

Electromagnetic compatibility (EMC) —

Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test

The European Standard EN 61000-4-2:1995, with the incorporation of amendments A1:1998 and A2:2001 has the status of a British Standard

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- Association of Consulting Scientists
- Association of Manufacturers of Domestic Electrical Appliances
- British Telecommunications plc
- ERA Technology Ltd.
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Federation of the Electronics Industry
- Lighting Industry Federation Ltd.
- Power Supply Manufacturers' Association — PSMA (BEAMA Ltd.)
- Radiocommunications Agency
- Sound and Communications Industries' Federation

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National foreword

This British Standard has been prepared by Subcommittee GEL/110/10 and is the English language version of EN 61000-4-2:1995 *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*, including amendments A1:1998 and A2:2001, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 61000-4-2:1995 including amendments 1:1998 and 2:2000 published by the International Electrotechnical Commission (IEC).

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 2 is indicated by **A2** **A2**.

IEC 61000 has been designated a Basic EMC Publication for use in the preparation of dedicated product, product family and generic EMC standards.

IEC 61000 will be published in separate Parts in accordance with 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 will be subdivided into Sections each of which may be published as either a standard or a Technical Report.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index” or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 33 and a back cover.

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Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test

(includes amendments A1:1998 and A2:2001)
(IEC 61000-4-2:1995 + A1:1998 + A2:2000)

Compatibilité électromagnétique (CEM) —
Partie 4-2: Techniques d'essai et de mesure —
Essais d'immunité aux décharges
électrostatiques
(inclut les amendements A1:1998 et A2:2001)
(CEI 61000-4-2:1995 + A1:1998 + A2:2000)

Elektromagnetische Verträglichkeit (EMV) —
Teil 4-2: Prüf- und Meßverfahren —
Prüfung der Störfestigkeit gegen die Entladung
statischer Elektrizität
(enthält Änderungen A1:1998 und A2:2001)
(IEC 61000-4-2:1995 + A1:1998 + A2:2000)

This European Standard was approved by CENELEC on 1995-03-06; amendment A1 was approved by CENELEC on 1998-04-01 and amendment A2 was approved by CENELEC on 2000-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 77B(CO)21, future edition 1 of IEC 1000-4-2, prepared by SC 77B, High-frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61000-4-2 on 1995-03-06.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-03-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-03-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Annex ZA is normative and Annex A and Annex B are informative. Annex ZA has been added by CENELEC.

Foreword to amendment A1

The text of document 77B/216/FDIS, future amendment 1 to IEC 61000-4-2:1995, prepared by SC 77B, High-frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61000-4-2:1995 on 1998-04-01.

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Foreword to amendment A2

The text of documents 77B/291 + 292/FDIS, future amendment 2 to IEC 61000-4-2:1995, prepared by SC 77B, High-frequency phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 61000-4-2:1995 on 2000-12-01.

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Introduction

IEC 1000-4 is a part of the IEC 1000 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.

These sections of IEC 1000-4 will be published in chronological order and numbered accordingly.

This section is an international standard which gives immunity requirements and test procedures related to “electrostatic discharge”.

1 Scope

This International Standard relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures.

The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment.

This standard defines:

- typical waveform of the discharge current;
- range of test levels;
- test equipment;
- test set-up;
- test procedure.

This standard gives specifications for tests performed in “laboratories” and “post-installation tests” performed on equipment in the final installation.

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.

In order not to impede the task of coordination and standardization, the product committees or users and manufacturers are strongly recommended to consider (in their future work or revision of old standards) the adoption of the relevant immunity tests specified in this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 1000-4. 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 1000-4 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 50(161):1990, *International Electrotechnical Vocabulary (IEV) — Chapter 161: Electromagnetic compatibility.*

IEC 68-1:1988, *Environmental testing — Part 1: General and guidance.*

3 General

This standard relates to equipment, systems, sub-systems and peripherals which may be involved in static electricity discharges owing to environmental and installation conditions, such as low relative humidity, use of low-conductivity (artificial fibre) carpets, vinyl garments, etc., which may exist in allocations classified in standards relevant to electrical and electronic equipment (for more detailed information, see clause A.1 of Annex A).

The tests described in this standard are considered to be a first step in the direction of commonly used tests for the qualitative evaluation of the performance of all electrical and electronic equipment as referred to in clause 1.

NOTE From the technical point of view the precise term for the phenomenon would be “static electricity discharge”. However, the term “electrostatic discharge” (ESD) is widely used in the technical world and in technical literature. Therefore, it has been decided to retain the term ESD in the title of this standard.

