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British Standard

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06 June 2002

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BRITISH STANDARD

BS EN 61326:1998 IEC 61326: 1997

Incorporating Amendments Nos. 1 and 2 (Amendment No. 1 renumbers the BS as BS EN 61326:1998)

Electrical equipment for measurement, control and laboratory use — EMC requirements

The European Standard EN 61326:1997 with the incorporation of amendments A1:1998 and A2:2001 has the status of a British Standard

ICS 33.100

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National foreword

This British Standard is the English language version of EN 61326:1997 including amendments A1:1998 and A2:2001. It is identical with IEC 61326:1997 including amendments 1:1998 and 2:2001.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/1, Systems considerations, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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⟩.

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 20, an inside back cover and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments
10167	November 1998	See national foreword
13454	21 January 2002	See national foreword

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 1997

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ISBN 0 580 27825 5

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61326

April 1997

+ A1

June 1998

+ A2

May 2001

ICS 33.100

Descriptors: Electrical equipment for measurement, electrical equipment for control, electrical equipment for laboratory use, electromagnetic compatibility, general requirements

English version

Electrical equipment for measurement, control and laboratory use — EMC requirements

(includes amendments A1:1998 and A2:2001)
(IEC 61326:1997 + A1:1998 + A2:2000)

Matériels électriques de mesure, de commande et de laboratoire
Prescriptions relatives à la CEM
(inclut les amendements A1:1998 et A2:2001)
(CEI 61326:1997 + A1:1998 + A2:2000)

Elektrische Betriebsmittel für Leittechnik und Laboreinsatz — EMV-Anforderungen
(enthält Änderungen A1:1998 und A2:2001)
(IEC 61326:1997 + A1:1998 + A2:2000)

This European Standard was approved by CENELEC on 1997-03-11; amendment A1 was approved by CENELEC on 1998-04-01, amendment A2 was approved by CENELEC on 2001-03-01. 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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Ref. No. EN 61326:1997 + A1:1998 + A2:2001 E

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Foreword

The text of document 65A/211/FDIS, future edition 1 of IEC 61326-1, prepared by SC 65A, System aspects, of IEC TC 65, Industrial-process measurement and control, and by IEC TC 66, Safety of measuring, control, and laboratory equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61326-1 on 1997-03-11.

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) 1997-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2001-07-01

Annexes designated "normative" are part of the body of the standard.

In this standard, Annex ZA is normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61326-1:1997 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of future amendment 1 (65A/248/FDIS) to the International Standard IEC 61326:1997, prepared by SC 65A, System aspects, of IEC TC 65, Industrial-process measurement and control, was submitted to the CENELEC formal vote and was approved by CENELEC as amendment A1 to EN 61326:1997 on 1998-04-01.

NOTE With this amendment the Eurpean Standard is renumbered EN 61326 and the title adapted accordingly.

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) 1999-02-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2001-07-01

Annexes designated "normative" are part of the body of the standard.

In this standard, Annex A, Annex B, Annex C and Annex ZA are normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of amendment 1:1998 to the International Standard IEC 61326:1997 was approved by CENELEC as an amendment to the European Standard without any modification.

Foreword to amendment A2

The text of document 65A/307/FDIS, future amendment 2 of IEC 61326-1:1997, prepared by SC 65A, System aspects, of IEC TC 65, Industrial-process measurement and control, was submitted to the Unique Acceptance Procedure and was approved by CENELEC and amendment A2 to EN 61326-1:1997 on 2001-03-01.

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) 2002-04-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2004-04-01

Endorsement notice

The text of amendment 2:2000 to the International Standard IEC 61326:1997 was approved by CENELEC as an amendment to the European Standard without any modification.

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Introduction

Instruments and equipment within the scope of this standard may often be geographically widespread and may have to operate under a wide range of environmental conditions.

The limitation of undesired electromagnetic emissions ensures that no other equipment, installed nearby, is unduly influenced by the equipment under consideration. The limits are more or less specified by, and therefore taken from, IEC and International Special Committee on Radio Interference (CISPR) publications.

However, the equipment has to function without undue degradation in a typical electromagnetic environment. The limit values for immunity, specified in this standard have been chosen under this assumption. Special risks, involving for example nearby or direct lightning strikes, circuit-breaking, or exceptionally high electromagnetic radiation in close proximity, are not covered.

Complex electric and/or electronic systems require EMC planning in all phases of their design and installation, taking into consideration the electromagnetic environment, any special requirements, and the severity of failures.

