

Electromagnetic compatibility (EMC) —

Part 4-12: Testing and measurement techniques — Oscillatory waves immunity test

The European Standard EN 61000-4-12:1995 with the incorporation of amendment A1:2001 has the status of a British Standard

ICS 29.020

Committees responsible for this British Standard

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- Association of Consulting Scientists
- Association of Manufacturers of Domestic Electrical Appliances
- British Telecommunications plc
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Federation of the Electronics Industry
- GAMBICA (BEAMA Ltd.)
- Lighting Industry Federation Ltd.
- Power Supply Manufacturers' Association [PSMA (BEAMA Ltd.)]
- Professional Lighting and Sound Association
- Radiocommunications Agency

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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 61000-4-12:1995 *Electromagnetic compatibility (EMC) — Part 4-12: Testing and measurement techniques — Oscillatory waves immunity test*, including amendment A1:2001, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 61000-4-12:1995 including amendment 1:2000 published by the International Electrotechnical Commission (IEC).

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

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 1 is indicated by **A1** **A1**.

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

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Partie 4-12: Techniques d'essai et de mesure —
Essais d'immunité aux ondes oscillatoires
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Teil 4-12: Prüf- und Meßverfahren —
Prüfung der Störfestigkeit gegen gedämpfte
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European Committee for Electrotechnical Standardization
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Foreword

The text of document 77B/141/DIS, future edition 1 of IEC 1000-4-12, 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 61000-4-12 on 1995-07-04.

The following dates were fixed:

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- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-04-01

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, Annex B, Annex C and Annex D are informative. Annex ZA has been added by CENELEC.

Foreword to amendment A1

The text of documents 77B/291+293/FDIS, future amendment 1 to IEC 61000-4-12:1995, 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 61000-4-12:1995 on 2000-12-01.

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Introduction

This standard is 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 standards and reports will be published in chronological order and numbered accordingly.

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

1 Scope

This section of IEC 1000-4 relates to the immunity requirements and test methods for electrical and electronic equipment, under operational conditions, to oscillatory waves represented by:

- a) non-repetitive damped oscillatory transients (ring wave) occurring in low-voltage power, control and signal lines supplied by public and non-public networks;
- b) repetitive damped oscillatory waves occurring mainly in power, control and signal cables installed in high voltage and medium voltage (HV/MV) stations.

NOTE According to the frequencies considered in this standard, it is only relevant for an insulated switchgear.

The object of this basic standard is to establish the immunity requirements and a common reference for evaluating in a laboratory the performance of electrical and electronic equipment intended for residential, commercial and industrial application, as well as of equipment intended for electrical stations, as applicable.

The purpose of this standard is to define:

- test voltage and current waveforms;
- ranges of test levels;
- test equipment;
- test set-up;
- test procedure.

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 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*.

IEC 1010-1:1990, *Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements*

3 General

The oscillatory waves to which equipment is subjected may influence the reliable operation of equipment and systems.

The main parameters of the oscillatory waves are considered here, mainly the repetition rates: low repetition rate (single shot), or high repetition rate (bursts). The single-shot oscillatory transients are known by the term “ring wave” and the bursts of damped oscillatory transients by the term “damped oscillatory wave”.

The ring wave appears at the terminals of equipment (equipment ports) as a consequence of switching in power and control lines, as well as a consequence of lightning. The single-event type and the decaying oscillatory waveform are the most significant parameters of this test.

The damped oscillatory wave appears at the terminals of equipment as a consequence of switching with restriking of the arc, typical of electrical plants, HV/MV stations, as well as of heavy industrial installations.

The relative fast rise time, the decaying oscillatory waveform, the high repetition rate and the duration of the burst are the most significant parameters of this test.

The test waveforms are defined in **6.1.1** and **6.1.2**. Information on the primary phenomena and selection of the test is given in Annex A.

It is the responsibility of the product committees to establish which phenomenon, among the ones considered in this standard, is relevant and to decide the applicability of the test.

4 Definitions

For the purpose of this section, the following definitions and terms apply. They are applicable to the restricted field of oscillatory transients; not all of them are included in IEC 50(161).

