BRITISH STANDARD

BS EN 61000-4-11:1994
Incorporating Amendment No. 1

Electromagnetic compatibility (EMC) —

Part 4-11: Testing and measurement techniques —

Voltage dips, short interruptions and voltage variations immunity tests

The European Standard EN 61000-4-11:1994 with the incorporation of amendment A1:2001 has the status of a British Standard

UDC 621.37.001.365

Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the national committees of the following countries:

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 November 1994

Amendments issued since publication

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Contents

National foreword

This British Standard has been prepared under the direction of the Electrotechnical Sector Board and is the English language version of EN 61000-4-11:1994 *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests,* including amendment A1:2001, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 61000-4-11 Edition 1.1:2001, which comprises edition 1:1994 consolidated by the incorporation of 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 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.

Cross-references

The British Standards which implement international 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 21 and a back cover.

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Descriptors: Electromagnetic compatibility, measurements, electric power networks, low voltage, electric equipment, electronic equipment, tests, voltage, electric power supply, variation

English version

Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests

(includes amendment A1:2001)
(IEC 61000-4-11:1994+A1:2000)

Compatibilité électromagnétique (CEM) —
Partie 4-11: Techniques d'essai et de mesure —
Essais d'immunité relatifs aux creux de tension, coupures brèves et variations de tension
(inclut l'amendement A1:2001)
(CEI 61000-4-11:1994+A1:2000)

Elektromagnetische Verträglichkeit (EMV) —
Teil 4-11: Prüf- und Meßverfahren —
Prüfung der Störfestigkeit gegen Spannungseinbrüche, Kurzzeitunterbrechungen und Spannungsschwankungen
(enthält Änderung A1:2001)
(IEC 61000-4-11:1994+A1:2000)

This European Standard was approved by CENELEC on 1993-12-08. Amendment A1:2001 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.

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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

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Foreword

The text of document 77B(CO)17, as prepared by Subcommittee 77B: High-frequency phenomena, of IEC Technical Committee 77: Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote in May 1993.

The reference document was approved by CENELEC as EN 61000-4-11 on 8 December 1993.

The following dates were fixed:

– latest date of publication of an identical national standard (dop) 1995-06-01
– latest date of withdrawal of conflicting national standards (dow) 1995-06-01

For products which have complied with the relevant national standard before 1995-06-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-06-01.

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, Annex A and Annex ZA are normative and Annex B and Annex C are informative.

Foreword to amendment A1

The text of documents 77B/291+293/FDIS, future amendment 1 to IEC 61000-4-11:1994, 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 61000-4-11:1994 on 2000-12-01.

The following dates were fixed:

– latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-09-01
– latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2003-12-01

Contents

INTRODUCTION

This section of part 4 belongs to the IEC 61000 series, *Electromagnetic compatibility (EMC),* 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 part is an international standard which gives immunity requirements and test procedures related to voltage dips, short interruptions and voltage variations.

ELECTROMAGNETIC COMPATIBILITY (EMC) ñ

Part 4-11: Testing and measurement techniques ñ Voltage dips, short interruptions and voltage variations immunity tests

1 Scope

This section of IEC 61000-4 defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations.

The standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase.

It does not apply to electrical and electronic equipment for connection to d.c. networks or 400 Hz a.c. networks. Tests for these networks will be covered by future IEC standards.

The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions, and voltage variations.

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.

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

IEC 60068-1:1988, *Environmental testing ñ Part 1: General and guidance*

IEC 61000-2-1:1990, *Electromagnetic compatibility (EMC) ñ Part 2: Environment ñ Section 1: Description of the environment ñ Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems*

IEC 61000-2-2:1990, *Electromagnetic compatibility (EMC) ñ Part 2: Environment ñ Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-4-1:1992, *Electromagnetic compatibility (EMC) ñ Part 4: Testing and measurement techniques ñ Section 1: Overview of immunity tests ñ Basic EMC publication*

3 General

Electrical and electronic equipment may be affected by voltage dips, short interruptions or voltage variations of power supply.

Voltage dips and short interruptions are caused by faults in the network, in installations or by a sudden large change of load. In certain cases, two or more consecutive dips or interruptions may occur. Voltage variations are caused by the continuously varying loads connected to the network.

These phenomena are random in nature and can be characterized in terms of the deviation from the rated voltage and duration. Voltage dips and short interruptions are not always abrupt, because of the reaction time of rotating machines and protection elements connected to the power supply network. If large mains networks are disconnected (local within a plant or wide area within a region) the voltage will only decrease gradually due to the many rotating machines, which are connected to the mains networks. For a short period, the rotating machines will operate as generators sending power into the network. Some equipment is more sensitive to gradual variations in voltage than to abrupt change. Most data-processing equipment has built-in power-fail detectors in order to protect and save the data in the internal memory so that after the mains voltage has been restored, the equipment will start up in the correct way. Some power-fail detectors will not react sufficiently fast on a gradual decrease of the mains voltage. Therefore, the d.c. voltage to the integrated circuits will decrease to a level below the minimum operating voltage before the power-fail detector is activated and data will be lost or distorted. When the mains voltage is restored, the data-processing equipment will not be able to restart correctly before it has been re-programmed.

