

© Copyright SEK. Reproduction in any form without permission is prohibited.

Programmerbara styrsystem – Del 2: Utrustning – Fordringar och provning

*Programmable controllers –
Part 2: Equipment requirements and tests*

Som svensk standard gäller europastandarden EN 61131-2:2007. Den svenska standarden innehåller den officiella engelska språkversionen av EN 61131-2:2007.

Nationellt förord

Europastandarden EN 61131-2:2007

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61131-2, Third edition, 2007 - Programmable controllers -
Part 2: Equipment requirements and tests**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61131-2, utgåva 2, 2003, gäller ej fr o m 2010-08-01.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

English version

**Programmable controllers -
Part 2: Equipment requirements and tests
(IEC 61131-2:2007)**

Automates programmables -
Partie 2: Spécifications
et essais des équipements
(CEI 61131-2:2007)

Speicherprogrammierbare Steuerungen -
Teil 2: Betriebsmittelanforderungen
und Prüfungen
(IEC 61131-2:2007)

This European Standard was approved by CENELEC on 2007-08-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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

Foreword

The text of document 65B/623/FDIS, future edition 3 of IEC 61131-2, prepared by SC 65B, Devices & process analysis, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61131-2 on 2007-08-01.

This European Standard supersedes EN 61131-2:2003.

EN 61131-2:2007 includes the following significant technical changes with respect to EN 61131-2:2003.

- a) DC power port requirements have been moved from Clause 8 to Clause 5.
- b) Correction of the following tests of Clause 6:
 - voltage range test;
 - fast supply voltage variation test;
 - slow supply voltage variation test;
 - gradual shut-down/start-up test.
- c) Change of EMC requirements in Clause 8:
 - requirements for radiofrequency interference in Table 33 changed from 3 V to 10 V;
 - for Zone B equipment;
 - reference to EMC basic standards with the last version;
 - reference to generic standards 61000-6-x;
 - cable length aligned to generic standards.
- d) Correction of the following tests in Clause 9:
 - voltage dips and interruptions – power port type tests and verifications.
- e) New organization of Clause 11:
 - equipment types and protection;
 - open PLC-system equipment;
 - enclosed PLC-system equipment:
 - Class I equipment,
 - Class II equipment,
 - Class III equipment;
 - protection against electric shock;
 - definition of secondary circuits which do not pose a risk of electric shock:
 - Class 2 circuit,
 - limited voltage/current circuit,
 - limited voltage circuit,
 - limited energy circuit ≤ 30 V a.c. or 42,2 V peak,
 - limited impedance circuit;
 - protection against the spread of fire within limited power circuits;
 - protective earthing requirements for enclosed equipment;
 - minor improvements in different subclauses;
 - impulse test only for verification of clearances.

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) 2008-05-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2010-08-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives EMC (89/336/EEC) and EMC2 (2004/108/EC). See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61131-2:2007 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 60112	NOTE	Harmonized as EN 60112:2003 (not modified).
IEC 60445	NOTE	Harmonized as EN 60445:2007 (not modified).
IEC 61140	NOTE	Harmonized as EN 61140:2002 (not modified).
IEC 62079	NOTE	Harmonized as EN 62079:2001 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060-1 + corr. March corr. March	1989 1990 1992	High-voltage test techniques - Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60068-2-1	2007	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	2007
IEC 60068-2-2	1974	Environmental testing - Part 2: Tests - Tests B: Dry heat	EN 60068-2-2 ¹⁾	1993
IEC 60068-2-6 + corr. March	1995 1995	Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 60068-2-14	1984	Environmental testing - Part 2: Tests - Test N: Change of temperature	EN 60068-2-14 ²⁾	1999
IEC 60068-2-27	1987	Basic environmental testing procedures - Part 2: Tests - Test Ea and guidance: Shock	EN 60068-2-27	1993
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60068-2-31	1969	Basic environmental testing procedures - Part 2: Tests - Test Ec: Drop and topple, primarily for equipment-type specimens	EN 60068-2-31 ³⁾	1993
IEC 60068-2-32	1975	Environmental testing - Part 2: Tests -Test Ed: Free fall	EN 60068-2-32 ⁴⁾	1993
IEC 60364-1 (mod)	2005	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	prHD 60364-1	200X
IEC 60364-4-41 (mod)	2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41 + corr. July	2007 2007
IEC 60417	Data- base	Graphical symbols for use on equipment	-	-

¹⁾ EN 60068-2-2 includes supplement A:1976 to IEC 60068-2-2.

