, ainsi que les suivants, s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

**3.1**
**environnement**

**3.1.1**
**environnement résidentiel, commercial et de l'industrie légère**
environnement couvert par la norme générique IEC 61000-6-3

Note 1 à l'article: Une indication relative aux lieux inclus dans cet environnement est donnée dans l'Annexe G.

**3.1.2**
**environnement industriel**
environnement couvert par la norme générique IEC 61000-6-4

Note 1 à l'article: Une indication relative aux lieux inclus dans cet environnement est donnée dans l'Annexe G.

**3.2**
**distance de protection**
distance au-delà de laquelle le niveau d'interférence d'un appareil électronique ou électrique ne doit pas altérer le fonctionnement d'un autre équipement électronique ou électrique, tel que des récepteurs de radiodiffusion et de télévision

**3.3**
**système d'alimentations décentralisées**
système de convertisseurs de puissance localisés alimenté à partir d'un bus de puissance distribuée

**3.4**
**accès**
interface particulière d'un produit avec l'environnement électromagnétique extérieur

Note 1 à l'article: Des exemples d'accès sont donnés dans la Figure 1.

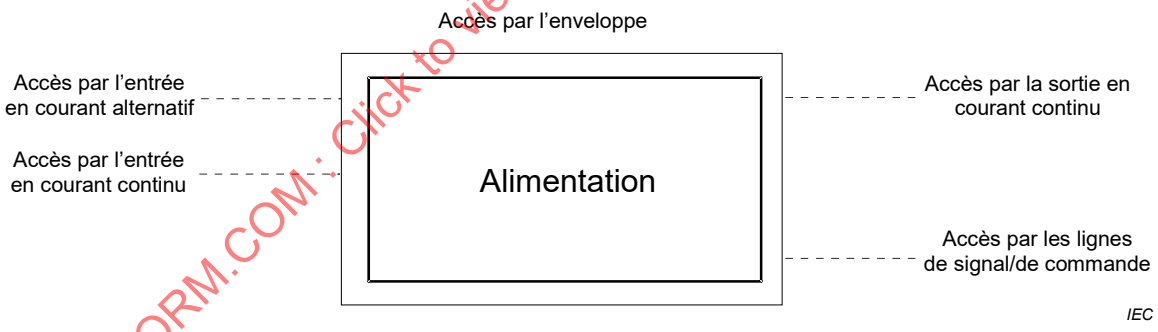


**Figure 1 – Exemples d'accès**

**3.4.1**
**accès par l'enveloppe**
frontière physique de l'alimentation à travers laquelle ou sur laquelle les champs électromagnétiques peuvent rayonner ou se heurter

**3.4.2**
**accès par le signal**
point de connexion d'entrée ou de sortie d'un signal à bas niveau fournissant une information de diagnostic ou de commande

**3.4.3**
**accès par l'entrée en courant continu**
point de connexion d'une source continue externe d'alimentation

**3.4.4**
**accès par la sortie en courant continu**
point de connexion externe de la sortie de la tension continue générée

**3.4.5**
**accès par l'entrée en courant alternatif**
point de connexion d'une source alternative externe d'alimentation

**3.5**
**alimentation**
dispositif électrique ou électronique qui transforme l'énergie d'une source appliquée à son entrée en une énergie générée sur sortie simple ou multiple

**3.5.1**
**alimentation-composant**
alimentation modulaire
sous-ensemble
assemblage de dispositifs électriques et/ou électroniques destiné à générer ou à modifier de l'énergie

Note 1 à l'article: L'alimentation-composant est conçue pour être incorporée dans un produit final par un installateur professionnel. Elle n'est pas conçue pour fonctionner individuellement.

**3.5.2**
**alimentation autonome**
alimentation destinée à un emploi direct en laboratoire, en atelier et dans d'autres lieux

Note 1 à l'article: C'est un produit final, complètement enfermé dans un boîtier qui protège contre les décharges électrostatiques et évite à l'utilisateur le risque de contacts dangereux avec des parties accessibles. Ce type d'alimentation comprend les alimentations de table à sortie fixe ou réglable, les alimentations intégrées dans la fiche secteur et les alimentations individuelles pour montage sur panneau.

**3.5.3**
**alimentation de table**
alimentation destinée aux laboratoires et aux utilisations similaires

Note 1 à l'article: C'est une alimentation autonome, parfois équipée de dispositifs de commande et de mesure.

**3.5.4**
**alimentation sur circuit imprimé**
alimentation sans châssis
carte de circuit imprimé dépourvue de fixation métallique de montage

Note 1 à l'article: C'est une alimentation-composant destinée à un installateur.