1 Scope

〉A1〈 This International Standard specifies minimum requirements for immunity and emissions regarding electromagnetic compatibility (EMC) for electrical equipment, operating from a supply of less than 1 000 V a.c. or 1 500 V d.c. or from the circuit being measured, intended for professional, industrial process and educational use, including equipment and computing devices for: 〉A1〈

— measurement and test;

— control;

— laboratory use;

— accessories intended for use with the above (such as sample handling equipment), intended to be used in industrial and non-industrial locations.

Computing devices and assemblies and similar equipment within the scope of information technology equipment (ITE) and complying with applicable ITE EMC standards can be used without additional testing.

Where a relevant dedicated EMC standard exists, it shall take precedence over all aspects of this product-family standard.

〉A1〈 The following equipment is covered in this standard. 〉A1〈

a) Electrical measurement and test equipment

This is equipment which by electrical means measures, indicates or records one or more electrical or non-electrical quantities, also non-measuring equipment such as signal generators, measurement standards, power supplies and transducers.

b) Electrical control equipment

This is equipment which controls one or more output quantities to specific values, with each value determined by manual settings, by local or remote programming, or by one or more input variables. This includes industrial process measurement and control (IPMC) equipment, which consists of devices such as:

— process controllers and regulators;

— programmable controllers (PC);

— power supply units of equipment and systems (centralized or dedicated);

— analogue/digital indicators and recorders;

— process instrumentation;

— transducers, positioners, intelligent actuators, etc.

c) Electrical laboratory equipment

This is equipment which measures, indicates, monitors or analyzes substances, or is used to prepare materials.

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[A1] This standard is applicable to

— equipment for use in industrial locations;

— equipment for use in laboratories or test and measurement areas with a controlled electromagnetic environment;

— test and measurement equipment which is portable and powered by battery or from the circuit being measured. [A1]

This equipment may also be used in areas other than laboratories.

2 Normative references

The following normative documents contain provision which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. [A1] All normative documents are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. [A1] Members of IEC and ISO maintain registers of currently valid International Standards.

2.1 General standards

IEC (151):1978, *International Electrotechnical Vocabulary (IEV) — Chapter 151: Electrical and magnetic devices.*

IEC 50(161):1990, *International Electrotechnical Vocabulary (IEV) — Chapter 161: Electromagnetic compatibility.*

IEC 1010, *Safety requirements for electrical equipment for measurement, control and laboratory use.*

2.2 Immunity standards

IEC 1000-4-2:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 2: Electrostatic discharge immunity test — Basic EMC Publication.*

IEC 1000-4-3:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 3: Radiated, radio-frequency, electromagnetic field immunity test.*

IEC 1000-4-4:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 4: Electrical fast transient/burst immunity test — Basic EMC Publication.*

IEC 1000-4-5:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 5: Surge immunity test.*

IEC 1000-4-6:1996, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 6: Immunity to conducted disturbances, induced by radio-frequency fields.*

IEC 1000-4-11:1994, *Electromagnetic compatibility (EMC) — Part 4: Testing and measuring techniques —Section 11: Voltage dips, short interruptions and voltage variations immunity tests — Basic EMC Publication.*

[A1] IEC 61000-4-8:1993, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 8: Power frequency magnetic field immunity test — Basic EMC Publication.* [A1]

2.3 Emission standards

IEC 1000-3-2:1995, *Electromagnetic compatibility (EMC) — Part 3: Limits — Section 2: Limits for harmonic current emissions (equipment input current ≤16 A per phase).*

IEC 1000-3-3:1994, *Electromagnetic compatibility (EMC) — Part 3: Limits — Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A.*

CISPR 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.*

CISPR 14:1993, *Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and electric apparatus.*

[A1] [A1]

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CISPR 16-1:1993, *Specification for radio disturbance and immunity measuring apparatus and methods — Part 1: Radio disturbance and immunity measuring apparatus,*

A1 CISPR 16-2:1996, *Specification for radio disturbance and immunity measuring apparatus and methods —Part 2: Methods of measurement of disturbances and immunity.* A1

CISPR 22:1993, *Limits and methods of measurement of radio disturbance characteristics of information technology equipment.*

3 Definitions

For the purposes of this part of IEC 61326, the definitions in IEC 50(161) apply, together with the following.

Other definitions, not included in IEC 50(161) and this standard, but nevertheless necessary for the application of the different tests, are given in the EMC basic publications.

3.1
type test
test of one or more samples of equipment (or parts of equipment) made to a particular design, to show that the design and construction meet one or more requirements of this standard. Statistical sampling is not required for measurement, control, and laboratory equipment

NOTE This definition is an amplification of IEV 151-04-15 definition to cover both design and construction requirements.

