IEC 61000-4-39

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

BASIC EMC PUBLICATION

PUBLICATION FONDAMENTALE EN CEM

Electromagnetic compatibility (EMC) – Part 4-39: Testing and measurement techniques – Radiated fields in close proximity – Immunity test

Compatibilité électromagnétique (CEM) – Partie 4-39: Techniques d'essai et de mesure – Champs rayonnés à proximité – Essai d'immunité

IEC 61000-4-39:2017-03(en-fr)

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

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FOREWORD

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International Standard IEC 61000-4-39 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms Part 4-39 of the IEC 61000 series. It has the status of a basic EMC publication in accordance with IEC Guide 107.

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

FDIS	Report on voting
77B/769/FDIS	77B/772/RVD

Full information on the voting for the approval of this standard 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 in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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: IEC 61000-6-1).

Particular considerations for IEC 61000-4-39

This part of IEC 61000 is an international standard which gives immunity requirements and test procedures related to radiated disturbances caused by radio-frequency fields from devices used in close proximity.

It is impossible to ignore that the everyday electromagnetic environment has greatly changed. Not long ago, handheld, frequency-modulated (FM) transceivers for business, public safety, and amateur radio communications represented the predominant RF applications. Distribution was limited (for example, by licenses) and in most cases the radiating antennas were outside buildings to get a high efficiency. The situation changed once technology allowed the manufacturing of compact wireless phones with low weight and a reasonable price. Wireless services (DECT, mobile phones, UMTS/WiFi/WiMAX/ Bluetooth®[1], baby monitors, etc.) have

[1] Bluetooth is the trade name of a product supplied by Bluetooth SIG This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of this product. Equivalent products may be used if they can be shown to lead to the same results.

come into widespread use and acceptance. Recognizing the fact that equipment for these new technologies could have the antenna inside the building and even inside the device housing and be omnipresent in nearly any setting including at work, in the home and in public transportation creates new situations for exposure of equipment to RF energy.

With the new digital technologies, the traditional modulation methods of AM and FM has given way to digital modulations with a variety of different amplitude and bandwidth characteristics. While overall time-averaged transmit power levels might have generally decreased over time due to improved network density and migration of services, the maximum possible (peak pulse) power levels in other bands have increased significantly. Moreover, the incorporation of multiple transmitting antennas (to support for example WiFi and Bluetooth links), evolving form factors, higher bit rates to facilitate data transfer and Internet access and the use of wireless headsets have resulted in a more complex and diverse pattern of use and exposure. Increased portability of transmitting devices has also drastically reduced the separation distance between sources of radiated RF energy and equipment likely to be disturbed by that energy.

It should be expected that the wireless technology revolution will continue to evolve with new applications using increasingly higher microwave frequencies.

Immunity testing according to existing standards, such as IEC 61000-4-3, 61000-4-20, 61000-4-21 and 61000-4-22, may not be suitable to assess compatibility with the complex electric and magnetic fields generated by RF emitters located in close proximity (for example, within a few centimetres) of the surface of electronic equipment. The power levels required for the higher disturbance intensities associated with such very small separation distances may make application of some of the existing test standards quite challenging or cost prohibitive.

New technologies use also magnetic fields. The fields are inhomogeneous and vary appreciably in both magnitude and direction over a region of space. Typically they can be generated by motors, power transformers, switching power supplies, higher-powered electronic article surveillance (EAS) gates or transmitters of radio-frequency identification (RFID) systems, inductive charging systems and near field communication (NFC) devices. The fields from such sources decrease rapidly as the distance from the source increases.

Because these new technologies use a very large range of the frequency spectrum it is necessary to use different test methods which consider the physical behavior of magnetic coupling in the lower frequency range and the more electrical based characteristic in the higher frequency range. Additionally, the widely diverging physical and electrical characteristics of equipment types that may be affected by portable transmitters in close proximity, as well as the applications for which such equipment is used, indicate a need for multiple test methods.

