

# INTERNATIONAL STANDARD



BASIC EMC PUBLICATION

**Electromagnetic compatibility (EMC) –  
Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic  
field immunity test**

Document Preview

[IEC 61000-4-10:2016](#)

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### ELECTROMAGNETIC COMPATIBILITY (EMC) –

#### Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test

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International Standard IEC 61000-4-10 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms Part 4-10 of the IEC 61000 series. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This second edition cancels and replaces the first edition published in 1993 and Amendment 1:2000. This edition constitutes a technical revision.

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

- a) new Annex A on induction coil field distribution;
- b) new Annex D on measurement uncertainty;
- c) new Annex E for numerical simulations;
- d) calibration using current measurement has been addressed in this edition.

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

CDV	Report on voting
77B/730/CDV	77B/746A/RVC

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 website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- 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 (insofar 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

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### 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).

~~These standards and reports will be published in chronological order and numbered accordingly.~~

This part is an international standard which gives immunity requirements and test procedures related to "damped oscillatory magnetic field".

## ELECTROMAGNETIC COMPATIBILITY (EMC) –

### Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test

#### 1 Scope and object

This part of IEC 61000 ~~relates to~~ specifies the immunity requirements ~~of equipment, only under operational conditions~~, test methods, and range of recommended test levels for equipment subjected to damped oscillatory magnetic disturbances related to medium voltage and high voltage sub-stations.

~~The applicability of this standard to equipment installed in different locations is determined by the presence of the phenomenon, as specified in clause 3.~~

The test defined in this standard is applied to equipment which is intended to be installed in locations where the phenomenon as specified in Clause 4 will be encountered.

This standard does not ~~consider~~ specify disturbances due to capacitive or inductive coupling in cables or other parts of the field installation. IEC 61000-4-18, which deals with conducted disturbances, covers these aspects.

The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment for medium voltage and high voltage sub-stations when subjected to damped oscillatory magnetic fields.

The test is mainly applicable to electronic equipment to be installed in H.V. sub-stations. Power plants, switchgear installations, smart grid systems may also be applicable to this standard and may be considered by product committees.

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 is 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 test levels for their products.

This standard ~~has the object to~~ defines:

- ~~recommended~~ a range of test levels;
- test equipment;
- test setups;
- test procedures.

#### 2 Normative references

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

~~IEC 60068-1:1988, Environmental testing – Part 1: General and guidance~~

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at [www.electropedia.org](http://www.electropedia.org))

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms and definitions

~~The following definitions and terms are used in this standard and apply to the restricted field of magnetic disturbances; not all of them are included in IEC 60050(161) [IEV].~~

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

##### 3.1.1 calibration

set of operations which establishes, by reference to standards, the relationship which exists, under specified conditions, between an indication and a result of a measurement

Note 1 to entry: This term is based on the "uncertainty" approach.

Note 2 to entry: The relationship between the indications and the results of measurement can be expressed, in principle, by a calibration diagram.

[SOURCE: IEC 60050-311:2001, 311-01-09]

##### 3.1.2 damped oscillatory wave generator

generator delivering a damped oscillation whose frequency can be set to 100 kHz or 1 MHz and whose damping time constant is five periods

##### 3.1.3 immunity

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]

##### 3.1.4 induction coil

conductor loop of defined shape and dimensions, in which a current flows, generating a magnetic field of defined ~~constancy in its plane and in the enclosed~~ uniformity in a defined volume

##### 3.1.5 induction coil factor

ratio between the magnetic field strength generated by an induction coil of given dimensions and the corresponding current value

Note 1 to entry: The field is that measured at the centre of the coil plane, without the EUT.

#### 4.4 immersion method

~~method of application of the magnetic field to the EUT, which is placed in the centre of an induction coil (figure 1)~~

##### 3.1.6 proximity method

method of application of the magnetic field to the EUT, where a small induction coil is moved along the side of the EUT in order to detect particularly sensitive areas

**4.6**

~~**ground (reference) plane (GRP)**~~

~~a flat conductive surface whose potential is used as a common reference for the magnetic field generator and the auxiliary equipment (the ground plane can be used to close the loop of the induction coil, as in figure 5)  
[IEV 161-04-36, modified]~~

**4.7**

~~**decoupling network, back filter**~~

~~electrical circuit intended to avoid reciprocal influence with other equipment not submitted to the magnetic field test~~

**4.8**

~~**burst**~~

~~a sequence of a limited number of distinct pulses or an oscillation of limited duration  
[IEV 161-02-07]~~

**3.1.7**

**reference ground**

part of the Earth considered as conductive, the electrical potential of which is conventionally taken as zero, being outside the zone of influence of any earthing (grounding) arrangement

[SOURCE: IEC 60050-195:1998, 195-01-01]

**3.1.8**

**system**

set of interdependent elements constituted to achieve a given objective by performing a specified function

Note 1 to entry: The system is considered to be separated from the environment and other external systems by an imaginary surface which cuts the links between them and the considered system. Through these links, the system is affected by the environment, is acted upon by the external systems, or acts itself on the environment or the external systems.