²⁾ EN 60068-2-14 includes A1:1986 to IEC 60068-2-14.

³⁾ EN 60068-2-31 includes A1:1982 to IEC 60068-2-31.

⁴⁾ EN 60068-2-32 includes A2:1990 to IEC 60068-2-32.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
A1	1999		+ corr. May A1	1993
				2000
IEC 60664-1	1992	Insulation coordination for equipment within low-voltage systems -		
+ A1	2000			
+ A2	2002	Part 1: Principles, requirements and tests	EN 60664-1 ⁵⁾	2003
IEC 60664-3	2003	Insulation coordination for equipment within low-voltage systems -	EN 60664-3	2003
		Part 3: Use of coating, potting or moulding for protection against pollution		
IEC 60695-2-11	2000	Fire hazard testing -	EN 60695-2-11	2001
		Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products		
IEC 60695-11-10	1999	Fire hazard testing -	EN 60695-11-10	1999
		Part 11-10: Test flames - 50 W horizontal and vertical flame test methods		
IEC 60947-5-1	2003	Low-voltage switchgear and controlgear -	EN 60947-5-1	2004
		Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices	+ corr. July	2005
IEC 60947-5-2	1997	Low-voltage switchgear and controlgear -	EN 60947-5-2	1998
(mod)		Part 5-2: Control circuit devices and switching elements - Proximity switches		
A1	1999		A1	1999
A2	2003		A2	2004
IEC 60947-7-1	2002	Low-voltage switchgear and controlgear -	EN 60947-7-1	2002
		Part 7-1: Ancillary equipment - Terminal blocks for copper conductors		
IEC 60950-1 (mod)	2001	Information technology equipment - Safety -	EN 60950-1 ⁶⁾	2001
		Part 1: General requirements	+ corr. August + A11	2007
				2004
IEC 61000-4-2	1995	Electromagnetic compatibility (EMC) -	EN 61000-4-2	1995
		Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test		
IEC 61000-4-3	2006	Electromagnetic compatibility (EMC) -	EN 61000-4-3	2006
		Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test		
IEC 61000-4-4	2004	Electromagnetic compatibility (EMC) -	EN 61000-4-4	2004
		Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test		
IEC 61000-4-5	2005	Electromagnetic compatibility (EMC) -	EN 61000-4-5	2006
		Part 4-5: Testing and measurement techniques - Surge immunity test		

⁵⁾ EN 60664-1 is superseded by EN 60664-1:2007, which is based on IEC 60664-1:2007.

⁶⁾ EN 60950-1 is superseded by EN 60950-1:2006, which is based on IEC 60950-1:2005 (mod).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-6	2003	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6 ⁷⁾ + corr. August	2007 2007
IEC 61000-4-8	1993	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	EN 61000-4-8	1993
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
IEC 61000-4-18	2006	Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Oscillatory wave immunity test	EN 61000-4-18	2007
IEC 61000-4-29	2000	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests	EN 61000-4-29	2000
IEC 61000-6-1	2005	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments	EN 61000-6-1	2007
IEC 61000-6-2	2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	EN 61000-6-2 + corr. September	2005 2005
IEC 61000-6-4	2006	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	EN 61000-6-4	2007
IEC 61010-1	2001	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements	EN 61010-1 + corr. June	2001 2002
IEC 61131-1	2003	Programmable controllers - Part 1: General information	EN 61131-1	2003
IEC 61131-3	2003	Programmable controllers - Part 3: Programming languages	EN 61131-3	2003
IEC/TR 61131-4	2004	Programmable controllers - Part 4: User guidelines	-	-
CISPR 14-1	2005	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	EN 55014-1	2006

⁷⁾ EN 61000-4-6 includes A1:2004 + A2:2006 to IEC 61000-4-6.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 16-1-2	2003	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances	EN 55016-1-2	2004
CISPR 16-1-4 A1	2003 2004	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbances	EN 55016-1-4 ⁸⁾ A1	2004 2005
CISPR 16-2-1 A1	2003 2005	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements	EN 55016-2-1 A1	2004 2005
CISPR 16-2-3	2006	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements	EN 55016-2-3	2006

⁸⁾ EN 55016-1-4 is superseded by EN 55016-1-4:2007, which is based on CISPR 16-1-4:2007.