Consequently, different types of tests are specified in this standard to simulate the effects of abrupt change voltage, and, optionally, for the reasons explained above, a type test is specified also for gradual voltage change. This test is to be used only for particular and justified cases, under the responsibility of product specification or product committees.

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

4 Definitions

For the purpose of this section of IEC 61000-4, the following definitions apply:

4.1
basic EMC standard (ACEC)[1)]
standard giving general and fundamental conditions or rules for the achievement of EMC, which are related or applicable to all products and systems, and serve as reference documents for product committees

4.2
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]

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1) Advisory Committee on Electromagnetic Compatibility.

4.3
voltage dip
(definition used for the purpose of this standard). A sudden reduction of the voltage at a point in the electrical system, followed by voltage recovery after a short period of time, from half a cycle to a few seconds
[IEV 161-08-10, modified]

4.4
short interruption
the disappearance of the supply voltage for a period of time typically not exceeding 1 min. Short interruptions can be considered as voltage dips with 100 % amplitude (see also 8.1, IEC 61000-2-1)

4.5
voltage variation
a gradual change of the supply voltage to a higher or lower value than the rated voltage. The duration of the change can be short or long with regard to the period

4.6
malfunction
the termination of the ability of an equipment to carry out intended functions or the execution of unintended functions by the equipment

5 Test levels

The voltages in this standard use the rated voltage for the equipment (U_T) as a basis for voltage test level specification.

Where the equipment has a rated voltage range the following shall apply:

ñ if the voltage range does not exceed 20 % of the lower voltage specified for the rated voltage range, a single voltage from that range may be specified as a basis for test level specification (U_T);

ñ in all other cases, the test procedure shall be applied for both the lower and upper voltages declared in the voltage range;

ñ guidance for the selection of test levels and durations is given in annex B.

5.1 Voltage dips and short interruptions

The change between U_T and the changed voltage is abrupt. The step can start and stop at any phase angles on the mains voltage. The following test voltage levels (in % U_T) are used: 0 %, 40 % and 70 %, corresponding to dips and interruptions of 100 %, 60 % and 30 %.

The preferred test levels and durations are given in table 1, and an example is shown in figure 1. The levels and durations shall be given in the product specification. A test level of 0 % corresponds to a total supply voltage interruption. In practice, a test voltage level from 0 % to 20 % of the rated voltage may be considered as a total interruption.

Shorter durations in the table, in particular the half-cycle, should be tested to be sure that the equipment under test (EUT) works in its intended performance.

Table 1 ñ Preferred test levels and durations for voltage dips and short interruptions

Test level % U_T	Voltage dip and short interruptions % U_T	Duration (in period)
0	100	0,5* 1 5 10 25 50 x
40	60	
70	30	

* For 0,5 period, the test shall be made in positive and negative polarity, i.e. starting at 0 and 180 respectively.

NOTE 1 One or more of the above test levels and durations may be chosen.

NOTE 2 If the EUT is tested for voltage dips of 100 %, it is generally unnecessary to test for other levels for the same durations. However, for some cases (safeguard systems or electromechanical devices) it is not true. The product specification or product committee shall give an indication of the applicability of this note.

NOTE 3 "x" is an open duration. This duration can be given in the product specification. Utilities in Europe have measured dips and short interruptions of duration between a period and 3 000 periods, but duration less than 50 periods are most common.

NOTE 4 Any duration may apply to any test level.

5.2 Voltage variations (optional)

This test considers a defined transition between rated voltage U_T and the changed voltage.

NOTE The voltage change takes place over a short period, and may occur due to change of load or stored energy in local power networks.

The preferred duration of the voltage changes and the time for which the reduced voltages are to be maintained are given in table 2. The rate of change of voltage should be constant; however, the voltage may be stepped. The steps should be positioned at zero crossings, and shall be not larger than 10 % of U_T. Steps under 1 % of U_T are considered as constant rate of change of voltage.

Table 2 ñ Timing of short-term supply voltage variations

Voltage test level	Time for decreasing voltage	Time at reduced voltage	Time for increasing voltage
40 % U_T	2 s ± 20 %	1 s ± 20 %	2 s ± 20 %
0 % U_T	2 s ± 20 %	1 s ± 20 %	2 s ± 20 %
	x	x	x

NOTE x represents an open set of durations and can be given in the product specification.

Figure 2 shows the voltage as a function of time. Other values may be taken in justified cases and shall be specified in product specification.