**3.5.5**
**alimentation à châssis ouvert**
alimentation utilisant généralement une carte de circuit imprimé montée sur une ossature métallique pour fixation au châssis de l'équipement d'un installateur professionnel

Note 1 à l'article: Cette ossature permet un transfert thermique pour le refroidissement des semiconducteurs de puissance. Occasionnellement, un capot peut être installé pour des raisons de sécurité et/ou pour réduire le risque d'interférence par rayonnement.

**3.5.6**
**alimentation à carte enfichable**
alimentation destinée à être enfichée dans un sous-ensemble

Note 1 à l'article: Elle peut se présenter sous forme de circuit imprimé, avec châssis ouvert ou capoté. Une alimentation à carte enfichable est généralement destinée à un installateur professionnel.

**3.5.7**
**alimentation enfermée**
alimentation capotée
alimentation complètement enfermée, capotée ou en coffret

Note 1 à l'article: La conception utilise l'enveloppe comme dissipateur de la chaleur ou emploie une ventilation forcée par ventilateur.

**3.5.8**
**alimentation intégrée dans la fiche secteur**
alimentation contenue dans un boîtier s'enfichant directement dans une prise secteur

**3.5.9**
**alimentation sans interruption**
**ASI**
alimentation destinée à servir de source d'énergie de secours en cas de coupure du secteur

Note 1 à l'article: Ce type de produit est normalement un appareil individuel.

**3.6**
**produit final**
module complet qui est conçu pour être autonome, utilisable par un utilisateur final en offrant directement la fonction pour l'utilisateur final

Note 1 à l'article: Il est destiné à être mis sur le marché et/ou à être utilisé dans un service soit en tant que seul élément, soit en tant que partie d'un système ou d'une alimentation (installation).

**3.7**
**système**
ensemble localisé de produits interconnectés facile à déplacer

Note 1 à l'article: Par exemple, un ordinateur avec souris, clavier, imprimante et moniteur ou un ensemble hi-fi avec TV et magnétoscope.

**3.8**
**installation**
ensemble de produits interconnectés difficile à déplacer

Note 1 à l'article: Par exemple, une usine de transformation ou une centrale électrique.

**3.9**
**installateur professionnel**
personne ou organisme techniquement compétent capable d'assembler/installer correctement des composants et des sous-ensembles dans un produit final, ou des produits finaux dans un système ou dans une installation et procédant à cet assemblage/installation en respectant complètement les exigences légales et techniques qui concernent les produits finaux, les systèmes ou les installations

**3.10**
**pleine charge assignée**
puissance maximale continue ou puissance moyenne indiquée sur l'alimentation

**3.11**
**alimentation réseau**

**3.11.1**
**réseau électrique industriel**
source d'énergie électrique destinée seulement à la consommation industrielle

**3.11.2**
**réseau électrique privé**
source d'énergie électrique locale qui n'est pas directement raccordée au réseau électrique public (par exemple, générateur ou ASI)

**3.11.3**
**réseau électrique public**
source d'énergie électrique fournie pour une utilisation publique courante en environnements domestiques, commerciaux ou de l'industrie légère

**3.12**
**fréquence critique d'une alimentation**
fréquence dont la longueur d'onde est égale à quatre fois la longueur du plus long côté de l'alimentation

**3.13**
**tension résiduelle**
<creux de tension> valeur minimale de la tension efficace enregistrée pendant un creux de tension ou une coupure brève

Note 1 à l'article: La tension résiduelle peut être exprimée sous la forme d'une valeur en volts, ou d'un pourcentage ou par unité dont la valeur est relative à la tension de référence.

**3.14**
**essai de type**
essai de conformité effectué sur une ou plusieurs entités représentatives de la production

[SOURCE: IEC 60050-151:2001, 151-16-16]

## 4 Applicabilité des essais aux différentes technologies des alimentations

Des préconisations sur ce point sont données dans l'Annexe A.

## 5 Exigences générales et conditions d'essai

### 5.1 Exigences générales

Le fabricant d'alimentations a la responsabilité de fournir pour ses produits les informations relatives aux performances CEM, aux domaines d'application et aux environnements prévus ainsi que les lignes directrices pour l'installation.

### 5.2 Conditions d'essai

Les essais doivent être effectués en suivant les instructions d'installation et de câblage recommandées par le fabricant. Aucune autre connexion que celles spécifiées par le fabricant n'est établie.