3.2
port
any particular interface of the specific device or system with the external electromagnetic environment within the scope of this standard [see Figure 1 for an example of equipment under test (EUT)]

NOTE I/O ports are input, output or bi-directional, measurement, control, or data ports.

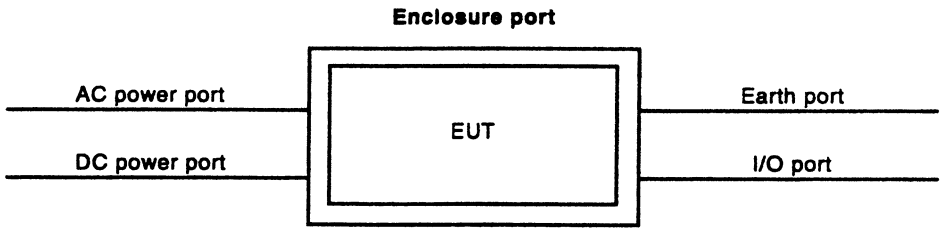

Figure 1 — Examples of ports

3.3
enclosure port
physical boundary of equipment through which electromagnetic fields may radiate or impinge

3.4
class A equipment
equipment suitable for use in establishments other than domestic, and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes [CISPR 11]

3.5
class B equipment
equipment for use in domestic establishments, and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes [CISPR 11]

3.6
long distance lines
lines within a building which are longer than 30 m, or which leave the building (including lines of outdoor installations)

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A1 3.7
industrial locations
locations characterized by a separate power network, in most cases supplied from a high- or medium-voltage transformer, dedicated for the supply of installations feeding manufacturing or similar plants with one or more of the following conditions:

— frequent switching of heavy inductive or capacitive loads;

— high currents and associated magnetic fields;

— presence of industrial, scientific and medical (ISM) apparatus (e.g. welding machines).

3.8
laboratory or test and measurement area
a laboratory or test and measurement area within the scope of this standard is an area that is specifically used for analysis, testing and servicing. Equipment within the scope has to be operated by trained personnel

3.9
controlled electromagnetic environment
a controlled electromagnetic environment within the scope of this standard is usually characterized by recognition and control of EMC threats by users of the equipment or design of the installation /A1

4 General

Equipment and systems within the scope of this standard can be subjected to various kinds of electromagnetic disturbances, conducted by power, measurement or control lines, or radiated from the environment. The types and levels of disturbances depend on the particular conditions in which the systems, subsystems or equipment are installed and operate.

Equipment such as generators, analyzers, frequency meters shall fulfil the requirements under conditions defined by the manufacturer (that is without a test object connected, or connecting a 50 Ω termination to the output of a signal generator).

The manufacturer shall give information that emissions which exceed the levels required by this standard may occur when equipment is connected to a test object.

The acceptance criteria regarding the immunity requirements are structured taking into account the functionality and dependability aspects.

Equipment and individual devices of a system within the scope of this standard may also be a source of electromagnetic disturbances over a wide frequency range. These disturbances may be conducted through power and signal lines, or be directly radiated; and may affect the performance of other equipment, or influence the external electromagnetic environment.

For emissions, the objective of these requirements is to ensure that the disturbances generated by the equipment and systems, when operated normally, do not exceed a level which could prevent other systems from operating as intended. Emission limits for industrial locations are given in Table 3. Emission limits for non-industrial locations are given in Table 4.

To comply with this standard, no additional EMC tests are required beyond those stated here.

A1 NOTE 1 Higher immunity levels than those specified may be necessary for particular applications (for example, when reliable operation of the equipment is essential for safety) or when the equipment is intended for use in harsher electromagnetic environments. /A1

NOTE 2 This standard does not specify basic safety requirements such as protection against electric shock, unsafe operation, insulation co-ordination and related dielectric tests for equipment. See IEC 1010 for safety requirements.

NOTE 3 The emission limits of this standard may not, however, provide full protection against interference to radio and television reception when the measurement, control or laboratory equipments is used closer than 30 m to the receiving antenna for industrial or professional applications, and closer than 10 m for domestic and commercial applications.

NOTE 4 In special cases, for example when highly susceptible equipment is being used in close proximity, additional mitigation measures may have to be employed to reduce the influencing electromagnetic emission further below the specified limits.

NOTE 5 The manufacturer may elect to perform all tests either on a single EUT or more than one. The testing sequence is optional.

