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

Part 1: General requirements

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National foreword

This British Standard is the UK implementation of EN 61326-1:2013. It is identical to IEC 61326-1:2012. It supersedes BS EN 61326-1:2006, which will be withdrawn on 14 August 2015.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/1, System considerations.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
31 October 2013	CEN Endorsement notice and Annex ZA corrected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61326-1

January 2013

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English version

Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

(IEC 61326-1:2012)

Matériel électrique de mesure, de commande et de laboratoire - Exigences relatives à la CEM - Partie 1: Exigences générales (CEI 61326-1:2012)

Elektrische Mess-, Steuer-, Regel- und Laborgeräte - EMV-Anforderungen - Teil 1: Allgemeine Anforderungen (IEC 61326-1:2012)

This European Standard was approved by CENELEC on 2012-08-14. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre 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

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Foreword

The text of document 65A/628/FDIS, future edition 2 of IEC 61326-1, prepared by SC 65A, "System aspects", of IEC TC 65, "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61326-1:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2013-07-11
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2015-08-14

This document supersedes EN 61326-1:2006.

EN 61326-1:2013 includes the following significant technical changes with respect to EN 61326-1:2006:

– the immunity test levels and performance criteria have been reviewed;

– requirements for portable test and measurement equipment have been clarified and amended;

– the description of the electromagnetic environments has been improved.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Endorsement notice

The text of the International Standard IEC 61326-1:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60359	NOTE	Harmonized as EN 60359.
IEC 61000-6-1:2005	NOTE	Harmonized as EN 61000-6-1:2007 (not modified).
IEC 61000-6-2:2005	NOTE	Harmonized as EN 61000-6-2:2005 (not modified).
IEC 61010 series	NOTE	Harmonized in EN 61010 series (not modified).
IEC 61326-2 series	NOTE	Harmonized in EN 61326-2 series (not modified).
IEC 61326-2-2	NOTE	Harmonized as EN 61326-2-2.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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 60050	Series	International Electrotechnical Vocabulary	-	-
IEC 61000-3-2 + A1 + A2	2005 2008 2009	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2 + A1 + A2	2006 2009 2009
IEC 61000-3-3	2008	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection	EN 61000-3-3	2008
IEC 61000-3-11	2000	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection	EN 61000-3-11	2000
IEC 61000-3-12	2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase	EN 61000-3-12	2011
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	2009
IEC 61000-4-3 + A1 + A2	2006 2007 2010	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3 + A1 + A2	2006 2008 2010
IEC 61000-4-4 + corr. June + A1	2004 2007 2010	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4 + A1	2004 2010
IEC 61000-4-5 + corr. October	2005 2009	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006

Publication	Year	Title	EN/HD	Year
IEC 61000-4-6	2008	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2009
IEC 61000-4-8	2009	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	EN 61000-4-8	2010
IEC 61000-4-11	2004	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004
CISPR 11 (mod) + A1	2009 2010	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011 + A1	2009 2010

Annex ZZ
(informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers protection requirements of Annex I, Article 1 of the EC Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive[s] concerned.

NOTE Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

CONTENTS

INTRODUCTION

Instruments and equipment within the scope of this standard may often be geographically widespread and hence 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 should function without undue degradation in an electromagnetic environment typical for the locations where it is intended to be operated. In this respect the standard specifies three different types of electromagnetic environment and the levels for immunity. More detailed information about issues related to electromagnetic environments are given in IEC 61000-2-5. 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 should 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.

This part of IEC 61326 specifies the EMC requirements that are generally applicable to all equipment within its scope. For certain types of equipment, these requirements will be supplemented or modified by the special requirements of one, or more than one, particular part within IEC 61326-2 series. These should be read in conjunction with the IEC 61326-1 requirements.

ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – EMC REQUIREMENTS –

Part 1: General requirements

1 Scope

This part of IEC 61326 specifies requirements for immunity and emissions regarding electromagnetic compatibility (EMC) for electrical equipment, operating from a supply or battery of less than 1 000 V a.c. or 1 500 V d.c. or from the circuit being measured. Equipment intended for professional, industrial-process, industrial-manufacturing and educational use is covered by this part. It includes equipment and computing devices for

– 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 may be used in systems within the scope of this part of IEC 61326 without additional testing, if they are suitable for the intended electromagnetic environment.