6 Test instrumentation

6.1 Test generators

The following features are common to the generator for voltage dips, short interruptions and voltage variations, except as indicated.

Examples of generators are given in annex C.

The generator shall have provision to prevent the emission of heavy disturbances which, if injected in the power supply network, may influence the test results.

6.1.1 Characteristics and performance of the generator

Specifications

Output voltage:	as required in table 1, ±5 %
Change with load at the output of the generator:	
100 % output, 0 to 16 A:	less than 5 %
70 % output, 0 to 23 A:	less than 7 %
40 % output, 0 to 40 A:	less than 10 %
Output current capability:	16 A r.m.s. per phase at rated voltage. The generator shall be capable of carrying 23 A at 70 % of rated voltage and 40 A at 40 % of rated voltage for a duration up to 5 s. (This requirement may be reduced according to the EUT rated steady-state supply current (see A.2)).
Peak inrush current drive capability (not required for voltage variation tests):	Not to be limited by the generator. However, the maximum peak drive capability of the generator need not exceed 500 A for 220 V ñ 240 V mains, or 250 A for 100 V ñ 120 V mains.
Overshoot/undershoot of the actual voltage, generator loaded with 100 Ω resistive load:	less than 5 % of the change in voltage
Voltage rise (and fall) time during abrupt change, generator loaded with 100 Ω resistive load:	between 1 µs and 5 µs
Phase shifting: (if necessary)	0 to 360
Phase relationship of voltage dips and interruptions with the power frequency:	less than ±10

Output impedance shall be predominantly resistive.

The output impedance of the test voltage generator must be low even during the transition.

6.1.2 Verification of the characteristics of the voltage dips, short interruptions and voltage variation generators

In order to compare the test results obtained from different test generators, the generator characteristics shall be verified according to the following:

ñ the 100 %, 70 % and 40 % r.m.s. output voltages of the generator shall conform to those percentages of the selected operating voltage: 230 V, 120 V, etc.;

ñ the r.m.s. values of all three voltages shall be measured at no load, and shall be maintained within a specified percentage of their nominal values;

ñ load regulation shall be verified at each of the three outputs, and shall not exceed 5 % for 16 A loading at 100 %, and specified percentages for 23 A loading at 70 %, and for 40 A loading at 40 %;

ñ tests at 70 % and 40 % need not exceed 5 s in duration.

If it is necessary to verify the peak inrush drive current capability, the generator shall be switched from 0 % to 100 % of full output, when driving a load consisting of an uncharged capacitor whose value is 1 700 µF in series with a suitable rectifier. The test shall be carried out at phase angles of both 90 and 270 . The circuit required to measure generator inrush current drive capability is given in A.1.

When it is believed that a generator with less than the specified standard generator peak inrush current may be used because the EUT may draw less than the specified standard generator peak inrush current (e.g., 500 A for 220 V ñ 240 V mains), this shall first be confirmed by measuring the EUT peak inrush current. When power is applied from the test generator, measured EUT peak inrush current shall be less than 70 % of the peak current drive capability of the generator, as already verified according to annex A. The actual EUT inrush current shall be measured both from a cold start and after a 5 s turn-off, using the procedure of annex B.

Generator switching characteristics shall be measured with a 100 Ω load of suitable power-dissipation rating.

Rise and fall time, as well as overshoot and undershoot, shall be verified for switching at both 90 and 270 , from 0 % to 100 %, 100 % to 70 %, 100 % to 40 %, and 100 % to 0 %.

Phase angle accuracy shall be verified for switching from 0 % to 100 % and 100 % to 0 %, at nine phase angles from 0 to 360 in 45 increments. It shall also be verified for switching from 100 % to 70 % and 70 % to 100 %, as well as from 100 % to 40 % and 40 % to 100 %, at 90 and 180 .

The voltage generators shall be recalibrated at defined time periods in accordance with a recognized quality assurance system.

6.2 Current monitor's characteristics for measuring peak inrush current capability

Output voltage in 50 Ω load:	0,01 V/A or more
Peak current:	1 000 A minimum
Peak current accuracy (3 ms duration pulse):	±10 %
r.m.s. current:	50 A minimum
I × T maximum:	10 A · s or more
Rise/fall time:	500 ns or less
Low-frequency 3 dB point:	10 Hz or less
Insertion resistor:	0,001 Ω or less
Construction:	Toroidal
Hole diameter:	5 cm minimum

6.3 Power source

The frequency of the test voltage must be within ±2 % of rated frequency.

7 Test set-up

The test shall be performed with the EUT connected to the test generator with the shortest power supply cable as specified by the EUT manufacturer. If no cable length is specified, it shall be the shortest possible length suitable to the application of the EUT.