4.1

EUT

equipment under test

4.2

port

particular interface of the EUT with the external electromagnetic environment

4.3

coupling

interaction between circuits, transferring energy from one circuit to another

4.4

coupling network

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

4.5**decoupling network**

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

4.6**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]

4.7**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 with the time-scale of interest [IEV 161-02-01]

4.8**rise time**

the interval of time between the instants at which the instantaneous value of a pulse first reaches 10 % value and then the 90 % value [IEV 161-02-05, modified]

4.9**burst**

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

5 Test levels

The preferential range of test levels for the ring wave and the damped oscillatory wave tests, applicable to power, signal and control ports of the equipment, is given in Table 1 and Table 2 respectively.

Different levels may apply to power, signal and control ports. The level(s) used for signal and control ports shall not differ by more than one level from that used for power supply ports.

Table 1 — Test levels for ring wave

Level	Common mode kV	Differential mode kV
1	0,5	0,25
2	1	0,5
3	2	1
4	4	2
x ^a	x	x

^a x is an open level. This level can be given in the product specification.

Table 2 — Test levels for damped oscillatory wave

Level	Common mode kV	Differential mode kV
1	0,5	0,25
2	1	0,5
3	2 ^b	1
4	—	—
x ^a	x	x

^a x is an open level. This level can be given in the product specification.
^b The value is increased to 2,5 kV for substation equipment.

The applicability of the two tests, respectively the ring wave and the damped oscillatory wave, shall refer to the product specification.

Specifications related to each test are given in 8.2.

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

6 Test equipment

6.1 Test generators

The following features are common to the generators of ring waves and the generators of damped oscillatory waves; additional, unique features are given in 6.1.1 and 6.1.2.

The generators shall have the capability to operate in short-circuit conditions.

The generator output shall be floating and the stray capacity unbalance of the output terminals to earth shall be less than 10 %. This condition is recommended to test EUT control and signal ports in differential mode; it is not necessary for power ports and common mode tests of control and signal ports.

The provisions to be taken whenever the output of the test generator is not floating are given in item b) of 8.2.

The generators shall have provisions to prevent the emission of heavy disturbances that may be injected in the power supply network, or may influence the test results.

Information on the impedance of the test generators is given in Annex C.

6.1.1 Characteristics and performance of the ring wave generator

The generator is a single-shot damped oscillatory wave generator with the following characteristics.

Specifications:

— voltage rise time (first peak):	0,5 4s $\pm$ 20 % (open-circuit condition);
— current rise time (first peak):	k 1 4s (short-circuit condition);
— oscillation frequency:	100 kHz $\pm$ 10 %;
— decaying (of each peak):	60 % of the preceding peak;
— transients' repetition:	1 to 60 transients per minute;
— output impedance:	12 7, 30 7 and 200 7, $\pm$ 20 % (switchable);
— open-circuit voltage (peak value):	250 V (–10 %) to 4 kV (+10 %);
— short-circuit current (minimum peak value):	333 A for 12 7 generator setting; 133 A for 30 7 generator setting; 20 A for 200 7 generator setting;
— phase relationship with the power frequency:	synchronizable from 0° to 360° with 10° steps;
— polarity of the first half period:	positive and negative.

The waveform of the ring wave (open-circuit voltage and short-circuit current) is given in Figure 1. An example of a schematic circuit of the generator is given in Figure 2.

The impedance of the test generator to be used for the different tests is given in 8.2.

6.1.2 Characteristics and performance of the damped oscillatory wave generator

The generator is a repetitive damped oscillatory wave generator with the following characteristics.

Specifications:

— voltage rise time (first peak):	75 ns $\pm$ 20 %;
— oscillation frequencies;	100 kHz and 1 MHz $\pm$ 10 %;
— repetition rate:	at least 40/s for 100 kHz and 400/s for 1 MHz;
— optional repetition rate:	$4 \cdot 10^{-4} \times$ oscillation frequency;
— decaying:	50 % of the peak value between the third and sixth periods;
— burst duration:	not less than 2 s;
— output impedance:	200 7 $\pm$ 20 %;
— peak open-circuit voltage:	250 V (–10 %) to 2,5 kV (+10 %);
— phase relationship with the power frequency:	no relation;
— polarity of the first half-period:	positive and negative.