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BASIC EMC PUBLICATION

PUBLICATION FONDAMENTALE EN CEM

**Electromagnetic compatibility (EMC) –
Part 4-5: Testing and measurement techniques – Surge immunity test**

**Compatibilité électromagnétique (CEM) –
Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de
choc**

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ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 4-5: Testing and measurement techniques –
Surge immunity test**

FOREWORD

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International Standard IEC 61000-4-5 has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical Committee 77: Electromagnetic compatibility.

It forms Part 4-5 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107.

This third edition cancels and replaces the second edition published in 2005, and constitutes a technical revision.

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

- a) new Annex E on mathematical modelling of surge waveforms;
- b) new Annex F on measurement uncertainty;
- c) new Annex G on method of calibration of impulse measuring systems;

- d) new Annex H on coupling/decoupling surges to lines rated above 200 A;
- e) moreover while surge test for ports connected to outside telecommunication lines was addressed in 6.2 of the second edition (IEC 61000-4-5:2005), in this third edition (IEC 61000-4-5:2014) the normative Annex A is fully dedicated to this topic. In particular it gives the specifications of the 10/700 μ s combined wave generator.

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

FDIS	Report on voting
77B/711/FDIS	77B/715/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

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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

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Mitigation methods and devices

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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 surge voltages and surge currents.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 4-5: Testing and measurement techniques – Surge immunity test

1 Scope and object

This part of IEC 61000 relates to the immunity requirements, test methods, and range of recommended test levels for equipment with regard to unidirectional surges caused by over-voltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment.

The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to surges. 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:

- 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 surge voltages caused by switching and lightning effects.

It is not intended to test the capability of the EUT's insulation to withstand high-voltage stress. Direct injections of lightning currents, i.e. direct lightning strikes, are not considered in this standard.

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)

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1

avalanche device

diode, gas tube arrestor, or other component that is designed to break down and conduct at a specified voltage

3.1.2

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]

3.1.3

clamping device

diode, varistor or other component that is designed to prevent an applied voltage from exceeding a specified value

3.1.4

combination wave generator CWG

generator with 1,2/50 μs or 10/700 μs open-circuit voltage waveform and respectively 8/20 μs or 5/320 μs short-circuit current waveform

3.1.5

coupling network CN

electrical circuit for the purpose of transferring energy from one circuit to another

3.1.6

coupling/decoupling network CDN

combination of a coupling network and a decoupling network

3.1.7

decoupling network DN

electrical circuit for the purpose of preventing surges applied to the EUT from affecting other devices, equipment or systems which are not under test

3.1.8

duration

3.1.8.1

duration

T_d

<surge voltage> time interval between the instant at which the surge voltage rises to 0,5 of its peak value, and then falls to 0,5 of its peak value (T_w)

$$T_d = T_w$$

SEE: Figures 2 and A.2

3.1.8.2 duration

T_d

<surge current for 8/20 μ s> 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 3.

3.1.8.3 duration

T_d

<surge current for 5/320 μ s> 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)

$$T_d = T_w$$

SEE: Figure A.3.

3.1.9 effective output impedance

<surge generator> ratio of the peak open-circuit voltage to the peak short-circuit current at the same output port

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3.1.10 electrical installation

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assembly of associated electrical equipment having co-ordinated characteristics to fulfil purposes

[SOURCE: IEC 60050-826:2004, 826-10-01]

3.1.11 front time

3.1.11.1 front time

T_f

<surge voltage> virtual parameter defined as 1,67 times the interval T between the instants when the impulse is 30 % and 90 % of the peak value

SEE: Figures 2 and A.2.

3.1.11.2 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: Figures 3 and A.3.

3.1.12 high-speed communication lines

input/output lines which operate at transmission frequencies above 100 kHz

3.1.13**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]

3.1.14**interconnection lines**

I/O lines (input/output lines) and/or communication lines and/or low voltage d.c. input/output lines (≤ 60 V), where secondary circuits (isolated from the a.c. mains supply) are not subject to transient over-voltages (i.e. reliably-grounded, capacitively-filtered d.c. secondary circuits where the peak-to-peak ripple is less than 10 % of the d.c. component)

3.1.15**power port**

port, at which the conductor or cable carrying the primary electrical power needed for the operation (functioning) of an apparatus or associated apparatus is connected to the apparatus

3.1.16**primary protection**

means by which the majority of stressful energy is prevented from propagating beyond a designated interface

3.1.17**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

IEC 61000-4-5:2014

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

3.1.18**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: Figures 3 and A.3.

[SOURCE: IEC 60050-161:1990, 161-02-05, modified – the content of the note has been included in the definition and “pulse” has been changed to “impulse”.]

3.1.19**secondary protection**

means by which the let-through energy from primary protection is suppressed

Note 1 to entry: It may be a special device or an inherent characteristic of the EUT.

3.1.20**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

[SOURCE: IEC 60050-161:1990, 161-08-11, modified – “surge” here applies to voltage, current and power]

3.1.21

symmetrical lines

pair of symmetrically driven conductors with a conversion loss from differential to common mode of greater than 20 dB

3.1.22

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.

3.1.23

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]

3.1.24

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
CD	Coupling device
CDN	Coupling/decoupling network
CLD	Clamping device
CN	Coupling network
CWG	Combination wave generator
DN	Decoupling network
EFT/B	Electrical fast transient/burst
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge
EUT	Equipment under test
GDT	Gas discharge tube
MU	Measurement uncertainty
PE	Protective earth
SPD	Surge protective device

4 General

4.1 Power system switching transients

Power system switching transients can be separated into transients associated with: