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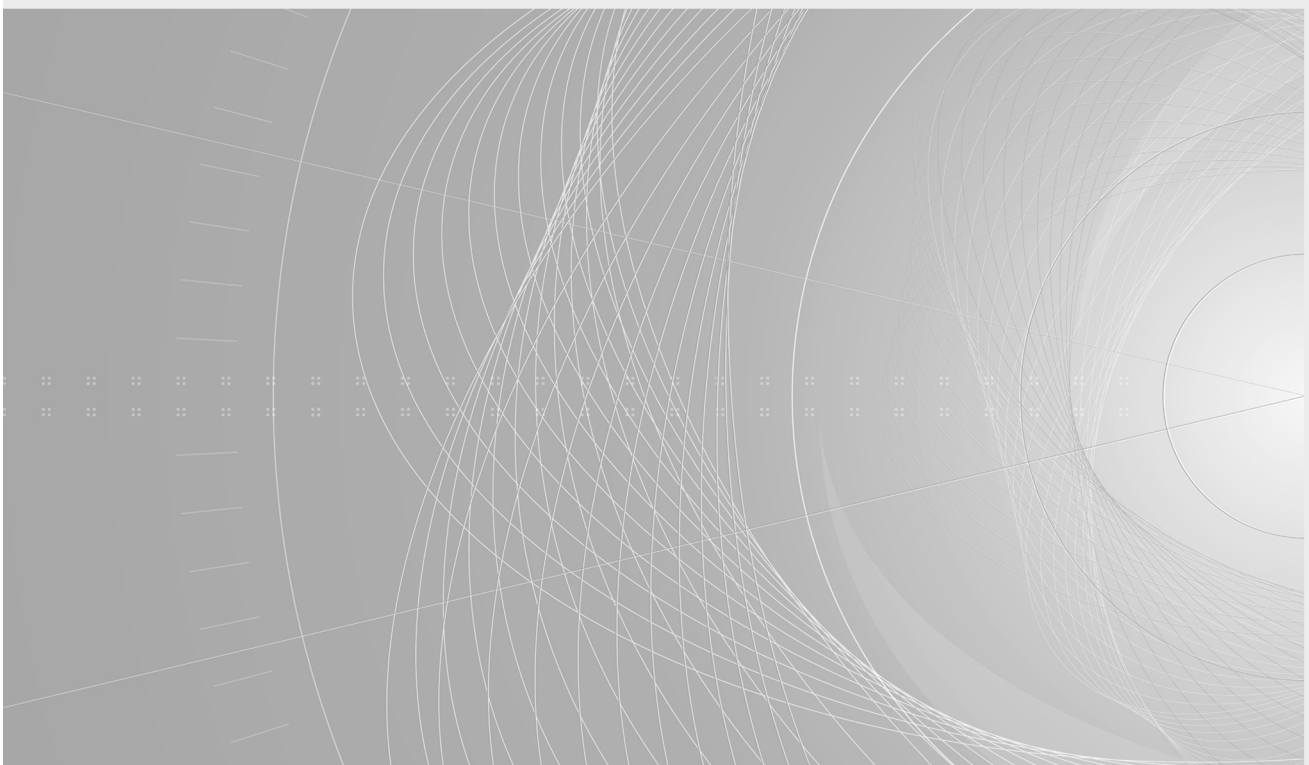
BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –
Part 4-9: Testing and measurement techniques – **Pulse** Impulse magnetic field
immunity test (<https://standards.iteh.ai>)

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INTERNATIONAL STANDARD



BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –
Part 4-9: Testing and measurement techniques – **Pulse** impulse magnetic field
immunity test

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 4-9: Testing and measurement techniques –
Impulse magnetic field immunity test**

FOREWORD

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International Standard IEC 61000-4-9 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms Part 4-9 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 B on induction coil field distribution;
- b) new Annex D on measurement uncertainty;
- c) new Annex E on mathematical modeling of surge waveform;
- d) new Annex F on characteristics using two standard induction coils;
- e) new Annex G on 3D numerical simulations;
- f) coil factor calculation and calibration using current measurement have been addressed in this edition.