The test set-up for the two types of phenomena described in this standard are:

ñ voltage dips and short interruptions;

ñ voltage variations with gradual transition between the rated voltage and the changed voltage (option).

Figure C.1a shows a schematic for the generation of voltage dips, short interruptions and voltage variations with gradual transition between rated and changed voltage using a generator with internal switching, and figure C.1b using a generator and a power amplifier.

Figure C.2 shows a schematic only for the generation of voltage variations with gradual transition between rated and changed voltage using variable transformers.

Both tests may be implemented with these set-ups.

Tests on the three-phase EUT are accomplished by using three sets of equipment mutually synchronized.

Examples of test set-ups are given in annex C.

8 Test procedures

Before starting the test of a given equipment, a test plan shall be prepared.

It is recommended that the test plan shall comprise the following items:

ñ the type designation of the EUT;

ñ information on possible connections (plugs, terminals, etc.) and corresponding cables, and peripherals;

ñ input power port of equipment to be tested;

ñ representative operational modes of the EUT for the test;

ñ performance criteria used and defined in the technical specifications;

ñ operational mode(s) of equipment;

ñ description of the test set-up.

If the actual operating signal sources are not available to the EUT, they may be simulated.

For each test any degradation of performance shall be recorded. The monitoring equipment should be capable of displaying the status of the operational mode of the EUT during and after the tests. After each group of tests a full functional check shall be performed.

8.1 Laboratory reference conditions

8.1.1 Climatic conditions

Unless otherwise specified by the committee responsible for the generic or product standard, the climatic conditions in the laboratory shall be within any limits specified for the operation of the EUT and the test equipment by their respective manufacturers.

Tests shall not be performed if the relative humidity is so high as to cause condensation on the EUT or the test equipment.

NOTE Where it is considered that there is sufficient evidence to demonstrate that the effects of the phenomenon covered by this standard are influenced by climatic conditions, this should be brought to the attention of the committee responsible for this standard.

8.1.2 Electromagnetic conditions

The electromagnetic conditions of the laboratory shall be such as to guarantee the correct operation of the EUT in order not to influence the test results.

8.2 Execution of the test

During the tests the main voltage for testing is monitored within an accuracy of 2 %. The zero crossing control of the generators must have an accuracy of ±10 .

8.2.1 Voltage dips and short interruptions

The EUT shall be tested for each selected combination of test level and duration with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event). Each representative mode of operation shall be tested.

Abrupt changes in supply voltage shall occur at zero crossings of the voltage, and at additional angles considered critical by product committees or individual product specifications preferably selected from 45 , 90 , 135 , 180 , 225 , 270 and 315 on each phase.

For three-phase systems, phase-by-phase test is preferred. In certain cases e.g. three-phase meters and three-phase power-supply equipment, all the three phases must be simultaneously tested. In the case of simultaneous application of dips or interruptions on all the three phases, the zero crossing condition of the voltage, as given in 6.1, will be fulfilled only on one phase.

8.2.2 Voltage variations (optional)

The EUT is tested to each of the specified voltage variations, three times at 10 s interval for the most representative modes of operations.

9 Evaluation of test results

The test results shall be classified in terms of the loss of function or degradation of performance of the equipment under test, relative to a performance level defined by its manufacturer or the requestor of the test, or agreed between the manufacturer and the purchaser of the product. The recommended classification is as follows:

a) normal performance within limits specified by the manufacturer, requestor or purchaser;

b) temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention;

c) temporary loss of function or degradation of performance, the correction of which requires operator intervention;

d) loss of function or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

The manufactureris specification may define effects on the EUT which may be considered insignificant, and therefore acceptable.

This classification may be used as a guide in formulating performance criteria, by committees responsible for generic, product and product-family standards, or as a framework for the agreement on performance criteria between the manufacturer and the purchaser, for example where no suitable generic, product or product-family standard exists.

10 Test report

The test report shall contain all the information necessary to reproduce the test. In particular, the following shall be recorded:

ñ the items specified in the test plan required by clause 8 of this standard;

ñ identification of the EUT and any associated equipment, for example, brand name, product type, serial number;

ñ identification of the test equipment, for example, brand name, product type, serial number;

ñ any special environmental conditions in which the test was performed, for example, shielded enclosure;

ñ any specific conditions necessary to enable the test to be performed;

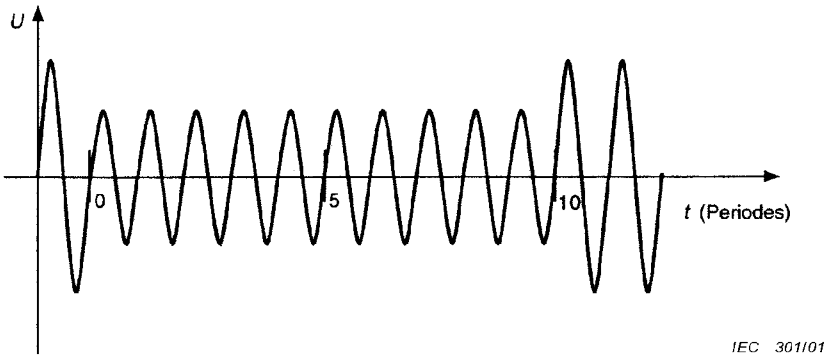
ñ performance level defined by the manufacturer, requestor or purchaser;