It is generally considered that this standard takes precedence over the corresponding generic EMC standards.

The following equipment is covered by this standard.

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;
   – power supply units for 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 analyses substances, or is used to prepare materials, and includes In Vitro Diagnostic (IVD) equipment. This equipment may also be used in areas other than laboratories, for example self-test IVD equipment may be used in the home.

Equipment within the scope of this standard might be operated in different electromagnetic environments; depending on the electromagnetic environment different emission and immunity test requirements are applicable.

This standard considers three types of electromagnetic environments:

- basic electromagnetic environment;
- industrial electromagnetic environment;
- controlled electromagnetic environment.

Corresponding immunity test requirements are described in Clause 6.

In terms of emission requirements, equipment shall be classified in Class A or Class B equipment, as per the requirements and procedure of CISPR 11. The corresponding emission requirements are described in Clause 7.

2 Normative references

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

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.com>)

IEC 61000-3-2:2005, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
Amendment 1:2008
Amendment 2:2009

IEC 61000-3-3:2008, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC 61000-3-11:2000, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤75 A per phase*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
Amendment 1:2007
Amendment 2:2010

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*
Amendment 1:2010

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
Amendment 1:2010

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 as well as the following apply.

3.1
basic electromagnetic environment
environment existing at locations characterized by being supplied directly at low voltage from the public mains network

EXAMPLES

– residential properties, for example houses, apartments;

– retail outlets, for example shops, supermarkets;

– business premises, for example offices, banks;

– areas of public entertainment, for example cinemas, public bars, dance halls;

– outdoor locations, for example petrol stations, car parks, amusement and sports centres;

– light-industrial locations, for example workshops, laboratories, service centres.

3.2
class A equipment
equipment suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes

[SOURCE: derived from CISPR 11:2009, 5.3]

3.3
class B equipment
equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes

[SOURCE: derived from CISPR 11:2009, 5.3]

3.4
controlled electromagnetic environment
environment usually characterized by recognition and control of EMC threats by users of the equipment or by design of the installation

3.5
d.c. distribution network
local d.c. electricity supply network in the infrastructure of a certain site or building intended for connection to the d.c. power port of any type of equipment

3.6
enclosure port
physical boundary of equipment through which electromagnetic fields may radiate or impinge

3.7
functional performance
operational performance characteristics specified by the manufacturer of the equipment, defining the ability of equipment to achieve the intended functions

3.8
industrial electromagnetic environment
environment existing at 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) equipment (for example, welding machines)

3.9
laboratory
test and measurement area
area that is specifically used for analysis, testing and servicing and where equipment is operated by trained personnel

3.10
long-distance lines
lines within a building which are longer than 30 m, or which leave the building (including lines of outdoor installations)

3.11
port
any particular interface of the specific device or system with the external electromagnetic environment

EXAMPLE See Figure 1 for an example of Equipment Under Test (EUT).

Note 1 to entry: I/O ports are input, output or bi-directional, measurement, control, or data ports.

Note 2 to entry: Within this document, ports intended to be connected with earth potential for functional reasons (functional earth ports) are considered as I/O ports

Note 3 to entry: Within this document the protective earth port (if any) is considered as part of the power port.

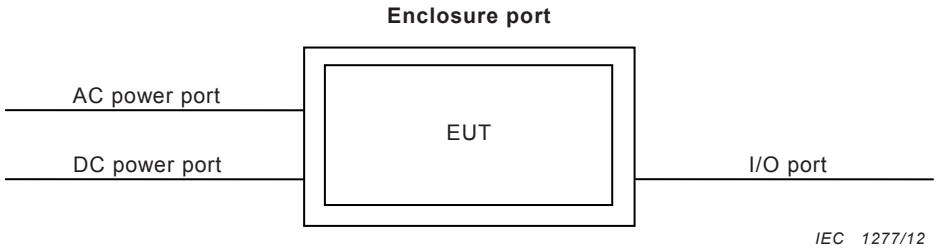

Figure 1 – Examples of ports

3.12
portable (measuring) instrument
measuring instrument designed to be easily carried by hand and to be connected and disconnected by the user

[SOURCE: IEC 60050-300:2001, 312-02-18]

3.13
type test
conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16]

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 operated.