CONTENTS

1	General	13
1.1	Scope and object.....	13
1.2	Compliance with this standard.....	14
1.3	Normative references	14
2	Type tests	17
2.1	Equipment to be tested (equipment under test/EUT).....	17
2.2	Special features for immunity and EMC tests.....	18
2.3	Withstand test conditions	19
2.4	Verification procedure	19
2.5	Requirements for test programmes and proper functioning verification procedures (PFVPs) to be provided by the manufacturer	19
2.6	General conditions for tests.....	20
3	Terms and definitions	20
4	Normal service conditions and requirements.....	28
4.1	Climatic conditions and requirements	28
4.1.1	Operating ambient air temperature	28
4.1.2	Relative humidity	28
4.1.3	Altitude.....	28
4.1.4	Pollution degree	29
4.2	Mechanical service conditions and requirements	29
4.2.1	Vibrations	29
4.2.2	Shock	29
4.2.3	Free falls (portable and hand-held equipment).....	30
4.3	Transport and storage conditions and requirements	30
4.3.1	Temperature.....	30
4.3.2	Relative humidity	30
4.3.3	Altitude.....	30
4.3.4	Free falls (PLC units in manufacturer's original packaging).....	31
4.3.5	Other conditions	31
4.4	Electrical service conditions and requirements	31
4.4.1	AC and d.c. equipment power supply.....	31
4.4.2	Overvoltage category, control of transient overvoltages.....	31
4.4.3	Non-periodic overvoltages	31
4.5	Special conditions and requirements	31
5	Functional requirements	31
5.1	Functional power supply and memory back-up requirements	33
5.1.1	AC and d.c. power supply	33
5.1.2	Memory back-up	34
5.2	Digital I/Os	34
5.2.1	Digital inputs (current sinking)	35
5.2.2	Digital outputs for alternating currents (current sourcing).....	37
5.2.3	Digital outputs for direct current (current sourcing)	40

5.3	Analogue I/Os	41
5.3.1	Analogue inputs.....	41
5.3.2	Analogue outputs.....	41
5.4	Communication interface requirements.....	42
5.5	Main processing unit(s) and memory(ies) of the PLC-system requirements	42
5.6	Remote input/output stations (RIOSs) requirements	42
5.7	Peripherals (PADTs, TEs, HMIs) requirements	42
5.8	PLC-system self-tests and diagnostics requirements	43
5.9	Functional earthing.....	43
5.10	Mounting requirements	43
5.11	General marking requirements	44
5.11.1	Functional identifications	44
5.11.2	Module location and module identifications.....	44
5.11.3	Functional earth terminals markings	44
5.12	Requirements for normal service and functional type tests and verifications	44
5.13	Requirements for information on normal service and function	44
6	Normal service and functional type tests and verifications	44
6.1	Climatic tests	44
6.2	Dry-heat and cold withstand tests.....	45
6.2.1	Variation of temperature	46
6.2.2	Cyclic damp heat withstand test	47
6.3	Mechanical tests	48
6.3.1	Vibration (type test associated with normal service conditions).....	48
6.3.2	Shock (type test associated with normal service conditions)	48
6.3.3	Free fall (type test associated with normal service conditions).....	49
6.3.4	Free fall (type test associated with transport and storage conditions)	49
6.3.5	Plugging/unplugging of removable units.....	49
6.4	Verification of special functional requirements for power ports and memory back-up – Special immunity limits for power ports	49
6.4.1	Verification of functional equipment power input port (a.c. or d.c.)	50
6.4.2	External energy supply variation tests (immunity tests).....	51
6.4.3	Improper equipment power supply connection tests	54
6.4.4	Verification of memory back-up requirements	55
6.5	Verification of input/output requirements	55
6.5.1	General	55
6.5.2	Verification of digital inputs.....	56
6.5.3	Verification of digital outputs	56
6.5.4	Verification of analogue I/Os.....	57
6.6	Verification of communication interface requirements	58
6.7	Verification of MPU requirements	58
6.8	Verification of remote I/O stations	59
6.8.1	Response time test.....	59
6.8.2	Loss of communication test	59
6.8.3	Verification of other requirements	59
6.9	Verification of peripheral (PADTs, TEs, HMIs) requirements.....	59
6.10	Verification of PLC-system self-tests and diagnostics	59
6.11	Verification of markings and manufacturer's documentation.....	59
7	General information to be provided by the manufacturer	60
7.1	Information on type and content of documentation.....	60