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5 EMC test plan

5.1 General

An EMC test plan shall be established prior to testing. It shall contain as a minimum the elements given in **5.2**, **5.3**, **5.4** and **5.5**.

It may be determined from consideration of the electrical characteristics and usage of a particular apparatus that some tests are inappropriate and therefore unnecessary. In such cases the decision not to test shall be recorded in the EMC test plan.

5.2 Configuration of EUT during testing

5.2.1 *General*

Measurement, control and laboratory equipment often consists of systems with no fixed configuration. The kind, number and installation of different subassemblies within the equipment may vary from system to system. Thus it is reasonable, and also recommended, not to test every possible arrangement.

To realistically simulate EMC conditions (related both to emission and immunity), the equipment assembly shall represent a typical installation as specified by the manufacturer. Such tests shall be carried out as type tests under normal conditions as specified by the manufacturer.

5.2.2 *Composition of EUT*

All devices, racks, modules, boards etc. significant to EMC and belonging to the EUT shall be documented.

5.2.3 *Assembly of EUT*

If an EUT has a variety of internal and external configurations, the TYPE TESTS shall be made with one or more typical configurations that represent normal use. All types of module shall be tested at least once. The rationale for this selection shall be documented in the EMC test plan.

5.2.4 *I/O ports*

Where there are multiple I/O ports all of the same type, connecting a cable to just one of those ports is sufficient, provided that it can be shown that the additional cables would not affect the results significantly.

5.2.5 *Auxiliary equipment*

When a variety of devices is provided for use with the EUT, at least one of each type of device shall be selected to simulate actual operating conditions. Auxiliary devices can be simulated.

5.2.6 *Cabling and earthing (grounding)*

The cables and earth (ground) shall be connected to the EUT in accordance with the manufacturer's specifications. There shall be no additional earth connections.

5.3 Operation conditions of EUT during testing

5.3.1 *Operation modes*

A selection of representative operation modes shall be made, taking into account that not all functions, but only the most typical functions of the electronic equipment can be tested. The estimated worst case operating modes for normal application shall be selected.

5.3.2 *Environmental conditions*

The tests shall be carried out within the manufacturer's specified environmental operating range (for example ambient temperature, humidity, atmospheric pressure), and within the rated ranges of supply voltage and frequency.

5.3.3 *EUT software during test*

The software used for simulating the different modes of operation shall be documented. This software shall represent the estimated worst case operating mode for normal application.

5.4 Specification of performance criteria

Performance criteria for each port and test shall be specified; where possible, as quantitative values.

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5.5 Test description

Each test to be applied shall be specified in the EMC test plan. The description of the tests, the test methods, the characteristics of the tests, and the test setups are given in the basic standards which are referred to in **6.2** and **7.2**. The contents of these basic standards need not be reproduced in the test plan; however, additional information needed for the practical implementation of the tests is given in this standard. In some cases, the EMC test plan shall specify the application in detail.

NOTE Not all known disturbance phenomena have been specified for testing purposes in this standard, but only those which are considered as most critical.

6 Immunity requirements

6.1 Conditions during the tests

The configuration and modes of operation during the tests shall be precisely noted in the test report.

[A1] Tests shall be applied to the relevant ports in accordance with Table 1, Table A.1, Table B.1 or Table C.1, as applicable. [A1]

The tests shall be conducted in accordance with the basic standards. The tests shall be carried out one at a time. If additional methods are required, the method and rationale shall be documented.

6.2 Immunity test requirements

The immunity testing requirements are given in Table 1.

[A1] Particular requirements for industrial locations are given in Table A.1.

Particular requirements for laboratories or test and measurement areas with a controlled electromagnetic environment are given in Table B.1.

Particular requirements for portable test and measurement equipment that is powered by battery or from the circuit being measured are given in Table C.1. [A1]

For input/output circuits where the manufacturer specifies that shielded cables must be used, or that the cables must be located on conductive cable trays or in conduits, the conducted immunity requirements can be omitted within the frequency range 150 kHz to 80 MHz.

Tests for earth ports are not specified separately because they are covered by the respective basic standards:

— dedicated protection earth ports are tested as a.c. power ports;

— functional earth connections are tested as I/O-ports.