ñ performance criterion specified in the generic, product or product-family standard;

ñ any effects on the EUT observed during or after the application of the test disturbance, and the duration for which these effects persist;

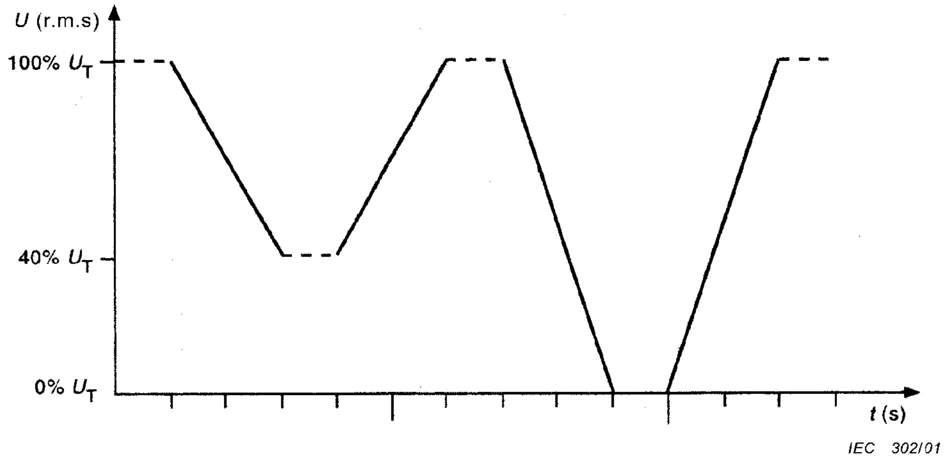
ñ the rationale for the pass/fail decision (based on the performance criterion specified in the generic, product or product-family standard, or agreed between the manufacturer and the purchaser);

ñ any specific conditions of use, for example cable length or type, shielding or grounding, or EUT operating conditions, which are required to achieve compliance.



NOTE The voltage decreases to 70 % for 10 periods. Step at zero crossing.

Figure 1 ñ Voltage dips



NOTE The voltage gradually decreases.

Figure 2 ñ Voltage variation

Annex A
(normative)

Test circuit details

A.1 Test generator peak inrush current drive capability

The circuit for measuring generator peak inrush current drive capability is shown in figure A.1. Use of the bridge rectifier makes it unnecessary to change rectifier polarity for tests at 270 versus 90 . The rectifier half-cycle mains current rating should be at least twice the generator's inrush current drive capability to provide a suitable operating safety factor.

The 1 700 µF electrolytic capacitor shall have a tolerance of ± 20 %. It shall have a voltage rating preferably 15 % ñ 20 % in excess of the nominal peak voltage of the mains, e.g. 400 V for 220 V ñ 240 V mains. It shall also be able to accommodate peak inrush current up to at least twice the generator's inrush current drive capability, to provide an adequate operating safety factor. The capacitor shall have the lowest possible equivalent series resistance (ESR) at both 100 Hz and 20 kHz, not exceeding 0,1 Ω at either frequency.

Since the test shall be performed with the 1 700 µF capacitor discharged, a resistor shall be connected in parallel with it and several RC time constants must be allowed between tests. With a 10 000 Ω resistor, the RC time constant is 17 s, so that a wait of 1,5 min to 2 min should be used between inrush drive capability tests. Resistors as low as 100 Ω may be used when shorter wait times are desired.

The current probe shall be able to accommodate the full generator peak inrush current drive for one-quarter cycle without saturation.

Tests shall be run by switching the generator output from 0 % to 100 % at mains phasings of both 90 and 270 , to ensure sufficient peak inrush current drive capability for both polarities.

A.2 EUT peak inrush current requirement

When a generator peak inrush current drive capability meets the specified requirement (e.g., at least 500 A for a 220 V ñ 240 V mains), it is not necessary to measure the EUT peak inrush current requirement.

However, a generator with less than this inrush current may be used for the test, if the inrush requirement of the EUT is less than the inrush drive capability of the generator. The circuit of figure A.2 shows an example of how to measure the peak inrush current of an EUT to determine if it is less than the inrush drive capability of a low-inrush drive capability generator.

