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REDLINE VERSION

INTERNATIONAL STANDARD

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BASIC EMC PUBLICATION

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

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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

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61000-4-6:2013. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

It forms Part 4-6 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This fifth edition cancels and replaces the fourth edition published in 2013. This edition constitutes a technical revision.

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

a) selection of injection devices revised;
b) need of AE impedance check for clamp injection removed and Annex H deleted;
c) saturation check revised;
d) new Annex H on testing with multiple signals;
e) level-setting only with feedback loop.

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

Draft	Report on voting
77B/863/FDIS	77B/865/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

IMPORTANT – The "colour inside" logo on the cover page of this document 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).

This part is an international standard which gives immunity requirements and test procedures 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

This part of IEC 61000 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 150 kHz up to 80 MHz.

NOTE 1 Product committees might decide to use the methods described in this document also for frequencies up to 230 MHz (see Annex B) although the methods and test instrumentation are intended to be used in the frequency range up to 80 MHz.

Equipment not having at least one conducting wire ~~and/~~or cable (such as mains supply, signal line or earth connection) which can couple the equipment to the disturbing RF fields is excluded from the scope of this document.

NOTE 2 Test methods are ~~defined~~ specified in this part of IEC 61000 to assess 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~~ specified are structured for the primary objective of establishing adequate repeatability of results at various facilities for quantitative analysis of effects.

The object of this document is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by RF fields. The test method in this document describes a consistent method to assess the immunity of an equipment or system against a ~~defined~~ specified phenomenon.

NOTE 3 As described in IEC Guide 107, this document 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.

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 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at <http://www.electropedia.org>)~~

CISPR 16-1-2, *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*

3 Terms and definitions

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

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
artificial hand
AH
electrical network simulating the impedance of the human body under average operational conditions between a hand-held electrical appliance and earth

Note 1 to entry: The construction should be in accordance with CISPR 16-1-2.

[SOURCE: IEC 60050-161:1990, 161-04-27, modified – the note has been added.]

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~~

Note 1 to entry: Auxiliary equipment can be useful for monitoring the EUT.

3.3
clamp injection
~~clamp injection is obtained by means of a clamp-on "current" injecting device on the cable~~

method of injecting signals onto cables using a clamp injection device

3.4
clamp injection device
clamp-on ~~"current" injecting device on a cable being~~ signal injecting device that is either a current clamp or an electromagnetic clamp

3.4.1
current clamp
transformer, the secondary winding of which consists of the cable into which the injection is made

3.4.2
electromagnetic clamp
EM clamp
injection device with combined capacitive and inductive coupling

3.5
common-mode impedance
ratio of the common-mode voltage and the common-mode current at a certain port

Note 1 to entry: 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~~ vectoral sum of all currents flowing through these terminal(s) or screen (see also Figure 15a) and Figure 15b)).

3.6
coupling factor
ratio ~~given~~ determined 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

3.7
coupling network
coupling device
electrical circuit or device for transferring energy from one circuit to another with a ~~defined~~ specified impedance

Note 1 to entry: Coupling and decoupling devices can be integrated into one box (coupling and decoupling network (CDN)) or they can be in separate networks.

3.8
coupling/decoupling network
CDN
electrical circuit incorporating the functions of both the coupling and decoupling networks

3.9
decoupling network
decoupling device
electrical circuit or device for preventing test signals applied to the EUT from affecting other devices, equipment or systems that are not under test

3.10
test generator
generator (RF generator, modulation source, attenuators, broadband power amplifier and filters) capable of generating the required test signal

SEE: Figure 4.