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Table 1 — Minimum immunity test requirements

Port	Phenomenon	Basic standard	Test value
Enclosure	Electrostatic discharge (ESD) Electromagnetic	IEC 1000-4-2 IEC 1000-4-3	4 kV/4 kV contact/air 3 V/m
[A1] AC power	Voltage dip/short interruptions Burst Surge Conducted RF	IEC 1000-4-11 IEC 1000-4-4 IEC 1000-4-5 IEC 1000-4-6	1 cycle/100 % [A1] 1 kV 0,5 kV[a]/1 kV[b] 3 V
DC power[d]	Burst Surge Conducted RF	IEC 1000-4-4 IEC 1000-4-5 IEC 1000-4-6	1 kV 0,5 kV[a]/1 kV[b] 3 V
I/O signal/control	Burst Surge Conducted RF	IEC 1000-4-4 IEC 1000-4-5 IEC 1000-4-6	0,5 kV[d] 1 kV[bc] 3 V[d]
I/O signal/control connected directly to mains supply	Burst Surge Conducted RF	IEC 1000-4-4 IEC 1000-4-5 IEC 1000-4-6	1 kV 0,5 kV[a]/1 kV[b] 3 V

[a] Line to line.
[b] Line to earth (ground).
[c] Only in the case of long distance lines (see **3.6**).
[d] Only in the case of lines > 3 m.

Equipment shall not become dangerous or unsafe as a result of the application of the tests.

6.3 System and application aspects

If higher levels or tests of other phenomena under system aspects are necessary for specific applications, the immunity shall be increased or mitigation measures in the installation shall be applied.

6.4 Random aspects

The performance criterion shall be observable during the test, and shall not be a random phenomenon. The duration of the test and number of tests shall be sufficient to test each function of the EUT as specified in the EMC test plan. Special care must be given to ensure that this is covered with automatic (processor) controlled EUTs.

NOTE For instance, in the case of electrostatic discharge testing of a digital device, the EUT should be exposed to at least 10 discharges at each polarity, test point and test level to exclude random effects. In case of burst testing, it may be advisable to extend the testing time to more than 1 min.

6.5 Performance criteria

The general principles (performance criteria) for the evaluation of the immunity test results are the following:

Performance criterion A: During testing normal performance within the specification limits

Example 1

If electronic equipment has a central processing unit and is required to work with high reliability, the processor shall operate without any apparent degradation from the manufacturer's specification.

Performance criterion B: During testing, temporary degradation, or loss of function or performance which is self-recovering

Example 1

A data transfer is controlled/checked by parity check or by other means. In the case of malfunctioning, such as caused by a lightning strike, the data transfer will be repeated automatically. The reduced data transfer rate at this time is acceptable.

Example 2

During testing, an analogue function value deviates by an allowed margin. After the test, the deviation vanishes.

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Example 3

In the case of a monitor used only for man-machine monitoring, it is acceptable that some degradation takes place for a short time, such as flashes during the burst application.

Performance criterion C: During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs

Example 1

In the case of an interruption in the mains longer than the specified buffer time, the power supply unit of the equipment is switched off. The switch-on may be automatic or carried out by the operator.

Example 2

After a program interruption caused by a disturbance, the processor functions of the equipment shall stop at a safe position and not be left in a "crashed state". Operator's decision prompts may be necessary.

Example 3

The test results in an opening of an over-current protection device which is replaced or reset by the operator.

Performance criterion D: Degradation or loss of function which is not recoverable due to damage to equipment, components, software, or to loss of data

For performance criteria B and C, the EUT has passed the tests if it has shown its specified immunity throughout the period of application of the test signal and, at the end of the tests, the EUT fulfils the functional requirements established in the technical product specification. The performance criteria D is normally not acceptable.

Because it is not possible to state only one performance criteria for each phenomenon, the following guidance is given:

— check the function normally fulfilled by certain equipment;

— the function of the device in relation to the phenomenon determines the performance criteria.

Examples of possible combinations are given in Table 2.

Performance criteria to the different functional aspects shall be given to the user on request.

Table 2 — Example of evaluation of immunity test results

	Essential operation (functional safety)	Continuous unmonitored operation	Continuous monitored operation	Non-continuous operation
ESD IEC 1000-4-2	A	B	B	C
EM IEC 1000-4-3	A	A	A	B
Burst IEC 1000-4-4	A	B	B	B
Surge IEC 1000-4-5	A	B	B	C
Conducted RF IEC 1000-4-6	A	A	A	C
Voltage interrupts IEC 1000-4-11	A	B	C	C
NOTE For type testing, it is highly recommended to choose performance criteria A for all phenomena and all tests. However, performance criteria B and/or C may be accepted provided that both the specification and the test report highlight such deviation(s) for the relevant combination(s) of function and test.				

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7 Emission requirements

In some countries, certain control devices are legally exempted from mandatory emission requirements. Where exempted by national regulation, the emission requirements stated in this standard do not apply.