The circuit uses the same current transformer as the circuit of figure A.1. Four peak inrush current tests are performed:

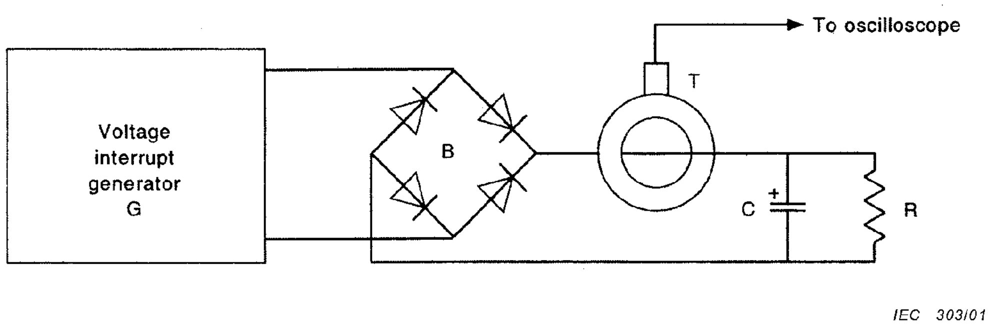
a) power off for at least 5 min; measure peak inrush current when it is turned back on at 90 ;

b) repeat (a), at 270 ;

c) power on preferably for at least one minute; off for 5 s; then measure peak inrush current when it is turned back on again at 90 ;

d) repeat (c), at 270 .

In order to be able to use a low-inrush drive current capability generator to test a particular EUT, that EUT's measured inrush current shall be less than 70 % of the measured inrush current drive capability of the generator.



where

G is the voltage interrupt generator, switched on at 90 and 270 ;

T is the current probe, with monitoring output to oscilloscope;

B is the rectifier bridge;

R is the bleeder resistor, not over 10 000 Ω or less than 100 Ω;

C is the 1 700 μF ±20 % electrolytic capacitor.

Figure A.1 ñ Circuit for determining the inrush current drive capability of the short interruptions generator

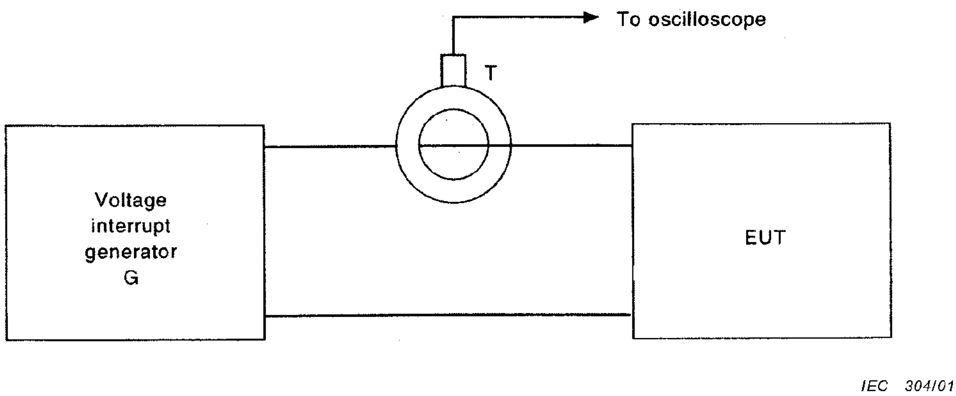


Figure A.2 ñ Circuit for determining the peak inrush current requirement of an EUT

Annex B
(informative)

Guide for the selection of test levels

The test parameters, duration and depth, should be selected by considering the data given below.

Consideration of the consequences of failure (including modes of potential failure and the action necessary to restore operation) should be borne in mind in selecting these parameters.

The following data is an extract from a UNIPEDE study [1].

This study was conducted with the purpose of providing customers and manufacturers with adequate information on the relative rate of occurrence, duration/depth of voltage dips and short interruptions, according to the definition of voltage dips issued from IEC 61000-2-2.

The study was confined to disturbances caused by faults or switching operations in the public supply systems.

Table B.1

Depth %	Duration			
	10 ms to <100 ms	100 ms to <500 ms	500 ms to <1 s	1 s to <3 s
10 to <30	61	66	12	6
30 to <60	8	36	4	1
60 to <100	2	17	3	2
100	0	12	24	5
	Number of disturbances /annum			

Reference document

[1] International Union of Producers and Distributors of Electrical Energy (UNIPEDE): 1991, No. 50.02.

Annex C
(informative)

Test instrumentation

Examples of generators and test set-ups.

Figures C.1 a and C.1 b show two possible test configurations for mains supply simulation. To show the behaviour of the EUT under certain conditions, interruptions and voltage variations are simulated by means of two transformers with variable output voltages.

Opening both switches simultaneously interrupts the power supply. The duration of the interruption can be preset. Voltage drops and rises are simulated by alternately closing switch 1 and switch 2. These two switches are never closed at the same time. It shall be possible to open and close the switches independently of the phase angle. Modern semiconductors such as power MOSFET and IGBT fulfil this requirement, whereas the thyristors and triacs used in the past can only open during zero crossing, and therefore do not simulate the real situation correctly.

