

Electromagnetic compatibility (EMC) —

Part 4-12: Testing and measurement techniques — Ring wave immunity test

The European Standard EN 61000-4-12:2006 has the status of a
British Standard

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National foreword

This British Standard is the UK implementation of EN 61000-4-12:2006. It is identical with IEC 61000-4-12:2006. It partially supersedes BS EN 61000-4-12:1996.

BS EN 61000-4-12:2006 constitutes a technical revision of the characteristics and performance of the test equipment but addresses only the ring wave immunity test. The content of BS EN 61000-4-12:1996 regarding damped oscillatory waves is replaced by BS EN 61000-4-18:2007. The date of withdrawal of BS EN 61000-4-12:1996 is 1 March 2010 which is the date of withdrawal published in BS EN 61000-4-18. For undated references to BS EN 61000-4-12, the ring wave test in BS EN 61000-4-12:2006 needs to be used after 1 November 2009. BS EN 61000-4-12:1996 may continue to be referenced for the damped oscillatory wave until 1 March 2010.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC — Policy committee, to Subcommittee GEL/210/12, EMC — Basic and generic standards.

A list of organizations represented on GEL/210/12 can be obtained on request to its secretary.

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Amendments issued since publication

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**Electromagnetic compatibility (EMC)
Part 4-12: Testing and measurement techniques -
Ring wave immunity test
(IEC 61000-4-12:2006)**

Compatibilité électromagnétique (CEM)
Partie 4-12: Techniques d'essai
et de mesure -
Essai d'immunité à l'onde
sinusoïdale amortie
(CEI 61000-4-12:2006)

Elektromagnetische Verträglichkeit (EMV)
Teil 4-12: Prüf- und Messverfahren -
Störfestigkeit gegen gedämpfte
Sinusschwingungen (Ringwave)
(IEC 61000-4-12:2006)

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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.

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CENELEC

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

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Foreword

The text of document 77B/509/FDIS, future edition 2 of IEC 61000-4-12, 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 2006-11-01.

This European Standard supersedes EN 61000-4-12:1995 + A1:2001.

It constitutes a technical revision of the characteristics and performance of the test equipment. It only addresses the ring wave immunity test.

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) 2007-08-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2009-11-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61000-4-12:2006 was approved by CENELEC as a European Standard without any modification.

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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 (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 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: 61000-6-1).

This part is an International Standard which gives immunity requirements and test procedures related to ring waves.

ELECTROMAGNETIC COMPATIBILITY (EMC) –**Part 4-12: Testing and measurement techniques –
Ring wave immunity test****1 Scope and object**

This part of IEC 61000 relates to the immunity requirements and test methods for electrical and electronic equipment, under operational conditions, to non-repetitive damped oscillatory transients (ring waves) occurring in low-voltage power, control and signal lines supplied by public and non-public networks.

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 applications, as well as of equipment intended for power stations and substations, as applicable.

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 should be 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 tests for their products.

The purpose of this standard is to define:

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

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050(161): *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

3 Terms and definitions

For the purpose of this document, the following terms and definitions, together with those in IEC 60050-161 apply.

NOTE Several of the most relevant terms and definitions from IEC 60050-161 are presented among the definitions below.

3.1**burst**

sequence of a limited number of distinct pulses or an oscillation of limited duration

[IEV 161-02-07]

3.2

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 This term is based on the "uncertainty" approach.

NOTE 2 The relationship between the indications and the results of measurement can be expressed, in principle, by a calibration diagram.

[IEV 311-01-09]

3.3

coupling

interaction between circuits, transferring energy from one circuit to another

3.4

coupling network

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

3.5

decoupling network

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

3.6

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]

3.7

port

particular interface of the EUT with the external electromagnetic environment

3.8

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]

3.9

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]

3.10

verification

set of operations which is used to check the test equipment system (e.g. the test generator and the interconnecting cables) and to demonstrate that the test system is functioning within the specifications given in Clause 6

NOTE 1 The methods used for verification may be different from those used for calibration.

NOTE 2 The procedure of 6.1.2 and 6.2.2 is meant as a guide to insure the correct operation of the test generator and other items making up the test set-up, so that the intended waveform is delivered to the EUT.

NOTE 3 For the purpose of this basic EMC standard this definition is different from the definition given in IEC 311-01-13.

4 General

4.1 Description of the phenomenon

The ring wave (described in Figure 1) is a typical oscillatory transient, induced in low-voltage cables due to the switching of electrical networks and reactive loads, faults and insulation breakdown of power supply circuits or lightning. It is, in fact, the most diffused phenomenon occurring in power supply (HV, MV, LV) networks, as well as in control and signal lines.