7.1 Conditions during measurements

The measurements shall be made in the operating mode in accordance with the EMC test plan (see clause **5**).

NOTE The conducted emission limits covered by this standard are given on a port-by-port basis.

The description of the tests, the test methods, and the test setups are given in the reference standards as stated in Table 3 and Table 4. The contents of the reference standards are not reproduced here; however, modifications or additional information needed for the practical implementation of application of the tests are given in this standard.

7.2 Emission limits

Table 3 gives the limit values for class A equipment.

Table 4 gives the limit values for class B equipment.

Choice of Table 3 or Table 4 values shall be made after taking into account the intended environment and emission regulations in the areas of use.

If the equipment fulfils the limit values of Table 3 but not Table 4, this shall be stated in the product specification.

For equipment using ISM frequencies, see CISPR 11.

Table 3 — Emission limits for class A equipment

Port	Frequency range MHz	Limits	Reference standard
⟨A1⟩ Enclosure	30 to 230	40 dB(μV/m) quasi peak, measured at 10 m distance	CISPR 16-1[a] and CISPR 16-2 ⟨A1⟩
	230 to 1 000	47 dB (μV/m) quasi peak, measured at 10 m distance	
⟨A1⟩ AC mains	0,15 to 0,5	79 dB (μV) quasi peak 66 dB (μV) average	CISPR 16-1 and CISPR 16-2 ⟨A1⟩
	0,5 to 5	73 dB (μV) quasi-peak 60 dB (μV) average	
	5 to 30	73 dB (μV) quasi peak 60 dB (μV) average	

[a] For alternative test site areas, see Annex A of CISPR 22.

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Table 4 — Emission limits for class B equipment

Port	Frequency range MHz	Limits	Reference standard
⟨A1⟩ Enclosure	30 to 230	30 dB (μV/m) quasi peak, measured at 10 m distance	CISPR 16-1[a] and CISPR 16-2 ⟨A1⟩
	230 to 1 000	37 dB (μV/m) quasi peak, measured at 10 m distance	
AC mains[b]	0 to 0,002	As specified in the reference standard	CEI 1000-3-2 CEI 1000-3-3
⟨A1⟩	0,15 to 0,5	66 dB (μV) to 56 dB (μV) quasi peak 56 dB (μV) to 46 dB (μV) average Limits decrease linearly with log. of frequency	CISPR 16-1 and CISPR 16-2 ⟨A1⟩
	0,5 to 5	56 dB (μV) quasi peak 46 dB (μV) average	
	5 to 30	60 dB (μV) quasi peak 50 dB (μV) average	

[a] For alternative test site areas, see Annex A of CISPR 22.
[b] For discontinuous disturbances, see CISPR 14.

8 Test results and test report

The test results shall be documented in a comprehensive test report with sufficient detail to provide for test repeatability.

The test report shall contain the following minimum information:

— EUT description;
— EMC test plan;
— test data and results;
— test equipment and set-up.

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Annex A (normative)
Immunity test requirements for equipment intended for use in industrial locations

This annex applies to instruments and equipment that are intended for installation in **industrial locations** (it covers all equipment that may be used in close proximity to high-level sources of disturbances).

NOTE Equipment not specifically designed for use in industrial locations may be used by controlling the EMC environment throughout installation and/or usage.

Table A.1 — Immunity test requirements for equipment intended for use in industrial locations

Port	Phenomenon	Basic standard	Test value
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV/8 kV contact/air
	EM field	IEC 61000-4-3	10 V/m
	Rated power frequency magnetic field	IEC 61000-4-8	30 A/m[e]
AC power	Voltage dip/short interruptions	IEC 61000-4-11	0,5 cycle, each polarity/100 %
	Burst	IEC 61000-4-4	2 kV
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]
	Conducted RF	IEC 61000-4-6	3 V[f]
DC power[g]	Burst	IEC 61000-4-4	2 kV
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]
	Conducted RF	IEC 61000-4-6	3 V[f]
I/O signal/control	Burst	IEC 61000-4-4	1 kV[d]
	Surge	IEC 61000-4-5	1 kV[bc]
	Conducted RF	IEC 61000-4-6	3 V[df]
I/O signal/control connected directly to power supply network	Burst	IEC 61000-4-4	2 kV
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]
	Conducted RF	IEC 61000-4-6	3 V[f]

[a] Line to line.
[b] Line to ground.
[c] Only in the case of long distance lines (see **3.6**).
[d] Only in the case of lines > 3 m.
[e] Only to magnetically sensitive equipment. CRT display interference is allowed above 1 A/m.
[f] The test level for the conducted RF test is lower than the level for the radiated RF test because the conducted RF test simulates the resonance condition at each frequency and is thus a more severe test.
[g] DC connections between parts of equipment/system which are not connected to a d.c. distribution network are treated as I/O signal/control ports.