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

CDV	Report on voting
77B/728/CDV	77B/745A/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

- 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 (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 "pulse magnetic field".

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-9: Testing and measurement techniques – **Pulse** **Impulse** magnetic field immunity test

1 Scope and object

This part of IEC 61000 ~~relates to~~ specifies the immunity requirements, test methods, and range of recommended test levels for equipment, ~~only under operational conditions~~, subjected to ~~pulse~~ impulse magnetic disturbances mainly ~~related to~~ encountered in:

- industrial installations,
- power plants,
- railway installations,
- 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 4.

This standard does not consider disturbances due to capacitive or inductive coupling in cables or other parts of the field installation. Other IEC standards dealing with conducted disturbances cover these aspects.

The object of this standard is to establish a common ~~and reproducible basis~~ reference for evaluating the ~~performance immunity~~ of electrical and electronic equipment ~~for household, commercial and industrial applications~~ when subjected to ~~pulse~~ impulse magnetic 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 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 defines:

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

The task of the described laboratory test is to find the reaction of the equipment under test (EUT) under specified operational conditions to impulse magnetic fields caused by switching and lightning effects.

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 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

~~IEC 60060-2:1973, *High-voltage test techniques — Part 2: Test procedures*~~

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

~~IEC 60469-1:1987, *Pulse techniques and apparatus — Part 1: Pulse terms and definitions*~~

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 combination wave generator CWG

generator with 1,2/50 μs open-circuit voltage waveform and 8/20 μs short-circuit current waveform

Note 1 to entry: This definition is abbreviated from the equivalent definition in IEC 61000-4-5.

Note 2 to entry: This note applies to the French language only.

3.1.3 duration

T_d
<surge current for 8/20 μs > virtual parameter defined as the time interval between the instant at which the surge current rises to 0,5 of its peak value, and then falls to 0,5 of its peak value (T_w), multiplied by 1,18

$$T_d = 1,18 \times T_w$$

SEE: Figure 2.

3.1.4 front time

T_f
<surge current> virtual parameter defined as 1,25 times the interval T_r between the instants when the impulse is 10 % and 90 % of the peak value

SEE: Figure 2.

3.1.5 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]

3.1.6 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 volume~~ uniformity in a defined volume

3.1.7 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.

3.1.8 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

3.1.9 reference ground plane ~~(GRP)~~

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]

3.1.10 rise time

T_r
interval of time between the instants at which the instantaneous value of an impulse first reaches 10 % value and then 90 % value

SEE: Figure 2.

3.1.11 surge

transient wave of electrical current, voltage or power propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease

3.1.12 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.

3.1.13 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]

**3.1.14
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.

**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)~~

**4.7
decoupling network, back filter**

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

3.2 Abbreviated terms

AE	Auxiliary equipment
CDN	Coupling/decoupling network
CWG	Combination wave generator
EFT/B	Electrical fast transient/burst
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge
EUT	Equipment under test
MU	Measurement uncertainty
RGP	Reference ground plane

4 General

The magnetic fields to which equipment is subjected may influence the reliable operation of equipment and systems.

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

Pulse magnetic fields are generated by lightning ~~strokes~~ strikes on buildings and other metal structures including aerial masts, earth conductors and earth networks and by initial faults transients in low, medium and high voltage electrical systems.

In high voltage sub-stations, ~~a pulse~~ an impulse magnetic field may also be generated by the switching of high voltage bus-bars and lines by circuit breakers.

The test is mainly applicable to electronic equipment to be installed in electrical generation and distribution plants as well as in ~~telecontrol~~ their control centres. It is not relevant for distribution network equipment (e.g. transformers, power lines).

Product committees may consider other ~~possible~~ applications.