INTERNATIONAL STANDARD

IEC 61000-4-3

Edition 2.1
2002-09

Edition 2:2002 consolidated with amendment 1:2002

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –

Part 4-3:
Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

Reference number
IEC 61000-4-3:2002+A1:2002(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (www.iec.ch/online_news/ justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC 61000-4-3

Edition 2.1
2002-09

Edition 2:2002 consolidated with amendment 1:2002

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –

Part 4-3:
Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61000-4-3 has been prepared by subcommittee 77B: High frequency phenomenon, of IEC technical committee 77: Electromagnetic compatibility.

This consolidated version of IEC 61000-4-3 is based on the second edition (2002) [documents 77B/339/FDIS and 77B/344/RVD] and its amendment 1 (2002) [documents 77B/352/FDIS and 77B/359/RVD].

It has the status of a basic EMC publication in accordance with IEC Guide 107.

It bears the edition number 2.1.

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

Annex J forms an integral part of this standard.

Annexes A to I as well as annex K are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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

INTRODUCTION

This standard is part of the IEC 61000 series, 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 9: Miscellaneous

Each part is further subdivided into sections which are to be published either as International Standards or as technical reports.

This section is an International Standard which gives immunity requirements and test procedures related to radiated, radio-frequency, electromagnetic fields.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

1 Scope and object

This section of IEC 61000-4 is applicable to the immunity of electrical and electronic equipment to radiated electromagnetic energy. It establishes test levels and the required test procedures.

The object of this section is to establish a common reference for evaluating the performance of electrical and electronic equipment when subjected to radio-frequency electromagnetic fields. Testing is not required at frequencies other than those specified in clause 5 of this standard. The possible future introduction of new radio services which may degrade the performance of electrical and electronic equipment may result in test levels being specified in other frequency bands.

This section deals with immunity tests related to general purposes. Particular considerations are devoted to the protection against radiofrequency emissions from digital radio telephones.

NOTE Test methods are defined in this section for measuring the effect that electromagnetic radiation has on the equipment concerned. The simulation and measurement of electromagnetic radiation is not adequately exact for quantitative determination of effects. The test methods defined are structured for the primary objective of establishing adequate repeatability of results at various test facilities for qualitative analysis of effects.

This section does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the tests and the severity level to be applied to their equipment.

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):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 61000-4-6:1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances induced by radio-frequency fields*

3 General

Most electronic equipment is, in some manner, affected by electromagnetic radiation. This radiation is frequently generated by such sources as the small hand-held radio transceivers that are used by operating, maintenance and security personnel, fixed-station radio and television transmitters, vehicle radio transmitters, and various industrial electromagnetic sources.

In recent years there has been a significant increase in the use of radio telephones and other radio transmitters operating at frequencies between 0,8 GHz and 3 GHz. Many of these services use modulation techniques with a non-constant envelope (e.g. TDMA).

In addition to electromagnetic energy deliberately generated, there is also spurious radiation caused by devices such as welders, thyristors, fluorescent lights, switches operating inductive loads, etc. For the most part, this interference manifests itself as conducted electrical interference and, as such, is dealt with in other parts of this standard. Methods employed to prevent effects from electromagnetic fields will normally also reduce the effects from these sources.

The electromagnetic environment is determined by the strength of the electromagnetic field (field strength in volts per metre). The field strength is not easily measured without sophisticated instrumentation nor is it easily calculated by classical equations and formulae because of the effect of surrounding structures or the proximity of other equipment that will distort and/or reflect the electromagnetic waves.

4 Definitions

For the purposes of this section of IEC 61000-4, the following definitions, together with those in IEC 60050(161) apply.