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

For emissions, the objective of the requirements given in this standard 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. The emission limits are considered in 7.2.

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

NOTE 1 Higher immunity levels, different number of tests and different performance criteria than those specified can 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.

NOTE 2 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 3 The manufacturer may elect to perform all tests either on a single EUT or more than one. The testing sequence is optional.

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 to 5.5.

It may be determined from consideration of the electrical characteristics and usage of a particular item of equipment 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. If relevant, the software version 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 modules 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, which are 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.

If not otherwise specified in more specific parts of the IEC 61326 series, electrostatic discharges shall not be applied to inner pins of plug-in ports or cable connectors (but to connected connectors accessible during the intended use of the EUT).

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 may 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 functional performance

For immunity tests, functional performance for each operating mode and test shall be specified; where possible, as quantitative values.

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 set-ups are given in the basic standards, which are referred to in 6.2 and 7.2. Additional information needed for the practical implementation of the tests is given in this standard. The contents of standards need not be reproduced in the test plan. 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.

Tests shall be applied to the relevant ports in accordance with Tables 1 or 2 or 3, as applicable.

The tests shall be conducted in accordance with the basic standards. The tests shall be carried out one at a time. If additional measures not described in the basic standards are required, these measures and their rationale shall be documented in the test report.

6.2 Immunity test requirements

Table 1 gives the immunity requirements for equipment intended to be used in a basic electromagnetic environment.

Table 2 gives the immunity requirements for equipment intended to be used in an industrial electromagnetic environment.

Table 3 gives the immunity requirements for equipment intended to be used in a controlled electromagnetic environment.

The performance criteria A, B, and C that are mentioned in the following tables are described in 6.4.

Table 1 – Immunity test requirements for equipment intended to be used in a basic electromagnetic environment

Port	Phenomenon	Basic standard	Test value	Perform-ance criterion
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact discharge 8 kV air discharge	B B
	Electromagnetic field	IEC 61000-4-3	3 V/m (80 MHz to 1 GHz) 3 V/m (1,4 GHz to 2 GHz) 1 V/m (2,0 GHz to 2,7 GHz)	A A A
	Power frequency magnetic field	IEC 61000-4-8	3 A/m (50 Hz, 60 Hz) [f]	A
AC power (including protective earth)	Voltage dip	IEC 61000-4-11	0 % during half cycle 0 % during 1 cycle 70 % during 25/30[e] cycles	B B C
	Short interruptions	IEC 61000-4-11	0 % during 250/300[e] cycles	C
	Burst	IEC 61000-4-4	1 kV (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	0,5 kV[a])/1 kV[b])	B
	Conducted RF	IEC 61000-4-6	3 V (150 kHz to 80 MHz)	A
DC power[d, g] (including protective earth)	Burst	IEC 61000-4-4	1 kV(5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	0,5 kV[a]/1 kV[b]	B
	Conducted RF	IEC 61000-4-6	3 V (150 kHz to 80 MHz)	A
I/O signal/control (including functional earth)	Burst	IEC 61000-4-4	0,5 kV[d](5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	1 kV[b, c]	B
	Conducted RF	IEC 61000-4-6	3 V[d] (150 kHz to 80 MHz)	A
I/O signal/control connected directly to mains supply	Burst	IEC 61000-4-4	1 kV(5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	0,5 kV[a]/1 kV[b]	B
	Conducted RF	IEC 61000-4-6	3 V (150 kHz to 80 MHz)	A

[a] Line to line.

[b] Line to ground.

[c] Only in the case of long-distance lines (see 3.10).

[d] Only in the case of lines >3 m.

[e] For example “25/30 cycles" means "25 cycles for 50 Hz test" or "30 cycles for 60 Hz test”.

[f] Only to magnetically sensitive equipment. CRT display interference is allowed above 1 A/m.

[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.