The output voltage of the variable transformers can either be adjusted manually or automatically by means of a motor.

Wave-form generators and power amplifiers can be used instead of variable transformers and switches (see figure C.1 b).

This configuration also allows testing of the EUT in the context of frequency variations and harmonics.

The first configuration (see figure C.1 a) can be simplified for partial tests, e.g. only one variable transformer is required for voltage variations (see figure C.2).

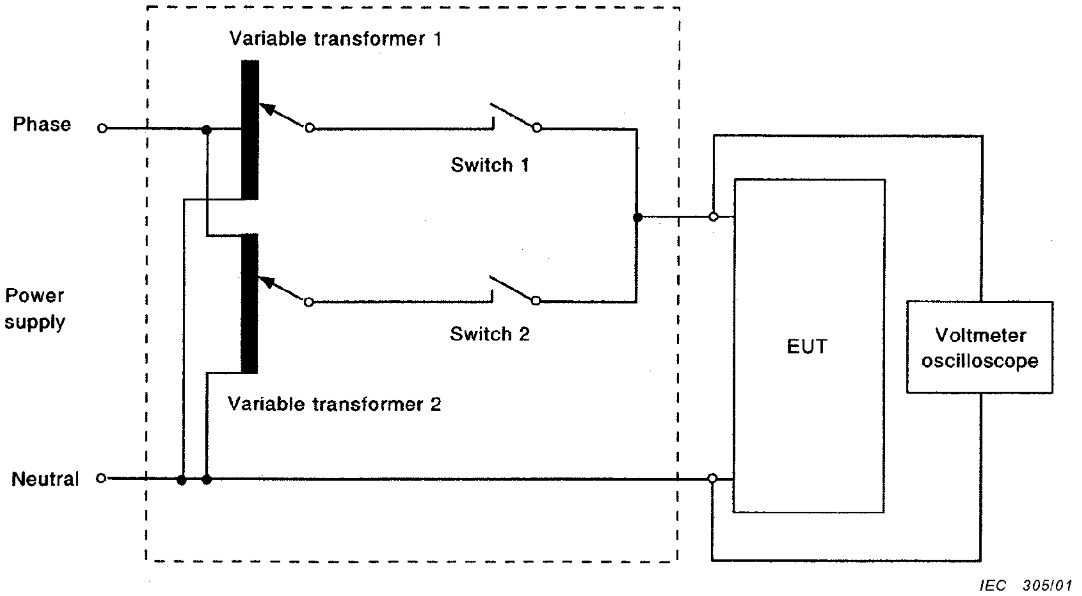


Figure C.1 a ñ Schematic of test instrumentation for voltage dips and short interruptions using variable transformers and switches

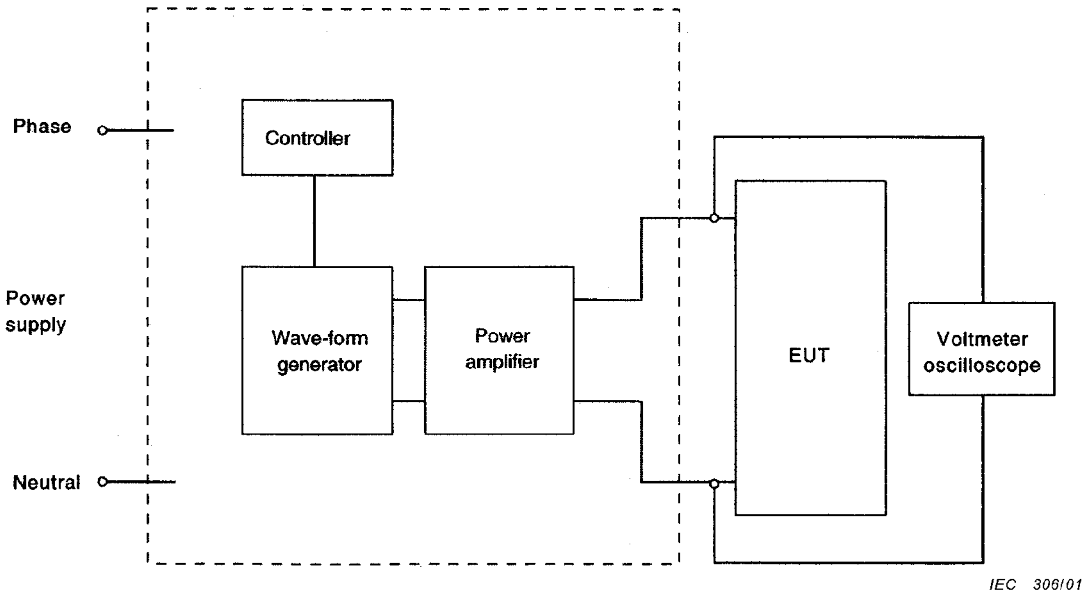


Figure C.1 b ñ Schematic of test instrumentation for voltage dips, short interruptions and variations using power amplifier

