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

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Elektromagnetische Verträglichkeit (EMV) - Teil 4-6: Prüf- und Messverfahren - Störfestigkeit gegen leitungsgeführte Störgrößen, induziert durch hochfrequente Felder

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

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English version

**Electromagnetic compatibility (EMC) -
Part 4-6: Testing and measurement techniques -
Immunity to conducted disturbances,
induced by radio-frequency fields
(IEC 61000-4-6:2003 + A1:2004 + A2:2006)**

Compatibilité électromagnétique (CEM) -
Partie 4-6: Techniques d'essai
et de mesure -
Immunité aux perturbations conduites,
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(CEI 61000-4-6:2003 + A1:2004 +
A2:2006)

Elektromagnetische
Verträglichkeit (EMV) -
Teil 4-6: Prüf- und Messverfahren -
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Störgrößen, induziert durch
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This European Standard was approved by CENELEC on 2007-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

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

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 61000-4-6:2006 and its amendments 1:2004 and 2:2006, prepared by SC 77B, High frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the formal vote and was approved by CENELEC as EN 61000-4-6 on 2007-06-01 without any modification.

This European Standard supersedes EN 61000-4-6:1996 + A1:2001 and EN 61000-4-6:1996/IS1:2004.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2008-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-06-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61000-4-6:2006 + A1:2004 + A2:2006 was approved by CENELEC as a European Standard without any modification.

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

- | | | |
|---------------|------|---|
| IEC 61000-4-3 | NOTE | Harmonized as EN 61000-4-3:2002 (not modified). |
| CISPR 20 | NOTE | Harmonized as EN 55020:2002 (not modified). |

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

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

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-161	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-

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¹⁾ Undated reference.



Corrigendum to EN 61000-4-6:2007

English version

Foreword

In the first paragraph, replace "IEC 61000-4-6:2006" by "IEC 61000-4-6:2003".

Endorsement notice

Replace "IEC 61000-4-6:2006" by "IEC 61000-4-6:2003".

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

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

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 61000-4-6 has been prepared by subcommittee 77B: High-frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

This standard forms part 4-6 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*.

This consolidated version of IEC 61000-4-6 consists of the second edition (2003) [documents 77B/377/FDIS and 77B/384/RVD], its amendment 1 (2004) [documents 77B/426/FDIS and 77B/431/RVD] and its amendment 2 (2006) [documents 77B/492/FDIS and 77B/502/RVD].

The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience.

It bears the edition number 2.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site 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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INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)
Definitions, terminology

Part 2: Environment

Description of the environment
Classification of the environment
Compatibility levels

Part 3: Limits

Emission limits
Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques
Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines
Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example : 61000-6-1).

This part is an international standard which gives immunity requirements and test procedure related to conducted disturbances induced by radio-frequency fields.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

1 Scope and object

This part of IEC 61000-4 relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection) which can couple the equipment to the disturbing RF fields is excluded.

NOTE 1 Test methods are defined in this part for measuring the effect that conducted disturbing signals, induced by electromagnetic radiation, have on the equipment concerned. The simulation and measurement of these conducted disturbances are not adequately exact for the quantitative determination of effects. The test methods defined are structured for the primary objective of establishing adequate repeatability of results at various facilities for quantitative analysis of effects.

The object of this standard is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by radio-frequency fields. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.

NOTE 2 As described in IEC Guide 107, this is a basic EMC publication for use by product committees of the IEC. As also stated in Guide 107, the IEC product committees are responsible for determining whether this immunity test standard should be applied or not, and if applied they are responsible for determining the appropriate test levels and performance criteria. TC 77 and its sub-committees are prepared to co-operate with product committees in the evaluation of the value of particular immunity tests for their products.

2 Normative references

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

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

3 Definitions

For the purpose of this part of IEC 61000, the definitions given in IEC 60050(161) as well as the following definitions apply.

3.1 artificial hand

electrical network simulating the impedance of the human body under average operational conditions between a hand-held electrical appliance and earth

[IEV 161-04-27]

NOTE The construction should be in accordance with CISPR 16-1.

3.2

auxiliary equipment

AE

equipment necessary to provide the equipment under test (EUT) with the signals required for normal operation and equipment to verify the performance of the EUT

3.3

clamp injection

clamp injection is obtained by means of a clamp-on “current” injecting device on the cable:

- **current clamp**: a transformer, the secondary winding of which consists of the cable into which the injection is made;
- **electromagnetic clamp** (EM clamp): injection device with combined capacitive and inductive coupling

3.4

common-mode impedance

ratio of the common mode voltage and the common-mode current at a certain port

NOTE This common mode impedance can be determined by applying a unity common mode voltage between the terminal(s) or screen of that port and a reference plane (point). The resulting common mode current is then measured as the vectorial sum of all currents flowing through these terminal(s) or screen (see also Figures 8a and 8b).

3.5

coupling factor

ratio given by the open-circuit voltage (e.m.f.) obtained at the EUT port of the coupling (and decoupling) device divided by the open-circuit voltage obtained at the output of the test generator

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3.6

coupling network

electrical circuit for transferring energy from one circuit to another with a defined impedance

NOTE Coupling and decoupling devices can be integrated into one box (coupling and decoupling network (CDN)) or they can be in separate networks.

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3.7

coupling/decoupling network

CDN

electrical circuit incorporating the functions of both the coupling and decoupling networks

3.8

decoupling network

electrical circuit for preventing test signals applied to the EUT from affecting other devices, equipment or systems that are not under test

3.9

test generator

generator (RF generator, modulation source, attenuators, broadband power amplifier and filters) capable of generating the required test signal (see Figure 3)

3.10**electromotive force****e.m.f.**

voltage at the terminals of the ideal voltage source in the representation of an active element
[IEV 131-01-38:1978]

3.11**measurement result** **U_{mr}**

voltage reading of the measurement equipment

3.12**voltage standing wave ratio****VSWR**

ratio of a maximum to an adjacent minimum voltage magnitude along the line

4 General

The source of disturbance covered by this part of IEC 61000 is basically an electromagnetic field, coming from intended RF transmitters, that may act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths involved. The in-going and outgoing leads (e.g. mains, communication lines, interface cables) behave as passive receiving antenna networks because of their length, which can be several wavelengths.

Between those cable networks, the susceptible equipment is exposed to currents flowing "through" the equipment. Cable systems connected to an equipment are assumed to be in resonant mode ($\lambda/4$, $\lambda/2$ open or folded dipoles) and as such are represented by coupling and decoupling devices having a common-mode impedance of 150Ω with respect to a ground reference plane. Where possible the EUT is tested by connecting it between two 150Ω common-mode impedance connections: one providing an RF source and the other providing a return path for the current.

This test method subjects the EUT to a source of disturbance comprising electric and magnetic fields, simulating those coming from intentional RF transmitters. These disturbing fields (E and H) are approximated by the electric and magnetic near-fields resulting from the voltages and currents caused by the test set-up as shown in Figure 2a.

The use of coupling and decoupling devices to apply the disturbing signal to one cable at the time, while keeping all other cables non-excited, see Figure 2b, can only approximate the real situation where disturbing sources act on all cables simultaneously, with a range of different amplitudes and phases.

Coupling and decoupling devices are defined by their characteristics given in 6.2. Any coupling and decoupling device fulfilling these characteristics can be used. The coupling and decoupling networks in Annex D are only examples of commercially available networks.