4 Definitions

For the purpose of this section of IEC 1000-4, the following definitions and terms apply and are applicable to the restricted field of electrostatic discharge; not all of them are included in IEC 50(161) [IEV].

4.1

degradation (of performance)

an undesired departure in the operational performance of any device, equipment or system from its intended performance
[IEV 161-01-19]

NOTE The term “degradation” can apply to temporary or permanent failure.

4.2

electromagnetic compatibility (EMC)

the ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment
[IEV 161-01-07]

4.3

antistatic material

material exhibiting properties which minimize charge generation when rubbed against or separated from the same or other similar materials

4.4

energy storage capacitor

the capacitor of the ESD-generator representing the capacity of a human body charged to the test voltage value. This may be provided as a discrete component, or a distributed capacitance

4.5

ESD

electrostatic discharge (see 4.10)

4.6

EUT

equipment under test

4.7

ground reference plane (GRP)

a flat conductive surface whose potential is used as a common reference
[IEV 161-04-36]

4.8

coupling plane

a metal sheet or plate, to which discharges are applied to simulate electrostatic discharge to objects adjacent to the EUT. HCP: Horizontal Coupling Plane; VCP: Vertical Coupling Plane

4.9**holding time**

interval of time within which the decrease of the test voltage due to leakage, prior to the discharge, is not greater than 10 %

4.10**electrostatic discharge; ESD**

a transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact

[IEV 161-01-22]

4.11**immunity (to a disturbance)**

the ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[IEV 161-01-20]

4.12**contact discharge method**

a method of testing, in which the electrode of the test generator is held in contact with the EUT, and the discharge actuated by the discharge switch within the generator

4.13**air discharge method**

a method of testing, in which the charged electrode of the test generator is brought close to the EUT, and the discharge actuated by a spark to the EUT

4.14**direct application**

application of the discharge directly to the EUT

4.15**indirect application**

application of the discharge to a coupling plane in the vicinity of the EUT, and simulation of personnel discharge to objects which are adjacent to the EUT

5 Test levels

The preferential range of test levels for the ESD test is given in Table 1.

Testing shall also be satisfied at the lower levels given in Table 1.

Details concerning the various parameters which may influence the voltage level to which the human body may be charged are given in clause A.2 of Annex A. Clause A.4 also contains examples of the application of the test levels related to environmental (installation) classes.

Contact discharge is the preferred test method. Air discharges shall be used where contact discharge cannot be applied. Voltages for each test method are given in Tables 1a and 1b. The voltages shown are different for each method due to the differing methods of test. It is not intended to imply that the test severity is equivalent between test methods.

Further information is given in clauses A.3, A.4 and A.5 of Annex A.

Table 1 — Test levels

1a – Contact discharge		1b – Air discharge	
Level	Test voltage kV	Level	Test voltage kV
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
x ^a	Special	x ^a	Special

^a “x” is an open level. The level has to be specified in the dedicated equipment specification. If higher voltages than those shown are specified, special test equipment may be needed.

6 Test generator

The test generator consists, in its main parts, of:

- charging resistor R_c ;
- energy-storage capacitor C_s ;
- distributed capacitance C_d ;
- discharge resistor R_d ;
- voltage indicator;
- discharge switch;
- interchangeable tips of the discharge electrode (see Figure 4);
- discharge return cable;
- power supply unit.

A simplified diagram of the ESD generator is given in Figure 1. Constructional details are not given.

The generator shall meet the requirements given in 6.1 and 6.2.

6.1 Characteristics and performance of the ESD generator

Specifications

- energy storage capacitance ($C_s + C_d$): 150 pF $\pm$ 10 %;
- discharge resistance (R_d): 330 Ω $\pm$ 10 %;
- charging resistance (R_c): between 50 M Ω and 100 M Ω ;
- output voltage (see note 1): up to 8 kV (nominal) for contact discharge;
up to 15 kV (nominal) for air discharge;
- tolerance of the output voltage indication: $\pm$ 5 %;
- polarity of the output voltage: positive and negative (switchable);
- holding time: at least 5 s;
- discharge, mode of operation (see note 2): single discharge (time between successive discharges
at least 1 s);
- waveshape of the discharge current: see 6.2.

NOTE 1 Open circuit voltage measured at the energy storage capacitor.

NOTE 2 The generator should be able to generate at a repetition rate of at least 20 discharges per second for exploratory purposes only.

The generator shall be provided with means of preventing unintended radiated or conducted emissions, either of pulse or continuous type, so as not to disturb the EUT or auxiliary test equipment by parasitic effects.

The energy storage capacitor, the discharge resistor, and the discharge switch shall be placed as close as possible to the discharge electrode.

The dimensions of the discharge tips are given in Figure 4.