INTERNATIONAL STANDARD

IEC 61000-4-5

Edition 1.1
2001-04

Edition 1:1995 consolidated with amendment 1:2000

BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –

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

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61000-4-5 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement and control.

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

This consolidated version of IEC 61000-4-5 is based on the first edition (1995), [documents 65A(CO)41+77B(CO)25 and 65A/168/RVD] and its amendment 1 (2000) [documents 77B/291+293/FDIS and 77B/298+300/RVD].

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by the corrigendum and amendment 1.

Annex A forms an integral part of this standard.

Annexes B and C are for information only.

The committee has decided that the contents of the base publication and its amendment 1 will remain unchanged until 2003. At this date, the publication will be

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

INTRODUCTION

This standard is part of the IEC 61000 series, 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 9: Miscellaneous

Each part is further subdivided into sections which are to be published either as international standards or as technical reports.

This section 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 section of IEC 61000-4 relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by overvoltages 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 section is to establish a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and interconnection lines.

This standard defines:

– range of test levels;
– test equipment;
– test set-up;
– test procedure.

The task of the described laboratory test is to find the reaction of the EUT under specified operational conditions caused by surge voltages from switching and lightning effects at certain threat levels.

It is not intended to test the capability of the insulation to withstand high-voltage stress. Direct lightning is not considered in this standard.

This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the tests and the severity level to be applied to their equipment.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 61000-4. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 61000-4 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

3 General

3.1 Switching transients

System switching transients can be separated into transients associated with:

a) major power system switching disturbances, such as capacitor bank switching;

b) minor switching activity near the instrumentation or load changes in the power distribution system;

c) resonating circuits associated with switching devices, such as thyristors;

d) various system faults, such as short circuits and arcing faults to the earthing system of the installation.

3.2 Lightning transients

The major mechanisms by which lightning produces surge voltages are the following:

a) a direct lightning stroke to an external circuit (outdoor) injecting high currents producing voltages by either flowing through earth resistance or flowing through the impedance of the external circuit;

b) an indirect lightning stroke (i.e. a stroke between or within clouds or to nearby objects which produces electromagnetic fields) that induces voltages/currents on the conductors outside and/or inside a building;

c) lightning earth current flow resulting from nearby direct-to-earth discharges coupling into the common earth paths of the earthing system of the installation.

The rapid change of voltage and flow of current which may occur when a protector is excited may couple into internal circuits.

3.3 Simulation of the transients

a) The characteristics of the test generator are such that it simulates the above-mentioned phenomena as closely as possible;

b) if the source of interference is in the same circuit, e.g. in the power supply network (direct coupling), the generator may simulate a low impedance source at the ports of the equipment under test;

c) if the source of interference is not in the same circuit (indirect coupling) as the ports of the victim-equipment, then the generator may simulate a higher impedance source.

4 Definitions

For the purposes of this section of IEC 61000-4, the following definitions together with those in IEC 60050(161) apply, unless otherwise stated.

4.1
balanced lines
a pair of symmetrically driven conductors with a conversion loss from differential to common mode of less than 20 dB

4.2
coupling network
electrical circuit for the purpose of transferring energy from one circuit to another

4.3
decoupling network
electrical circuit for the purpose of preventing surges applied to the EUT from affecting other devices, equipment or systems which are not under test

4.4
duration
the absolute value of the interval during which a specified waveform or feature exists or continues. [IEC 60469-1]

4.5
EUT
equipment under test

4.6 front time

surge voltage
the front time T_1 of a surge voltage is a 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 figure 2)

current surge
the front time T_1 of a surge current is a virtual parameter defined as 1,25 times the interval T, between the instants when the impulse is 10 % and 90 % of the peak value (see figure 3). [IEC 60060-1 modified]

4.7
immunity
the ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance. [IEV 161-01-20]

4.8
electrical installation
an assembly of associated electrical equipment to fulfil a specific purpose or purposes and having coordinated characteristics. [IEV 826-01-01]

4.9
interconnection lines consist of:

– I/O lines (input/output lines);
– communication lines;
– balanced lines.

4.10
primary protection
the means by which the majority of stressful energy is prevented from propagating beyond the designated interface

4.11
rise time
the interval of time between the instants at which the instantaneous value of a pulse first reaches a specified lower value and then a specified upper value

NOTE Unless otherwise specified, the lower and upper values are fixed at 10 % and 90 % of the pulse magnitude. [IEV 161-02-05]

4.12
secondary protection
the means by which the let-through energy from primary protection is suppressed. It may be a special device or an inherent characteristic of the EUT

4.13
surge
a 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. [IEV 161-08-11 modified]

4.14
system
set of interdependent elements constituted to achieve a given objective by performing a specified function

NOTE 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. [IEV 351-01-01]

4.15
time to half-value T_2
the time to half-value T_2 of a surge is a virtual parameter defined as the time interval between the virtual origin O_1 and the instant when the voltage current has decreased to half the peak value. [IEC 60060-1 modified]

4.16
transient
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. [IEV 161-02-01]