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[A1] Annex B (normative)
Immunity test requirements for equipment used in controlled EM environments

Equipment covered within this annex is intended for use in laboratories or test and measurement areas with a controlled electromagnetic environment.

The manufacturer shall state that equipment fulfilling the requirements in Table B.1 is designed to operate in a controlled electromagnetic environment, i.e. where RF transmitters such as mobile telephones may not be used in close proximity.

NOTE 1 In general, analysis, test and service laboratories have controlled EMC environments, and personnel in these areas are usually trained to be able to interpret results. Hence, the test values shown in Table B.1 are relaxed from those in Table 1.

NOTE 2 If RF transmitters are used in close proximity, they may disturb equipment within the scope of this standard.

Table B.1 — Immunity test requirements for equipment used in controlled EM environments

Port	Phenomenon	Basic standard	Test value
Enclosure	Electrostatic discharge (ESD) EM field	IEC 61000-4-2 IEC 61000-4-3	4 kV/8 kV contact/air 1 V/m
AC power	Voltage dip/short interruptions Burst Surge Conducted RF	IEC 61000-4-11 IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-6	0,5 cycle, each polarity/100 % 1 kV 0,5 kV[a]/1 kV[b] 1 V
DC power[cd]	Burst Surge Conducted RF	IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-6	1 kV Not required 1 V
I/O signal/control	Burst Surge Conducted RF	IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-6	0,5 kV[c] Not required 1 V[c]
Measurement I/O[c]	Burst Surge Conducted RF	IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-6	X[e] Not required X[e]

[a] Line to line.
[b] Line to ground.
[c] Only in case of lines > 3 m.
[d] DC connections between parts of equipment/system which are not connected to a d.c. distribution network are treated as I/O signal/control ports.
[e] The rated disturbance values shall be stated in the product specification by the manufacturer.

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A1 Annex C (normative)
Immunity test requirements for portable test and measurement equipment

Equipment covered within this annex is portable test and measurement equipment that is powered by battery or from the circuit being measured. Equipment that can be operated while charging is excluded from this annex.

NOTE 1 Test and measurement instruments within the scope of this standard can be used in a wide range of locations but by personnel capable of interpreting the results obtained. If these instruments are connected to a mains supply, it is normally only by their test or measurement leads and only for a short duration of the test. Hence, the test values shown in Table C.1 are relaxed from those in Table 1.

NOTE 2 If RF transmitters are used in close proximity, they may disturb equipment within the scope of this standard.

Table C.1 — Immunity test requirements for portable test and measurement equipment

Port	Phenomenon	Basic standard	Test value
Enclosure	Electrostatic discharge (ESD) EM field	IEC 61000-4-2 IEC 61000-4-3	4 kV/8 kV contact/air 3 V/m

There are no further requirements for the mains chargers used by the products within the scope of this standard. A1

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A2 Annex D (normative)
Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications

D.1 General

In addition to the requirement of this standard, this annex specifies more detailed test configurations, operational conditions and performance criteria for equipment with test and measurement circuits (both internal and/or external to the equipment) that are not EMC protected for operational and/or functional reasons, as specified by the manufacturer.

Examples of such equipment include, but are not limited to, oscilloscopes, logic analyzers, spectrum analyzers, network analyzers, digital multimeters (DMM) and board test systems.

The manufacturer specifies the environment for which the product is intended to be used and utilizes the corresponding test level specification in this standard.

D.2 Test configurations

D.2.1 *I/O ports for test and measurement purpose (T and M ports)*

Test and measurement (T and M) input ports shall be capped and shorted unless this leads to an operating condition unsuitable for measuring the emission and immunity performance of the product. In this case, an appropriate input signal shall be applied.

Test and measurement (T and M) output ports not needed to evaluate the essential functions of the EUT shall be capped and/or terminated.

NOTE 1 Probes and/or test leads to be used with the test and measurement ports do not need to be connected. Such test leads can vary substantially from one application to another and are often connected to equipment that has the covers removed and may be in various stages of dissembly to provide access to test points inside. Connected test leads may increase emissions and/or reduce immunity in certain applications.

NOTE 2 Capped means locally covered in a screening manner.

D.2.2 *Auxiliary equipment*

Auxiliary equipment necessary for the normal operation of the equipment under test (EUT) shall be included as part of the equipment to be tested.