Table 2 – Immunity test requirements for equipment intended to be used in an industrial electromagnetic environment

Port	Phenomenon	Basic standard	Test value	Perform-ance criterion
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact discharge 8 kV air discharge	B B
	Electromagnetic field	IEC 61000-4-3	10 V/m (80 MHz to 1 GHz) 3 V/m (1,4 GHz to 2 GHz) 1 V/m (2,0 GHz to 2,7 GHz)	A A A
	Power frequency magnetic field	IEC 61000-4-8	30 A/m (50 Hz, 60 Hz) [e]	A
AC power (including protective earth)	Voltage dip	IEC 61000-4-11	0 % during 1 cycle 40 % during 10/12[g] cycles 70 % during 25/30 [g] cycles	B C C
	Short interruptions	IEC 61000-4-11	0 % during 250/300 [g] cycles	C
	Burst	IEC 61000-4-4	2 kV(5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]	B
	Conducted RF	IEC 61000-4-6	3 V[f] (150 kHz to 80 MHz)	A
DC power[f] (including protective earth)	Burst	IEC 61000-4-4	2 kV (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]	B
	Conducted RF	IEC 61000-4-6	3 V[f] (150 kHz to 80 MHz)	A
I/O signal/ control (including functional earth)	Burst	IEC 61000-4-4	1 kV (5/50 ns, 5 kHz)[d]	B
	Surge	IEC 61000-4-5	1 kV[b, c]	B
	Conducted RF	IEC 61000-4-6	3 V[d, f] (150 kHz to 80 MHz)	A
I/O signal/ control connected directly to mains supply	Burst	IEC 61000-4-4	2 kV (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	1 kV[a]/2 kV[b]	B
	Conducted RF	IEC 61000-4-6	3 V[f] (150 kHz to 80 MHz)	A

[a] Line to line.

[b] Line to ground.

[c] Only in the case of long-distance lines (see 3.10).

[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] 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.

[g] For example “25/30 cycles" means "25 cycles for 50 Hz test" or "30 cycles for 60 Hz test”.

Table 3 – Immunity test requirements for equipment intended to be used in a controlled electromagnetic environment

Port	Phenomenon	Basic standard	Test value	Performance criterion
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact discharge 8 kV air discharge	B B
	Electromagnetic field	IEC 61000-4-3	1 V/m (80 MHz to 1 GHz) 1 V/m (1,4 GHz to 2 GHz) 1 V/m (2,0 GHz to 2,7 GHz)	A A A
AC power (including protective earth)	Voltage dip	IEC 61000-4-11	0 % during half cycle	B
	Burst	IEC 61000-4-4	1 kV (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	0,5 kV[a]/1 kV[b]	B
	Conducted RF	IEC 61000-4-6	1 V (150 kHz to 80 MHz)	A
DC power[c, d] (including protective earth)	Burst	IEC 61000-4-4	1 kV (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	Not required	-
	Conducted RF	IEC 61000-4-6	1 V (150 kHz to 80 MHz)	A
I/O signal/ control (including functional earth)	Burst	IEC 61000-4-4	0,5 kV[c] (5/50 ns, 5 kHz)	B
	Surge	IEC 61000-4-5	Not required	-
	Conducted RF	IEC 61000-4-6	1 V[c] (150 kHz to 80 MHz)	A

[a] Line to line.

[b] Line to ground.

[c] Only in the 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.

The manufacturer shall state that equipment fulfilling the requirements in Table 3 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 In general, analysis, test and service laboratories have controlled EM environments, and personnel in these areas are usually trained to be able to interpret results. Such environments normally contain equipment which requires protection by devices like Uninterruptible Power Supplies (UPS), filters, or surge suppressers. Hence, the test values shown in Table 3 are relaxed from those in Table 1.

6.3 Random aspects

The duration of each test and/or the number of tests shall be sufficient to ensure that the performance criterion is met consistently. Due care shall be taken to avoid a false test pass due to random effects (for example, due to a timing relationship between the test stimulus and the operation of the EUT).

NOTE This is of particular concern for EUTs with functionality that can be defined or controlled by software or firmware.

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.