4.1
amplitude modulation
process by which the amplitude of a carrier wave is varied following a specified law

4.2
anechoic chamber
shielded enclosure which is lined with radio-frequency absorbers to reduce reflections from the internal surfaces

4.2.1
fully anechoic chamber
shielded enclosure whose internal surfaces are totally lined with anechoic material

4.2.2
semi-anechoic chamber
shielded enclosure where all internal surfaces are covered with anechoic material with the exception of the floor, which shall be reflective (ground plane)

4.2.3
modified semi-anechoic chamber
semi-anechoic chamber which has additional absorbers installed on the ground plane

4.3
antenna
transducer which either emits radio-frequency power into space from a signal source or intercepts an arriving electromagnetic field, converting it into an electrical signal

4.4
balun
device for transforming an unbalanced voltage to a balanced voltage or vice versa [IEV 161-04-34]

4.5
continuous waves (CW)
electromagnetic waves, the successive oscillations of which are identical under steady-state conditions, which can be interrupted or modulated to convey information

4.6
electromagnetic (EM) wave
radiant energy produced by the oscillation of an electric charge characterized by oscillation of the electric and magnetic fields

4.7
far field
region where the power flux density from an antenna approximately obeys an inverse square law of the distance.

For a dipole this corresponds to distances greater than $\lambda/2\pi$, where λ is the wavelength of the radiation

4.8
field strength
the term "field strength" is applied only to measurements made in the far field. The measurement may be of either the electric or the magnetic component of the field and may be expressed as V/m, A/m or W/m^2; any one of these may be converted into the others

NOTE For measurements made in the near field, the term "electric field strength" or "magnetic field strength" is used according to whether the resultant electric or magnetic field, respectively, is measured. In this field region, the relationship between the electric and magnetic field strength and distance is complex and difficult to predict, being dependent on the specific configuration involved. Inasmuch as it is not generally feasible to determine the time and space phase relationship of the various components of the complex field, the power flux density of the field is similarly indeterminate.

4.9
frequency band
continuous range of frequencies extending between two limits

4.10
induction field
predominant electric and/or magnetic field existing at a distance $d < \lambda/2\pi$, where λ is the wavelength and the physical dimensions of the source are much smaller than distance d

4.11
isotropic
having properties of equal values in all directions

4.12
polarization
orientation of the electric field vector of a radiated field

4.13
shielded enclosure
screened or solid metal housing designed expressly for the purpose of isolating the internal from the external electromagnetic environment. The purpose is to prevent outside ambient electromagnetic fields from causing performance degradation and to prevent emission from causing interference to outside activities

4.14
stripline
terminated transmission line consisting of two parallel plates between which a wave is propagated in the transverse electromagnetic mode to produce a specified field for testing purposes [IEV 161-04-31]

4.15
spurious radiation
any undesired electromagnetic emission from an electrical device

4.16
sweep
continuous or incremental traverse over a range of frequencies

4.17
transceiver
combination of radio transmitting and receiving equipment in a common housing

4.18
human body-mounted equipment
equipment which is intended for use when attached to the human body. This definition includes hand-held devices which are carried by people while in operation (e.g. pocket devices) as well as electronic aid devices and implants

4.19
maximum RMS value
the highest short-term RMS value of a modulated RF signal during an observation time of one modulation period. The short-term RMS is evaluated over a single carrier cycle. For example, in figure 1b), the maximum RMS voltage is:

$$V_{\text{maximum RMS}} = V_{\text{p-p}} / (2 \times \sqrt{2}) = 1{,}8 \text{ volts}$$

4.20
non-constant envelope modulation
RF modulation schemes where the amplitude of the carrier wave varies slowly in time compared with the period of the carrier itself. Examples include conventional amplitude modulation and TDMA

4.21
TDMA (time division multiple access)
a time multiplexing modulation scheme which places several communication channels on the same carrier wave at an allocated frequency. Each channel is assigned a time slot during which, if the channel is active, the information is transmitted as a pulse of RF power. If the channel is not active no pulse is transmitted, thus the carrier envelope is not constant. During the pulse, the amplitude is constant and the RF carrier is frequency- or phase-modulated

5 Test levels

5.1 Test levels related to general purposes

The preferential range of test levels is given in table 1.

Frequency range: 80 MHz to 1 000 MHz.

Table 1 – Test levels

Level	Test field strength V/m
1	1
2	3
3	10
x	Special
NOTE x is an open test level. This level may be given in the product specification.	