D.3 Operational conditions

When both battery and a.c. options are available, both modes of operation shall comply.

D.3.1 *Oscilloscopes*

The oscilloscope ports shall be set for maximum sweep speed, maximum sensitivity and continuous acquisition mode unless other modes are known to provide worst-case emission or immunity results within normal applications.

D.3.2 *Logic analyzers*

The logic analyzer shall be set for data analysis modes during emissions testing and continuous data acquisition mode during immunity testing unless other modes are known to provide worst-case emission or immunity results within normal applications.

D.3.3 *Digital multimeters (DMM)*

Typical set-ups include: peak detect, maximum sensitivity (usually auto-range, if available, will suffice) and continuous acquisition mode.

D.3.4 *Other equipment*

For equipment not mentioned in **D.3.1**, **D.3.2** and **D.3.3**, the following philosophy shall apply.

A selection of representative operation modes shall be made, taking into account that not all functions, but only the most typical functions of the equipment can be tested. The estimated worst-case operating modes for normal application shall be selected. A2

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D.4 Immunity test conditions — Performance criteria

D.4.1 *Tests with transient electromagnetic phenomenon*

During testing, the EUT may have temporary degradation or loss of function or performance which is self-recovering. Self-recovery times greater than 10 s shall be specified by the manufacturer. Trigger functions shall not be evaluated. No change in actual operating state or loss of stored data is allowed.

Electrostatic discharges shall be applied to the housing shield, but not to the inner pins of shielded port or cable oonnectors. Examples include: BNC, D-subminiature, IEEE 488 (GPIB), RS232 and IEEE 1284-B (Parallel printer port).

D.4.2 *Test with continuously present electromagnetic phenomenon*

No visual degradation of parameters of the EUT is allowed during application of the test except as specified by the manufacturer.

No test for power frequency magnetic field is required.

D.5 Typical product specific immunity test parameters

D.5.1 *Oscilloscopes*

Typical parameters observed during immunity testing include trace width deviation, trace offset and display noise.

D.5.2 *Logic analyzers*

Typical parameters observed during immunity testing include logic analyzer functional operations that may cause system lock-up or change of function or mode.

D.5.3 *Digital multimeters (DMM)*

Typical parameters observed during immunity, testing include the displayed measurement value.

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Annex ZA (normative)
Normative references to international publications with their corresponding 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 (including amendments).

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

Publication	Year	Title	EN/HD	Year
IEC 50(151)	1978	International Electrotechnical Vocabulary (IEV) Chapter 151: Electrical and magnetic devices	—	—
IEC 50(161)	1990	Chapter 161: Electromagnetic compatibility	—	—
IEC 61000-3-2	1995	Electromagnetic compatibility (EMC) Part 3: Limits Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	EN 61000-3-2 A 12	1995 1996
⟨A1⟩ IEC 61000-4-8	1993	Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 8: Power frequency magnetic field immunity test	EN 61000-4-8	1993 ⟨A1⟩
IEC 1000-3-3	1994	Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to and including 16 A	EN 61000-3-3	1995
IEC 1000-4-2	1995	Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test — Basic EMC publication	EN 61000-4-2	1995
IEC 1000-4-3 (mod)	1995	Section 3: Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	1996
IEC 1000-4-4	1995	Section 4: Electrical fast transient/burst immunity test — Basic EMC publication	EN 61000-4-4	1995
IEC 1000-4-5	1995	Section 5: Surge immunity test	EN 61000-4-5	1995
IEC 1000-4-6	1996	Section 6: Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	1996
IEC 1000-4-11	1994	Section 11: Voltage dips, short interruptions and voltage variations immunity tests — Basic EMC publication	EN 61000-4-11	1994
IEC 1010 (mod)	series	Safety requirements for electrical equipment for measurement, control and laboratory use	EN 61010	series
CISPR 11 (mod)	1990	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011	1991
CISPR 14-1	1993	Electromagnetic compatibility Requirements for household appliances, electric tools and similar apparatus Part 1: Emission — Product family standard	EN 55014-1	1993

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Publication [A1]	Year	Title	EN/HD	Year [A1]
CISPR 16-1	1993	Specification for radio disturbance and immunity measuring apparatus and methods Part 1: Radio disturbance and immunity measuring apparatus	—	—
[A1] CISPR 16-2	1996	Specification for radio disturbance and immunity measuring apparatus and methods Part 2: Methods of measurement of disturbances and immunity	—	—
CISPR 22	1993	Limits and methods of measurement of radio disturbance characteristics of information technology equipment	EN 55022	1994

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