At present this document covers magnetic field disturbance sources in the frequency range 9 kHz to 26 MHz.In the frequency range 26 MHz to 380 MHz no testing is yet defined. In the frequency range 380 MHz to 6 GHz testing using a TEM horn antenna is defined. It has been argued that especially in the frequency range above 380 MHz the specified test methods do not take into consideration the possible variations in field impedance from real life close proximity transmitters, which may represent sources having field impedances far below the far field impedance of 377 Ω (predominantly magnetic field sources) and far above 377 Ω (predominantly electrical field sources). In the frequency range above 380 MHz the signal wavelength is such that the reactive nearfield from the source begins at only a few centimeters from the source (around approximately 0,1 λ). At this distance the field impedance approximates more and more to the far field impedance of 377 Ω. The TEM horn antenna represents a field source which is not far from 377 Ω.

Activities are ongoing to identify antenna types that can be characterised by field impedance and radiation pattern over a specified illumination window size, which for the ease of testing should be as large as possible and should preferably cover a large frequency range. Antenna types that are not covered by manufacturer's intellectual property rights, and which can be unambiguously characterised by for instance near field scanning or numerical model characterisation, are preferred for the present basic standard.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-39: Testing and measurement techniques – Radiated fields in close proximity – Immunity test

1 Scope

This part of IEC 61000 specifies immunity requirements for electrical and electronic equipment when it is exposed to radiated electromagnetic energy from RF transmitters used in close proximity. It establishes test levels and the required test procedures. The applicable frequency range is 9 kHz to 6 GHz. Fixed-installation equipment being exposed to portable transmitting devices, mobile equipment exposed to fixed transmitting devices and mobile equipment exposed to other mobile transmitting devices are considered.

The object of this document is to establish a common reference for evaluating the immunity requirements of electrical and electronic equipment that is exposed to radiated, RF electromagnetic fields from sources at close distances. It is understood that this part of IEC 61000 does not replace general immunity requirements of electrical and electronic equipment to radiated electromagnetic energy as given in IEC 61000-4-3 and other parts of IEC 61000 and that it is only applicable if an equipment or system is exposed to disturbance sources in close proximity.

In the context of this document, “close proximity” generally refers to a separation distance between the source and victim equipment of less than or equal to 200 mm for frequencies greater than 26 MHz and 500 mm for frequencies lower than 26 MHz.

The test methods documented in this part of IEC 61000 describe consistent methods to assess the immunity of an equipment or system against a defined phenomenon in the respective frequency range. Product committees would consider the applicability of the test and then if necessary select the applicable test method depending on the EUT, frequency range, disturbance source, etc.

NOTE 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.

This document deals with immunity tests related to RF magnetic and electromagnetic fields from any source used in close proximity to other electrical or electronic equipment or systems.

This document is an independent test method. Other test methods should not be used as substitutes for claiming compliance with this document.

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 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at www.electropedia.org)

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

NOTE Where the terms “voltage” and “current” are used in this document, they mean the r.m.s. values of an alternating or direct voltage or current unless stated otherwise.

3.1.1
electromagnetic compatibility
EMC
ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990, 161-01-07]

3.1.2
electromagnetic disturbance
any electromagnetic phenomenon which can degrade the performance of a device, equipment or system or adversely affect living or inert matter.

Note 1 to entry: An electromagnetic disturbance can be electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

[SOURCE: IEC 60050-161:1990, 161-01-05]

3.1.3
(electromagnetic) emission
phenomenon by which electromagnetic energy emanates from a source

[SOURCE: IEC 60050-161:1990, 161-01-08]

3.1.4
electromagnetic environment
totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, the electromagnetic environment is time dependent and its description may need a statistical approach.

[SOURCE: IEC 60050-161:1990, 161-01-01]

3.1.5
far field
that region of the electromagnetic field of an antenna wherein the predominant components of the field are those which represent a propagation of energy and wherein the angular field distribution is essentially independent of the distance from the antenna

Note 1 to entry: In the far field region, all the components of the electromagnetic field decrease in inverse proportion to the distance from the antenna.