7.1.1	Information on catalogues and datasheets	60
7.1.2	Information on user's manuals	60
7.1.3	Information on technical documentation	60
7.2	Information on compliance with this standard	60
7.3	Information on reliability	61
7.4	Information on other conditions	61
7.5	Information on shipping and storage	61
7.6	Information on a.c. and d.c. power supply	61
7.7	Information on digital inputs (current sinking)	61
7.8	Information on digital outputs for alternating currents (current sourcing)	62
7.9	Information on digital outputs for direct current (current sourcing)	63
7.10	Information on analogue inputs	63
7.10.1	Information on analogue input static characteristics	63
7.10.2	Information on analogue input dynamic characteristics	63
7.10.3	Information on analogue input general characteristics	64
7.10.4	Information on analogue input miscellaneous characteristics	64
7.11	Information on analogue outputs	64
7.11.1	Information on analogue output static characteristics	64
7.11.2	Information on analogue output dynamic characteristics	64
7.11.3	Information on analogue output general characteristics	65
7.11.4	Information on analogue output miscellaneous characteristics	65
7.12	Information on communication interfaces	65
7.13	Information on main processing unit(s) and memory(ies) of the PLC-system	65
7.14	Information on remote input/output stations (RIOs)	66
7.15	Information on peripherals (PADTs, TEs, HMIs)	67
7.16	Information on self-tests and diagnostics	67
8	Electromagnetic compatibility (EMC) requirements	67
8.1	General	67
8.2	Emission requirements	68
8.2.1	General requirements for emission	68
8.2.2	Emission limits in the low-frequency range	68
8.2.3	Emission limits in the high-frequency range	68
8.3	EMC immunity requirements	68
8.3.1	General	69
8.3.2	Performance criteria	70
8.3.3	Immunity levels	71
8.3.4	Voltage dips and interruptions power ports	73
8.4	Requirements for EMC tests and verifications	74
8.5	Requirements for information on EMC	74
9	Electromagnetic compatibility (EMC) type tests and verifications	74
9.1	Electromagnetic compatibility-related tests	74
9.2	Test environment	75
9.3	Measurement of radiated interference	75
9.4	Measurement of conducted interference	75
9.5	Electrostatic discharge	76
9.6	Radiofrequency electromagnetic field – Amplitude modulated	76
9.7	Power-frequency magnetic fields	77
9.8	Fast transient bursts	77
9.9	High-energy surges	78

9.10	Conducted radiofrequency interference	78
9.11	Damped oscillatory wave (for zone C only)	79
9.12	Voltage dips and interruptions	79
10	Electromagnetic compatibility (EMC) information to be provided by the manufacturer	80
11	Safety requirements	80
11.1	Equipment types and protection	80
11.1.1	Open PLC-system equipment	80
11.1.2	Enclosed PLC-system equipment	80
11.2	Protection against electrical shock	82
11.2.1	Permissible limits for accessible parts	82
11.2.2	Dielectric strength	83
11.2.3	Ports requiring protection	83
11.2.4	Protection in normal condition	84
11.2.5	Protection in single-fault condition	85
11.2.6	Secondary circuits which do not pose a risk of electrical shock	86
11.3	Protection against the spread of fire	87
11.3.1	Limited power circuits	87
11.4	Clearance and creepage distances requirements	88
11.4.1	Clearances relating to overvoltage category II	89
11.4.2	Clearances for micro-environment where voltages are known and controlled	90
11.4.3	Creepage distances for basic and supplementary insulation	91
11.4.4	Creepage distances for double/reinforced insulation	94
11.4.5	Creepage for field-wiring terminals	94
11.5	Flame-retardant requirements for non-metallic materials	94
11.5.1	Non-metallic enclosure material	94
11.5.2	Non-metallic material supporting live parts	94
11.5.3	Non-metallic parts	95
11.5.4	Decorative and labelling materials	95
11.5.5	Internal wiring or interconnection cables	95
11.6	Temperature limits	95
11.7	Enclosures	95
11.7.1	Open equipment	96
11.7.2	Enclosed equipment	96
11.8	Operator-accessible hazardous live field-wiring terminal constructional requirements	96
11.9	Provisions for protective earthing	96
11.9.1	Protective earthing requirements for enclosed equipment	97
11.9.2	Protective earthing requirements for open equipment	97
11.10	Wiring	98
11.10.1	Internal wiring	98
11.10.2	Interconnection wiring	98
11.10.3	Equipment power input cord	98
11.11	Switching devices	99
11.12	Components related to safety requirements	99
11.13	Battery requirements	99
11.14	Maximum voltage and minimum voltage	99
11.15	Markings and identification	99
11.15.1	External wiring terminals identification	100