The ring wave is representative of a wide range of electromagnetic environments of residential, as well as industrial installations. It is suitable for checking the immunity of equipment in respect of the above-mentioned phenomena, which give rise to pulses characterized by sharp front-waves that, in the absence of filtering actions, are in the order of 10 ns to a fraction of μs . The duration of these pulses may range from 10 μs to 100 μs .

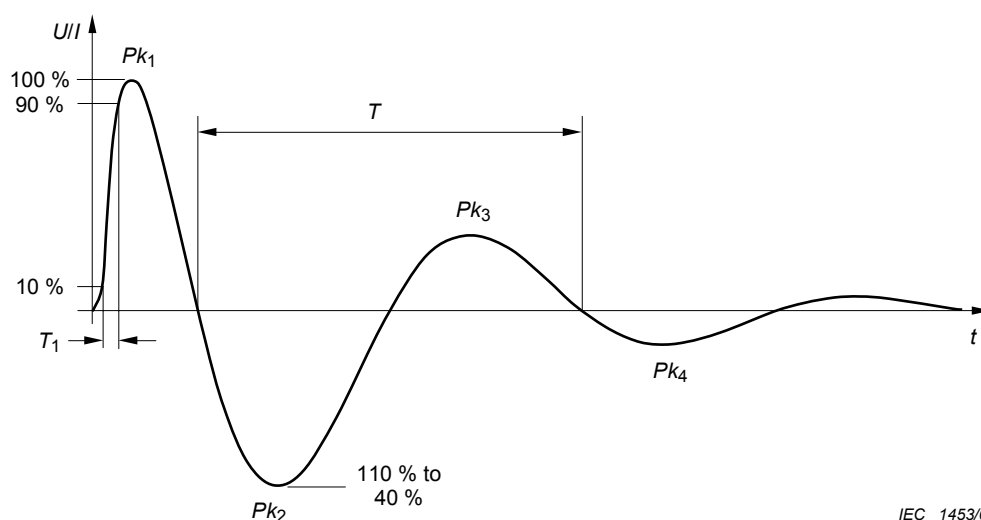
The rise time and duration of the parameters are subject to modification, depending on the propagation media and path.

The propagation of the wave in the lines (power and signal) is always subject to reflections, due to the mismatching impedance (the lines are terminated on their own loads or connected to protection devices, input line filters, etc.). These reflections produce oscillations, whose frequency is related to the propagation speed. The presence of parasitic parameters (stray capacitance of components like motors, transformer windings, etc.) are other conditioning factors.

The rise time is reduced to slowing down due to the low-pass characteristic of the line involved in the propagation. This modification is more relevant for the fast rise times (in the order of 10 ns), and less relevant for values in the range of a fraction of μs .

The resultant phenomenon at the equipment ports is an oscillatory transient, or ring wave. This ring wave with a defined 0,5 μs rise time and 100 kHz oscillation frequency has been determined to be typical and is widely used by some industries for testing products.

Another cause of the ring wave is lightning, which itself is characterized by a unidirectional waveform (standard 1,2/50 μs pulse). Circuits subjected to the indirect effects of lightning (inductive coupling among lines) are influenced by the derivative of the primary pulse and the coupling mechanisms involved, which gives rise to oscillations. The characteristics of the resulting ring wave depend on the reactive parameters of the ground circuits, metal structures involved in the lightning current flow, and the propagation in the low-voltage transmission lines.



Key

T_1 Rise time
 T Oscillation period

NOTE Only Pk_1 is specified for the current waveform.

Figure 1 – Waveform of the ring wave (open circuit voltage and short circuit current)

Other IEC standards, such as IEC 61000-4-5, refer to the 1,2/50 μ s standard lightning pulse, which may be considered to be complementary to ring wave described in this document.

It is the responsibility of the product committees to define the most appropriate test, according to the phenomenon considered as relevant.

4.2 Relevant parameters

4.2.1 Repetition rate

The repetition rate of the transient is directly related to the frequency of occurrence of the primary phenomenon. It is higher whenever the primary cause is the load switching in control lines, and less frequent in the case of faults and lightning. The occurrence may range from 1/s to 1/month or 1/year.

The repetition rate may be increased in order to reduce the duration of the test. However, it should be selected according to the characteristics of the transient protectors involved.

4.2.2 Phase angle

Equipment failures related to ring wave on power supply sources can depend on the phase angle of the ac mains at which the transient is applied. When a protection element operates during a ring-wave test, power-follow might occur depending on the phase angle at which the transient occurs. Power-follow is the current from the connected power source that flows through a protective element, or from any arc in the EUT both during and following the transient.