3.11
electromotive force
e.m.f.
voltage at the terminals of the ideal voltage source in the representation of an active element

3.12
measurement result
U_{mr}
voltage reading of the measurement equipment

3.13
voltage standing wave ratio
VSWR
ratio of a maximum to an adjacent minimum voltage magnitude along the line

4 General

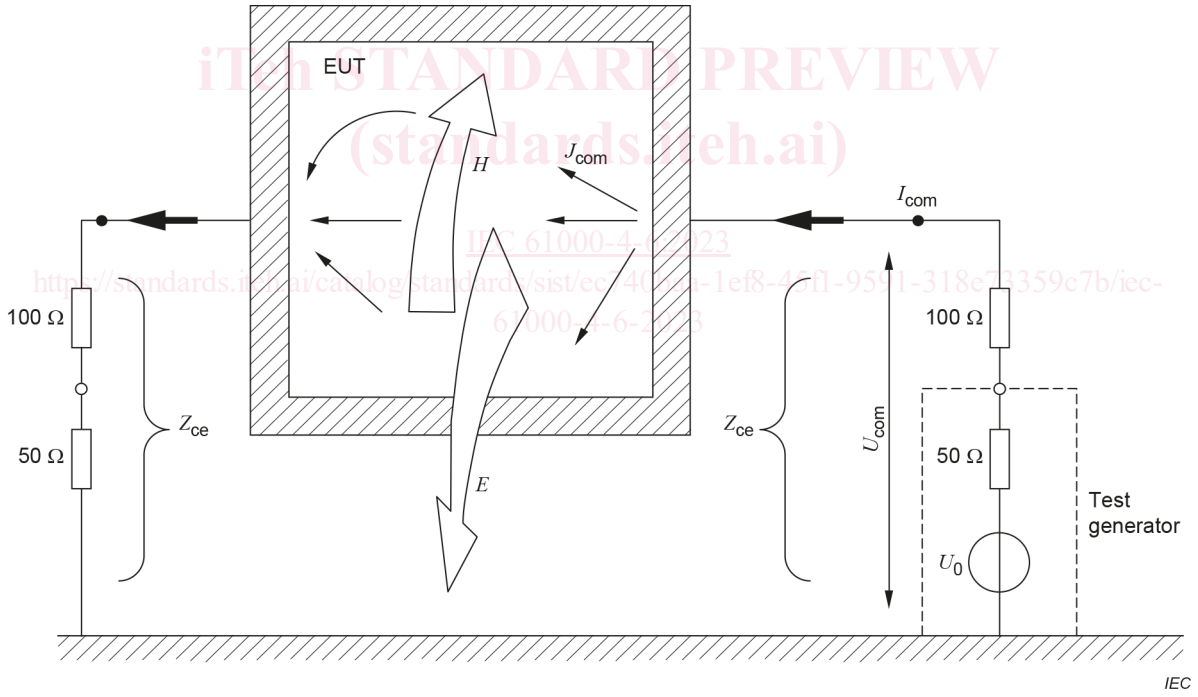
The source of disturbance covered by this document is basically an electromagnetic field, coming from intended RF transmitters, that ~~may~~ can act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths of the interfering signals. The leads entering and exiting the EUT (e.g. mains, communication lines, interface cables) behave as passive receiving antenna networks and signal conduction paths for both intentional and unintentional signals.

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 (λ/4, λ/2 open or folded dipoles) and as such are represented by coupling and decoupling devices having a common-mode impedance of 150 Ω with respect to a reference ground plane. ~~Where possible the EUT is tested by connecting it~~ For the method described herein, the EUT is connected between two 150 Ω 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 setup as shown in Figure 1.

The use of coupling and decoupling devices to apply the disturbing signal to one cable at a time, while keeping all other cables nonexcited (see Figure 2), 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~~ specified in 6.2. Any coupling and decoupling device fulfilling these characteristics can be used. The CDNs in ~~Annex D~~ Annex C are only examples of commercially available networks.



Z_{ce} Common-mode impedance of the CDN, Z_{ce} = 150 Ω

U_0 Test generator source voltage (e.m.f.)

U_{com} Common-mode voltage between EUT and reference plane

I_{com} Common-mode current through the EUT

J_{com} Current density on conducting surface or current on other conductors of the EUT

E, H Electric and magnetic fields

NOTE The 100 Ω resistors are included in the CDNs. The left input is loaded by a (passive) 50 Ω load and the right input is loaded by the source impedance of the test generator.

Figure ~~a)~~ 1 – Diagram showing EM fields near the EUT due to common-mode currents on its cables