11.15.2	Live parts	100
11.15.3	Protective earth terminals markings.....	100
11.15.4	Enclosed Class II equipment	100
11.15.5	Equipment supplied by SELV/PELV.....	101
11.15.6	Rating information	101
11.16	Requirements for safety type tests and verifications	101
11.17	Requirements for safety routine tests and verifications	101
11.17.1	Requirement for dielectric strength verification	101
11.17.2	Requirement for protective earthing verification.....	101
11.18	Requirements for information on safety.....	101
12	Safety type tests and verifications	102
12.1	Safety-related mechanical tests and verifications	102
12.1.1	Impact withstand test.....	102
12.1.2	Operator accessibility tests.....	103
12.1.3	General examination of openings.....	103
12.1.4	Wire flexing test.....	104
12.1.5	Temperature test	104
12.1.6	Protective coating test	104
12.1.7	Rigidity test	104
12.1.8	Clearance and creepage verification.....	105
12.1.9	Field-wiring terminals constructional verification	105
12.2	Safety-related electrical tests	105
12.2.1	Dielectric withstand verification test.....	105
12.2.2	Protective earthing continuity test.....	107
12.2.3	Stored energy injury risk test	108
12.2.4	Overload test.....	108
12.2.5	Endurance test	108
12.3	Single-fault condition tests	109
12.3.1	Single-fault condition – General.....	109
12.3.2	Single-fault condition – Breakdown of components test	109
12.3.3	Single-fault condition – Protective impedance test.....	110
12.3.4	Single-fault condition – isolation transformers test.....	110
12.4	Limited power circuits test.....	110
13	Safety routine tests	110
13.1	Dielectric withstand test	110
13.2	Dielectric withstand verification test.....	111
13.3	Protective earthing test	111
14	Safety information to be provided by the manufacturer	111
14.1	Information on evaluation of enclosures for open equipment (power dissipation).....	112
14.2	Information on mechanical terminal connection	112
Annex A (informative)	Illustration of PLC-system hardware definitions	113
Annex B (informative)	Digital input standard operating range equations.....	114
Annex C (normative)	Test tools.....	115
Annex D (informative)	Zone C – EMC immunity levels	118
Annex E (informative)	Overvoltage example.....	120
Bibliography		122

Figure 1 – EUT configurations	18
Figure 2 – Typical interface/port diagram of a PLC-system	32
Figure 3 – I/O Parameters.....	35
Figure 4 – U-I operation regions of current-sinking inputs	36
Figure 5 – Temporary overload waveform for digital a.c. outputs.....	38
Figure 6 – Temporary overload waveform for digital d.c. outputs.....	40
Figure 7 – Third harmonic immunity test	51
Figure 8 – Gradual shut-down/start-up test	52
Figure 9 – Fast supply voltage variation test	53
Figure 10 – Slow supply voltage variation test	54
Figure 11 – EMC immunity zones.....	69
Figure 12 – Impact withstand test procedure.....	102
Figure 13 – Dielectric withstand test procedures	107
Figure A.1 – Programmable controller system (PLC-system).....	113
Figure C.1 – Jointed test finger	115
Figure C.2 – 15 mm × 3 mm test pin	116
Figure C.3 – 100 mm × 4 mm test pin	116
Figure C.4 – 100 mm × 3 mm test pin	117
Figure E.1 – Creepage distances of circuits where recurring peak voltages are generated	120
Table 1 – General conditions for tests.....	20
Table 2 – Operating ambient air temperature of PLC-systems.....	28
Table 3 – Sinusoidal vibrations service conditions for PLC-systems.....	29
Table 4 – Free fall on concrete floor for portable and hand-held equipment	30
Table 5 – Free fall on concrete floor in manufacturer's original packaging	31
Table 6 – Rated values and operating ranges of incoming power supply.....	33
Table 7– Voltage interruptions (functional requirements).....	34
Table 8 – Standard operating ranges for digital inputs (current sinking)	37
Table 9 – Rated values and operating ranges for current sourcing digital a.c. outputs	38
Table 10 – Rated values and operating ranges (d.c.) for current-sourcing digital d.c. outputs	40
Table 11 – Rated values and impedance limits for analogue inputs.....	41
Table 12 – Rated values and impedance limits for analogue outputs.....	41
Table 13 – Dry-heat and cold withstand tests.....	45
Table 14 – Change of temperature, withstand and immunity tests	46
Table 15 – Cyclic (12 + 12) damp-heat test.....	47
Table 16 – Immunity vibration test	48
Table 17 – Immunity shock test.....	48
Table 18 – Free-fall immunity/withstand tests (portable and hand-held equipment)	49
Table 19 – Free-fall withstand test (units within manufacturer's original packaging)	49
Table 20 – Insertion/withdrawal of removable units	49
Table 21 – Voltage ripple and frequency range immunity test.....	50