**3.1.9**

**transient**, adjective and noun

pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval short compared to the time scale of interest

[SOURCE: IEC 60050-161:1990, 161-02-01]

**3.1.10**

**verification**

set of operations which is used to check the test equipment system (e.g. the test generator and its interconnecting cables) to demonstrate that the test system is functioning

Note 1 to entry: The methods used for verification may be different from those used for calibration.

Note 2 to entry: For the purposes of this basic EMC standard this definition is different from the definition given in IEC 60050-311:2001, 311-01-13.

**3.2 Abbreviations**

AE	Auxiliary equipment
EMC	Electromagnetic compatibility
EUT	Equipment under test
MU	Measurement uncertainty
PE	Protective earth
RGP	Reference ground plane

## 4 General

Damped oscillatory magnetic fields are generated by the switching of H.V. bus-bars by isolators or disconnectors. The magnetic fields to which equipment is subjected ~~may~~ can influence the reliable operation of equipment and systems.

The following tests are intended to demonstrate the immunity of equipment when subjected to damped oscillatory magnetic field related to the specific location and installation condition of the equipment (e.g. proximity of equipment to the disturbance source).

~~The test is mainly applicable to electronic equipment to be installed in H.V. sub-stations. Possible other applications may be considered by the product committees.~~

The wave shape of the test field ~~consists of~~ corresponds to a damped oscillatory wave (see Figure 2). The characteristics are given in 6.2.2.

Information on the oscillation frequency is given in Annex C.

## 5 Test levels

The preferred range of test levels is given in Table 1.

**Table 1 – Test levels**

Level	Damped oscillatory magnetic field strength A/m (peak)
1	not applicable
2	not applicable
3	10
4	30
5	100
X <sup>a</sup>	special

NOTE The magnetic field strength is expressed in A/m; 1 A/m corresponds to a free space magnetic flux density of 1,26  $\mu$ T.

a ~~"n.a." = not applicable.~~  
~~"x" is an open~~ can be any level, above, below or in between the others.  
 This level, as well the duration of the test, ~~can be given in the product specification~~ shall be specified in the dedicated equipment specification.

~~Information on the selection of the test levels is given in Annex C.~~

~~Information on actual levels is given in annex D.~~

~~The duration of the test is 2 s.~~

The test levels shall be selected according to the installation conditions. Classes of installation are given in Annex B.

## 6 Test equipment

~~The test magnetic field is obtained by a current flowing in an induction coil; the application of the test field to the EUT is by the immersion method.~~

~~An example of application of the immersion method is given in figure 1.~~

~~The test equipment includes the current source (test generator), the induction coil and auxiliary test instrumentation.~~

#### ~~6.1 Test generator~~

~~The generator, with the output waveform corresponding to the test magnetic field, shall be able to deliver the required current in the induction coils specified in 6.2.~~

~~The generator power capability shall therefore be dimensioned by taking into account the coil impedance; the inductance may range from 2,5  $\mu$ H for the 1 m standard coil, to several  $\mu$ H (e.g. 6  $\mu$ H) for a rectangular induction coil (1 m  $\times$  2,6 m, see 6.2).~~

~~The specifications of the generator are:~~

- ~~— current capability, determined by the maximum selected test level and induction coil factor (see 6.2.2 and annex A), ranging from 0,87 (1 m standard coil for testing table-top or small equipment to 0,66 (rectangular induction coil, 1 m  $\times$  2,6 m, for testing floor-standing or large equipment);~~
- ~~— operability in short-circuit condition;~~
- ~~— low output terminal connected to the earth terminal (for connection to the safety earth of the laboratory);~~
- ~~— precautions to prevent the emission of large disturbances that may be injected in the power supply network or may influence the test results.~~

~~The characteristics and performances of the current source or test generator for the field considered in this standard are given in 6.1.1.~~

##### ~~6.1.1 Characteristics and performances of the test generator~~

~~The test generator is a repetitive damped sinusoid current generator with characteristics as follows:~~

###### ~~Specifications~~

~~Oscillation frequency: 0,1 MHz and 1 MHz  $\pm$  10 %~~

~~Decay rate: 50 % of the peak value after 3 to 6 cycles~~

~~Repetition rate: at least 40 transients/s at 0,1 MHz, 400 transients/s at 1 MHz~~

~~Test duration: 2 s (+10 %, 0 %) or continuous~~

~~Output current range: from 10 A to 100 A, divided by the coil factor~~

~~NOTE The output current range for the standard coil is from 12 A to 120 A.~~

~~The waveform of the output current is given in figure 2.~~

~~The schematic circuit of the generator is given in figure 3.~~

##### ~~6.1.2 Verification of the characteristics of the test generator~~

~~In order to compare the results for different test generators, the essential characteristics of the output current parameters shall be verified.~~

~~The output current shall be verified with the generator connected to the standard induction coil specified in 6.2.1 a); the connection shall be realized by twisted conductors or coaxial cable of up to 3 m length and suitable cross-section.~~

~~The emission of disturbances by the generator shall be verified (see 6.1).~~