La configuration, l'orientation et les conditions des essais électriques de l'alimentation doivent être représentatives des conditions les plus défavorables de son utilisation. Si elles ne le sont pas, tous les mesurages doivent être effectués à la tension d'entrée nominale assignée, à pleine charge assignée et à une température ambiante comprise entre 15 °C et 35 °C. L'alimentation doit être à sa température normale de fonctionnement.

La charge est censée ne générer aucune perturbation électromagnétique. Les charges résistives peuvent être refroidies par un ventilateur ou par un fluide.

Tous les essais spécifiés dans le présent document sont exclusivement des essais de type.

Une alimentation est réputée satisfaire aux exigences spécifiées dans le présent document si elle satisfait aux exigences fonctionnelles et de performance définies en appliquant les méthodes d'essai spécifiées dans le présent document.

Des précautions doivent être prises vis-à-vis d'un équipement en essai (*equipment under test* – EUT) devenant dangereux ou peu sûr lors des essais d'immunité spécifiés dans le présent document.

## 6 Exigences d'émission

### 6.1 Généralités

Si la disposition des câbles de l'application est connue, elle doit être utilisée. Si elle ne l'est pas, elle doit être choisie conformément à 6.3 et 6.4. La disposition des câbles mise en œuvre durant l'essai doit être indiquée dans la documentation.

### 6.2 Phénomènes à basse fréquence ($f \leq 9$ kHz; entrée en courant alternatif seulement)

#### 6.2.1 Encoches de commutation

Seules les alimentations avec commutation du courant primaire sont concernées par ce paragraphe. Les alimentations de forte puissance conçues comme des convertisseurs commutés par le réseau peuvent créer des encoches si elles sont connectées à une source à haute impédance. Les mesurages ou calculs ne sont pas obligatoires. Des informations et des recommandations sont fournies dans l'Annexe B.

#### 6.2.2 Harmoniques de courant et interharmoniques

Les limites pour les alimentations connectées au réseau électrique public et absorbant un courant assigné d'entrée jusqu'à 16 A sont indiquées dans l'IEC 61000-3-2. Ces exigences sont applicables aux appareils et aux composants considérés comme couverts par le domaine d'application de l'IEC 61000-3-2.

NOTE Les limites pour les courants harmoniques produits par les appareils connectés aux réseaux publics basse tension ayant un courant appelé > 16 A et ≤ 75 A par phase sont données dans l'IEC 61000-3-12.

Les mesurages d'harmoniques sont dépendants de la source de tension, particulièrement dans le cas des alimentations. Dans de nombreux cas, l'emploi du réseau électrique public dans ce but peut ne pas être approprié.

Par conséquent une des méthodes suivantes doit être utilisée.

a) Utilisation du réseau électrique public, conformément à la norme associée IEC 61000-3-2 ou IEC 61000-3-12:
   – les limites des harmoniques de la source de tension doivent être satisfaites pendant que l'alimentation fonctionne à pleine charge assignée.

b) Utilisation d'une source fictive, conformément à la norme associée IEC 61000-3-2 ou IEC 61000-3-12.

c) Calcul ou simulation, conformément à la norme associée IEC 61000-3-12:
   – utilisation de la source de tension comme une onde sinusoïdale parfaite;
   – notification du pire cas pour l'impédance interne de l'alimentation dans la plage de fréquences allant de la fréquence de la source jusqu'à la 40$^{ième}$ harmonique.

Pour les recommandations, voir l'Annexe C. Les phénomènes interharmoniques susceptibles de se produire dans des conditions particulières de la charge ne peuvent pas être pris en compte dans le présent document; cet aspect système est sous la responsabilité de l'utilisateur et/ou de l'installateur.

### 6.2.3 Fluctuations de tension et papillotement

Les limites pour les alimentations connectées au réseau électrique public et absorbant un courant assigné d'entrée jusqu'à 16 A sont indiquées dans l'IEC 61000-3-3. Ces exigences sont applicables aux appareils et aux composants considérés comme couverts par le domaine d'application de l'IEC 61000-3-3, mais ne sont pas obligatoires pour les alimentations utilisées dans les pays où il n'y a pas de réglementation exigeant la limitation des fluctuations et du papillotement de la tension.

Pour les alimentations, seuls les mesurages ou les calculs de $d_{max}$ (variation relative maximale de la tension) sont nécessaires.

Il est recommandé de mesurer l'amplitude et la durée du courant d'appel et de calculer la valeur efficace de la première période qui suit la mise en marche. Beaucoup d'alimentations ont un courant d'appel de durée inférieure à 10 ms, ce qui signifie que les courants d'appel élevés sont encore au-dessous de la limite $d_{max}$.