Table 22 – Third harmonic immunity test.....	50
Table 23 – Gradual shut-down/start-up test	52
Table 24 – Supply voltage variation tests	53
Table 25 – Voltage interruptions immunity test (Functional tests).....	54
Table 26 – Back-up duration withstand test.....	55
Table 27 – Change of energy source test.....	55
Table 28 – Overload and short-circuit tests for digital outputs	57
Table 29 – Emission limits	68
Table 30 – EMC immunity zones, example regarding surge	70
Table 31 – Criteria to prove the performance of a PLC-system against EMC disturbances	70
Table 32 – Enclosure port tests, Zones A and B.....	71
Table 33 – Conducted immunity tests, Zone B	72
Table 34 – Conducted immunity tests, zone A.....	73
Table 35 – Voltage dips and interruptions (EMC requirements).....	74
Table 36 – Radiated emission measurement.....	75
Table 37 – Conducted emission measurement	75
Table 38 – Electrostatic discharge immunity test.....	76
Table 39 – Radiated electromagnetic field immunity test.....	76
Table 40 – Power-frequency magnetic field immunity test	77
Table 41 – Fast transient burst immunity test.....	77
Table 42 – High-energy surge immunity test	78
Table 43 – Conducted r.f. immunity test	78
Table 44 – Damped oscillatory wave immunity test	79
Table 45 – Voltage dips and interruptions immunity test (EMC tests)	79
Table 46 – Shock protection requirements for open and enclosed equipment.....	84
Table 47 – Limits of output current and output power for inherently limited power sources.....	88
Table 48 – Limits of output current, output power and ratings for over-current protective devices for non-inherently limited power sources.....	88
Table 49 – Minimum clearances in air corresponding to overvoltage category II conditions (except for field wiring terminals) for basic/supplementary insulation.....	89
Table 50 – Minimum clearances in air corresponding to overvoltage category II conditions (except for field wiring terminals) for double /reinforced insulation	90
Table 51 – Minimum clearances in air at field-wiring terminals	90
Table 52 – Minimum clearances in air for micro-environment where the voltages are known and controlled	91
Table 53 – Classification of material group according to comparative tracking index (CTI).....	91
Table 54 – Minimum creepage distances for other than printed circuit boards (1).....	92
Table 55 – Minimum creepage distances for printed circuit boards (1), (6), (9) (basic and supplementary insulation)	93
Table 56 – Minimum creepage distances related to recurring peak voltages on printed wiring boards without protective coating (1) (pollution degrees 1 and 2).....	94
Table 57 – Temperature limits	95
Table 58 – Impact withstand test (1)	102

Table 59 – Operator accessibility tests (1)	103
Table 60 – Dielectric withstand voltages for impulse a.c. power-frequency and d.c. tests for basic/supplementary insulation (5)	106
Table 61 – Dielectric withstand voltages for impulse a.c. power frequency and d.c. tests for double/reinforced insulation (5)	107
Table 62 – Overload test circuit values	108
Table 63 – Endurance test circuit values.....	109
Table 64 – Routine dielectric withstand test (5).....	111
Table D.1 – Enclosure port tests, Zone C.....	118
Table D.2 – Conducted immunity tests, Zone C.....	119

PROGRAMMABLE CONTROLLERS –

Part 2: Equipment requirements and tests

1 General

1.1 Scope and object

This part of IEC 61131 specifies requirements and related tests for programmable controllers (PLCs) and their associated peripherals (for example, programming and debugging tools (PADTs), human-machine interfaces (HMIs), etc.) which have as their intended use the control and command of machines and industrial processes.