Table 1 gives details of the field strength of the unmodulated signal. For testing of equipment, this signal is 80 % amplitude modulated with a 1 kHz sinewave to simulate actual threats (see figure 1). Details of how the test is performed are given in clause 8.

NOTE 1 Product committees may decide to choose a lower or higher transition frequency than 80 MHz between IEC 61000-4-3 and IEC 61000-4-6 (see annex H).

NOTE 2 Product committees may select alternative modulation schemes.

NOTE 3 IEC 61000-4-6 also defines test methods for establishing the immunity of electrical and electronic equipment against radiated electromagnetic energy. It covers frequencies below 80 MHz.

5.2 Test levels related to the protection against RF emissions from digital radio telephones

The preferred range of test levels is given in table 2 for the frequency ranges from 800 MHz to 960 MHz and from 1,4 GHz to 2,0 GHz.

Table 2 – Frequency ranges: 800 MHz to 960 MHz and 1,4 GHz to 2,0 GHz

Level	Test field strength V/m
1	1
2	3
3	10
4	30
x	Special
NOTE x is an open test level. This level may be given in the product standard.	

The test field strength column gives values of the unmodulated carrier signal. For testing of equipment, this carrier signal is 80 % amplitude modulated with a 1 kHz sine wave to simulate actual threats (see figure 1). Details of how the test is performed are given in clause 8.

If the product is intended to conform only to the requirements of particular countries, the measurement range 1,4 GHz to 2,0 GHz may be reduced to cover just the specific frequency bands allocated to digital mobile telephones in those countries. In this situation, the decision to test over reduced frequency ranges shall be documented in the test report.

Product committees shall specify the applicable test level for each of the frequency ranges. In the frequency range mentioned in both tables 1 and 2, the test need only be performed at the higher of the two test levels.

NOTE 1 Annex A contains an explanation regarding the decision to use sine wave modulation also for tests related to protection against RF emissions from digital radio telephones.

NOTE 2 Annex F contains guidance with regard to selecting test levels.

NOTE 3 The measurement ranges for table 2 are the frequency bands generally allocated to digital radio telephones (annex I contains the list of frequencies known to be allocated to specific digital radio telephones at the time of publication).

NOTE 4 The principle threat above 800 MHz is from radio telephone systems. Other systems operating in this frequency range, e.g. radio LANs operating at 2,4 GHz, are generally very low power (typically lower than 100 mW), so they are much less likely to present significant problems.

6 Test equipment

The following types of test equipment are recommended:

– *Anechoic chamber:* of a size adequate to maintain a uniform field of sufficient dimensions with respect to the equipment under test (EUT). Additional absorbers may be used to damp reflections in chambers which are not fully lined.

  NOTE Alternative methods of generating EM fields include TEM cells and stripline circuits, unlined screened rooms, partially lined shielded rooms, and open area test sites.

  These devices have limitations in the size of equipment which can be accommodated in the uniform field, the frequency range, or infringement of local regulations.

  Care should be taken to ensure that the conditions of test are equivalent to those in the anechoic chamber.

– *EMI filters:* care shall be taken to ensure that the filters introduce no additional resonance effects on the connected lines.

– *RF signal generator(s)* capable of covering the frequency band of interest and which can be amplitude modulated by a 1 kHz sinewave to 80 % depth. They shall have either an automated sweep capability of $1{,}5 \times 10^{-3}$ decade/s or slower or, in the case of r.f. synthesizers, be capable of being programmed with frequency-dependent step-sizes and dwell times. They shall also be capable of being set manually.

  The use of low-pass or band-pass filters may be necessary to avoid problems caused by harmonics to equipment which is intended to receive signals for monitoring purposes.

– *Power amplifiers:* to amplify signal (unmodulated and modulated) and provide antenna drive to the necessary field level. The harmonics and distortion produced by the power amplifier shall be at a level less than or equal to 15 dB below carrier level.

– *Field generating antennas (see annex B):* biconical, log periodic or any other linearly polarized antenna system capable of satisfying frequency requirements. Circularly polarized antennas are under consideration.