6.4 Performance criteria

6.4.1 General

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

6.4.2 Performance criterion A

The equipment shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

6.4.3 Performance criterion B

The equipment shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

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 may deviate. After the test, the deviation vanishes.

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.

EXAMPLE 4 An intended change of the operating state is allowed if self-recoverable.

6.4.4 Performance criterion C

Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

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 programme interruption caused by a disturbance, the processor functions of the equipment stops at a defined position and is not left in a "crashed state". The operator's decision prompts may be necessary.

EXAMPLE 3 The test results in an opening of an over-current protection device that is replaced or reset by the operator.

7 Emission requirements

7.1 Conditions during measurements

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

The description of the tests, the test methods, and the test set-ups are given in the reference standards as stated in 7.2. 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 may be given in the different parts of the IEC 61326 series.

7.2 Emission limits

The equipment shall be classified and respective information shall be provided per the applicable group and class as specified within CISPR 11:2009, Clause 5. Equipment classification and choice of respective limits shall be determined after taking into account the intended environment and emission requirement in the areas of use.

For Class A equipment, the limits, the measuring methods and the provisions given in CISPR 11 apply.

For Class B equipment, the limits, the measuring methods and the provisions given in CISPR 11, IEC 61000-3-2 (or IEC 61000-3-12) and IEC 61000-3-3 (or IEC 61000-3-11) apply.

For equipment using frequencies in the ISM bands, see CISPR 11.

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 requirements, i.e. which type of electromagnetic environment is considered;
– performance criteria;
– test data and results;
– if applicable, characteristics of equipment operation deviation from functional performance;
– test equipment and test set-up.

9 Instructions for use

The manufacturer shall indicate the electromagnetic environment for which the EUT is intended to be used.

If the manufacturer has specified a minimum performance level or any permissible performance loss (as allowed in 6.4), valid under the electromagnetic immunity conditions (see 6.2), then the related performance level shall be described in the instructions for use.

Annex A
(normative)

Immunity test requirements for portable test and measurement equipment powered by battery or from the circuit being measured

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 annex 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 number of electromagnetic phenomena shown in Table A.1 is reduced in relation to Table 1.

NOTE 2 Examples for equipment included in the scope of this annex but not limited to, are: equipment covered by the scope of IEC 61326-2-2, digital multi-meters, stand alone current clamps, laboratory equipment, programmers, on-site calibration units. Such equipment is intended to be operated by skilled personal and for a short duration of measuring time only.

NOTE 3 Examples for equipment excluded from the scope of this annex are: monitoring equipment, control equipment, energy meters, power meters, power analyzers, power quality instruments, oscilloscopes. Such equipment is typically operated over a longer duration of measuring time.

NOTE 4 If RF transmitters are used in close proximity, they may disturb equipment within the scope of this standard.

Table A.1 – Immunity test requirements for portable test and measurement equipment

Port	Phenomenon	Basic standard	Test value	Performance criterion
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact discharge 8 kV air discharge	B B
	Electromagnetic field	IEC 61000-4-3	3 V/m (80 MHz to 1 GHz) 3 V/m (1,4 GHz to 2 GHz) 1 V/m (2,0 GHz to 2,7 GHz)	A A A
	Power-frequency magnetic field [a]	IEC 61000-4-8	3 A/m at 50 Hz, 60 Hz [b]	A

[a] Only to magnetically sensitive equipment. CRT display interference is allowed above 1 A/m.

[b] The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended for use in areas supplied only at one of these frequencies need only be tested at that frequency

A battery charger used by the products within the scope of this Annex shall be tested according to the requirements given in one of the Tables 1, 2 or 3 depending on the intended electromagnetic environment.

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IEC 61010 (all parts), *Safety requirements for electrical equipment for measurement, control, and laboratory use*

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IEC 61326-2-2, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable test, measuring and monitoring equipment used in low-voltage distribution systems*

IEEE 1284:2000, *IEEE standard signalling method for a bi-directional parallel peripheral interface for personal computers*

TIA/EIA-232-F, *Interface between data terminal equipment and data circuit-terminating equipment employing serial binary data interchange*

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