Les fluctuations du courant d'entrée d'une alimentation peuvent être causées par une variation dans le temps de la charge de l'alimentation. Cet aspect système est sous la responsabilité de l'utilisateur et/ou de l'installateur.

NOTE Les limites pour les fluctuations de tension et le papillotement des alimentations connectées au réseau électrique public et absorbant un courant assigné d'entrée ≤ 75 A sont données dans l'IEC 61000-3-11.

## 6.3 Émission conduite à haute fréquence

### 6.3.1 Généralités

Le réseau fictif d'alimentation (AMN – artificial mains network) exigé est défini en 4.3 de la CISPR 16-1-2:2014.

Les mesurages doivent être réalisés conformément à la méthode définie dans la CISPR 16-21.

La disposition de l'équipement en essai (EUT) et son raccordement au réseau AMN sont définis en 7.4.1 de la CISPR 16-2-1:2014.

D'autres publications du CISPR fournissent des détails supplémentaires sur les essais relatifs à certains équipements en essai, comme la CISPR 11 pour les applications ISM et la CISPR 22 pour les applications ATI.

### 6.3.2 Émission conduite à haute fréquence pour les accès par l'entrée

Pour les accès par l'entrée en courant alternatif, voir le Tableau H.1.

Pour les accès par l'entrée en courant continu, voir le Tableau H.2.

### 6.3.3 Émission conduite à haute fréquence pour les accès par la sortie en courant continu

Pour les accès par la sortie en courant continu, voir le Tableau H.2.

## 6.4 Émission rayonnée à haute fréquence

### 6.4.1 Généralités

Les mesurages doivent être réalisés conformément à la méthode de référence définie dans la CISPR 16-2-3.

NOTE La méthode de mesure de la CISPR 16-2-2 est une variante qui ne s'applique qu'à la bande de fréquences comprise entre 30 MHz et 300 MHz. Les limites sont indiquées dans le Tableau H.3.

### 6.4.2 Mesurages des perturbations rayonnées

Les essais de perturbations rayonnées doivent être réalisés conformément à la CISPR 16-2-3.

Les câbles de la charge dont la longueur n'est pas indiquée doivent être disposés horizontalement, être à égale distance les uns des autres et doivent avoir une longueur de 1 m.

Le câble d'alimentation est placé horizontalement à 1 m, puis verticalement à 0,8 m vers le sol, où il est raccordé à la source d'énergie. Les câbles ne sont pas blindés, à moins que l'alimentation ne soit fournie avec un câble blindé.

Toute autre disposition doit être justifiée et expliquée dans la documentation.

La distance entre l'antenne et l'alimentation doit être de 10 m si les limites du Tableau H.3 sont appliquées.

Peut être mesurée à une distance de 3 m, en augmentant les limites de 10 dB.

Peut être mesurée à une distance de 30 m, en réduisant les limites de 10 dB.

### 6.4.3 Mesurage de la puissance perturbatrice

Le récepteur de mesure doit comporter un détecteur de quasi-crête et doit être conforme aux exigences de la CISPR 16-2-2. La pince absorbante doit être conçue et étalonnée conformément à la CISPR 16-1-3.

NOTE Généralement, les pinces se réfèrent au mesurage d'un champ rayonné à 10 m.

Pour le montage et la procédure de mesure, voir la Figure 2.

L'alimentation et le câble à soumettre aux essais doivent être placés sur un support non métallique de 0,8 m de hauteur et à au moins 0,8 m de tous les autres objets métalliques.

Le câble en essai est tendu sur une longueur d'au moins 5 m sur un support non métallique permettant de déplacer la pince absorbante le long du câble en essai. La pince doit être placée dans la bonne orientation autour du câble (le capteur de courant côté alimentation).

Tous les autres câbles sont soit déconnectés (si cela n'empêche pas le fonctionnement correct de l'équipement sans les câbles), soit équipés de tubes en ferrite absorbante (pinces) à proximité de l'alimentation.

Chaque câble de l'alimentation doit être tour à tour soumis à l'essai. Les câbles dont la longueur est supérieure à 5 m sont soumis à l'essai selon la méthode décrite ci-dessus avec 5 m de câble pour le montage d'essai. La disposition de la partie du câble en excès n'est pas critique.

Les câbles qui, en application normale, sont d'une longueur inférieure à 5 m sont soumis à l'essai comme suit:

Les câbles dont la longueur est:

- $\leq$ 0,25 m ne sont pas mesurés du tout;
- $< s$ sont rallongés pour égaler $s$;