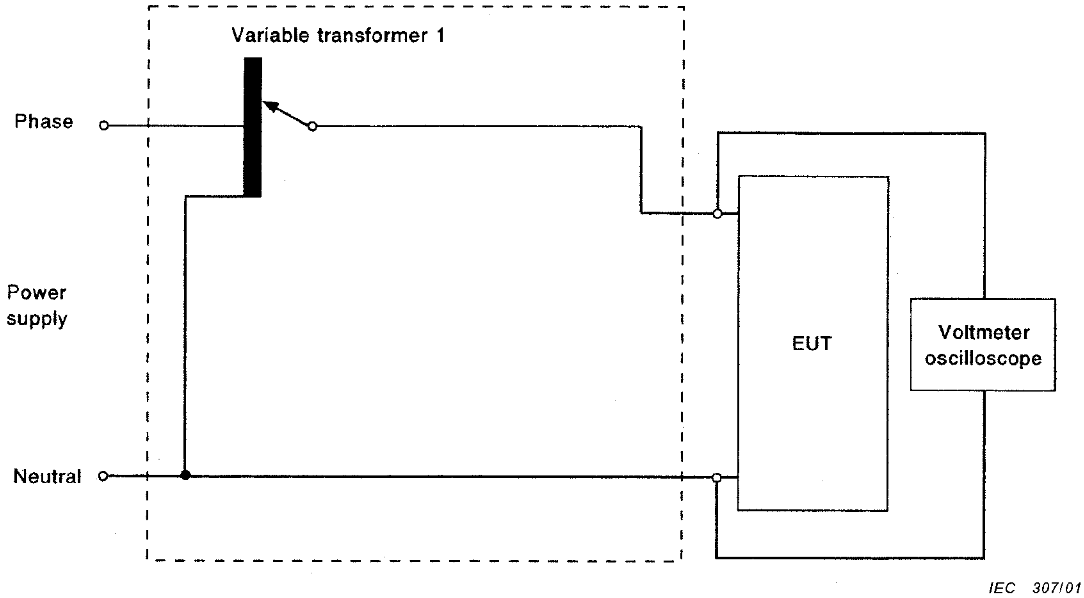


Figure C.2 ñ Schematic of a simplified test instrumentation for voltage variations

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Annex ZA (normative)
Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC publication	Date	Title	EN/HD	Date
50(161)	1990	*International Electrotechnical Vocabulary (IEV) —* *Chapter 161: Electromagnetic compatibility*	—	—
68-1	1988	*Environmental testing —* *Part 1: General and guidance* (corrigendum October 1988)	HD 323.1 S2	1988
1000-2-1	1990	*Electromagnetic compatibility (EMC)* *Part 2: Environment —* *Section 1: Description of the environment Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems*	—	—
1000-2-2 (mod)	1990	*Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*	ENV 61000-2-2	1993
1000-4-1	1992	*Part 4: Testing and measurement techniques —* *Section 1: Overview of immunity tests — Basic EMC publication*	EN 61000-4-1	1994

National annex NA (informative) Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Electrotechnical Sector Board to Technical Committee GEL/110, upon which the following bodies were represented:

Association of Consulting Scientists

Association of Control Manufacturers TACMA (BEAMA Ltd.)

Association of Manufacturers of Domestic Electrical Appliances

Association of Manufacturers of Power Generating Systems and Association of British Generating Set Manufacturers

BEAMA Ltd.

BEAMA Metering Association (BMA)

British Industrial Truck Association

British Lighting Association for the Preparation of Standards (Britlaps)

British Telecommunications plc

Building Automation and Mains Signalling Association (BAMSA) (BEAMA Ltd.)

Department of Health

Department of Trade and Industry (National Physical Laboratory)

Department of Trade and Industry (Standards Policy unit)

Department of Transport

ERA Technology Ltd.

Electrical Installation Equipment Manufacturers Association (BEAMA Ltd.)

Electricity Association

Federation of the Electronics Industry

GAMBICA (BEAMA Ltd.)

Health and Safety Executive

Induction and Dielectric Heating Manufacturers Association

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Lighting Industry Federation Ltd.

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Rotating Electrical Machines Association (BEAMA Ltd.)

Society of British Gas Industries

Society of Motor Manufacturers and Traders Limited

Sound and Communications Industries Federation

Transmission and Distribution Association (BEAMA Ltd.)

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Radio and Electronic Equipment Manufacturers Association

Electrical Contractors Association

Power Supply Manufacturers Association PSMA (BEAMA Ltd.)

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