PLCs and their associated peripherals are intended to be used in an industrial environment and may be provided as open or enclosed equipment. If a PLC or its associated peripherals are intended for use in other environments (light industrial, commercial, residential), then the specific requirements, standards and installation practices for those other environments should be additionally applied to the PLC and its associated peripherals.

This standard also applies to any products performing the function of PLCs and/or their associated peripherals.

Equipment covered in this standard is intended for use in overvoltage category II (IEC 60664-1) in low-voltage installations, where the rated equipment supply voltage does not exceed a.c. 1 000 V r.m.s. (50/60 Hz), or d.c. 1 500 V. (If PLCs or their associated peripherals are applied in overvoltage category III installations, then additional analysis will be required to determine the suitability of the equipment for those applications.)

This standard does not deal with the functional safety or other aspects of the overall automated system. PLCs, their application programme and their associated peripherals are considered as components of a control system.

Since PLCs are component devices, safety considerations for the overall automated system including installation and application are beyond the scope of this standard. Refer to IEC 60364-1 or applicable national/local regulations for electrical installation and guidelines.

However, PLC safety as related to electric shock and fire hazards, electrical interference immunity and error detecting of the PLC-system operation (such as the use of parity checking, self-testing diagnostics, etc.), are addressed.

The object of this standard is

- to establish the definitions and identify the principal characteristics relevant to the selection and application of PLCs and their associated peripherals;
- to specify the minimum requirements for functional, electrical, mechanical, environmental and construction characteristics, service conditions, safety, EMC, user programming and tests applicable to PLCs and the associated peripherals.

This standard also specifies

- a) service, storage and transportation requirements for PLCs and their associated peripherals (Clause 4);
- b) functional requirements for PLCs and their associated peripherals (Clause 5);
- c) EMC requirements for PLCs and their associated peripherals (Clause 8);

- d) safety requirements for PLCs and their associated peripherals (Clause 11);
- e) information that the manufacturer is required to supply (Clauses 7, 10 and 14);
- f) test methods and procedures that are to be used for the verification of compliance of PLCs and their associated peripherals with the requirements (Clauses 6, 9 and 12).
- g) safety routine tests for PLCs and their peripherals (Clause 13).

The tests are type tests or production routine tests, and not tests related to the ways PLC systems are applied.

1.2 Compliance with this standard

When compliance with this standard is indicated without qualification, compliance with all clauses, including all tests and verifications required in this standard, should be verified. Moreover, the manufacturer's obligations expressed in this standard are not waived if no type test is required, or if the test conditions are restricted for practical reasons.

When compliance with some portion of this standard is indicated, it is only necessary to verify compliance with those clauses against which the compliance claim is made. The manufacturer's obligations as indicated above are still applicable. The smallest unit of this standard for compliance purposes should be a clause, such as Clauses 5, 8 or 11.

Compliance with a portion of this standard is provided to facilitate efforts with respect to particular conformity assessment requirements (for example, Clause 8, 9 and 10 as the compliance requirements for the EU electromagnetic compatibility directive or Clause 11, 12, 13 and 14 as the compliance requirements for the EU low-voltage directive).

Compliance with constructional requirements and with requirements for information to be provided by the manufacturer should be verified by suitable examination, visual inspection and/or measurement.

All requirements not tested according to the clauses on tests and verifications should be verifiable under a procedure to be agreed to by the manufacturer and the user.

The manufacturer shall provide, on request, compliance verification information for all requirements referenced in the claims of compliance with all or a portion of this standard.

It is the manufacturer's responsibility to ensure that delivered PLC equipment and associated peripherals are equivalent to the sample(s) which have been type-tested according to this standard and therefore that they comply with all requirements of this standard.

Significant modifications shall be indicated through the use of suitable revision level indexes and markings (see 5.11 and 11.15) and shall comply with this standard.

NOTE A new type test may be required to confirm compliance.

Where the manufacturer is allowed to select among several options, he shall clearly specify in his catalogues and/or datasheets those to which any portion of the PLC-system equipment complies. This applies to severity classes of voltage dips (i.e. PS1 or PS2) and types of digital inputs (i.e. Type 1 or Type 3).

1.3 Normative references

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

IEC 60060-1:1992, *High-voltage test techniques – Part 1: General definitions and test requirements*