Note 2 to entry: For a broadside antenna having a maximum overall dimension D which is large compared to the wavelength λ, the far field region is commonly taken to exist at distances greater than $2D^2/\lambda$, from the antenna in the direction of maximum radiation.

[SOURCE: IEC 60050-712:1992, 712-02-02, modified – the word "region" has been removed from the term.]

3.1.6
field strength
electric or magnetic component of the field

Note 1 to entry: Field strength may be expressed as V/m or A/m.

Note 2 to entry: 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.

3.1.7
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-01-20]

3.1.8
immunity test level
the level of a test signal used to simulate an electromagnetic disturbance when performing an immunity test

[SOURCE: IEC 60050-161:1990, 161-04-41]

3.1.9
reactive near field (region)
near field
that region of space immediately surrounding an antenna, where the predominant components of the electromagnetic field are those which represent an exchange of reactive energy between the antenna and the surrounding medium

[SOURCE: IEC 60050-712:1992, 712-02-01, modified – in the term, "induction field (region)" has been replaced by "near field".]

3.1.10
polarisation
orientation of the electric field vector of a radiated field

3.1.11
radio frequency
RF
frequency in the portion of the electromagnetic spectrum that is between the audio-frequency portion and the infrared portion and that is useful for radio transmission

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CDMA	Code division multiple access
DECT	Digital Enhanced Cordless Telecommunication
EAS	Electronic article surveillance
EUT	Equipment under test
FRS	Family radio service

GMRS	General mobile radio service
GSM	Global system for mobile communication
iDEN	integrated digital enhanced network
LTE	Long term evolution
NFC	Near field communication
RFID	Radio-frequency identification
TEM	transverse electromagnetic
TETRA	Trans-European trunked radio
UMTS	Universal Mobile Telecom System
VSWR	Voltage standing wave ratio
WiMAX	Worldwide interoperability for microwave access
WLAN	Wireless local area network

4 General

Immunity of EUTs to disturbances from RF transmitters can be tested using several different methods, including those described in IEC 61000-4-3, IEC 61000-4-20, IEC 61000-4-21, IEC 61000-4-22 and this part of IEC 61000, as shown in Figure 1. This part of IEC 61000 describes test methods unique to the situation in which the transmitter is used in close proximity to the EUT and the case of inhomogeneous magnetic fields (see Figure 2). In this context, "close proximity" generally refers to separation distances between the transmitter and the equipment of 200 mm or less for RF fields (frequencies greater than 26 MHz) and 500 mm for magnetic fields (frequencies lower than 26 MHz). Fixed-installation equipment being exposed to portable transmitting devices, mobile equipment exposed to fixed transmitting devices and mobile equipment exposed to other mobile transmitting devices are considered.

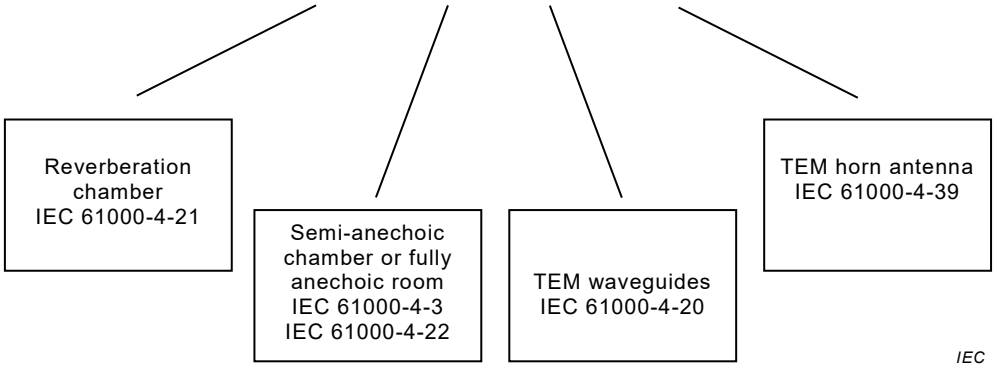

Figure 1 – Overview showing the test methods that could be used for evaluating equipment immunity to disturbances from RF transmitters