BS EN IEC 61800-5-1:2023
Incorporating corrigendum September 2023



BSI Standards Publication

Adjustable speed electrical power drive systems

Part 5-1: Safety requirements — Electrical, thermal and energy

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Full document details: BS EN IEC 61800-5-1:2023

National foreword

This British Standard is the UK implementation of EN IEC 61800-5-1:2023. It is identical to IEC 61800-5-1:2022, incorporating corrigendum September 2023. It supersedes BS EN 61800-5-1:2007+A11:2021, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power electronics.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected
30 November 2023	Implementation of IEC corrigendum September 2023

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English Version

Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1:2022 + COR1:2023)

Entraînements électriques de puissance à vitesse variable - Partie 5-1: Exigences de sécurité - Électrique, thermique et énergétique (IEC 61800-5-1:2022 + COR1:2023)

Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl - Teil 5-1: Anforderungen an die Sicherheit - Elektrische, thermische und energetische Anforderungen (IEC 61800-5-1:2022 + COR1:2023)

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European foreword

The text of document 22G/455/FDIS, future edition 3 of IEC 61800-5-1 + COR1, prepared by SC 22G "Adjustable speed electric power drive systems (PDS)" of IEC/TC 22 "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61800-5-1:2023.

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) 2024-04-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-10-20

This document supersedes EN 61800-5-1:2007 and all of its amendments and corrigenda (if any).

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The text of the International Standard IEC 61800-5-1:2022 + COR1:2023 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 standard indicated:

IEC 60034-9:2021	NOTE	Approved as EN IEC 60034-9:—[1] (not modified)
IEC 60060-1:2010	NOTE	Approved as EN 60060-1:2010 (not modified)
IEC 60068-1:2013	NOTE	Approved as EN 60068-1:2014 (not modified)
IEC 60068-2-14	NOTE	Approved as EN IEC 60068-2-14
IEC 60068-2-31:2008	NOTE	Approved as EN 60068-2-31:2008 (not modified)
IEC 60071-1:2019	NOTE	Approved as EN IEC 60071-1:2019 (not modified)
IEC 60073:2002	NOTE	Approved as EN 60073:2002 (not modified)
IEC 60085:2007	NOTE	Approved as EN 60085:2008 (not modified)
IEC 60112:2020	NOTE	Approved as EN IEC 60112:2020 (not modified)
IEC 60127-2:2014	NOTE	Approved as EN 60127-2:2014 (not modified)
IEC 60127-4:2005	NOTE	Approved as EN 60127-4:2005 (not modified)

[1] To be published. Stage at the time of publication: FprEN IEC 60034-9:2021.

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IEC 60204-1:2016	NOTE	Approved as EN 60204-1:2018
IEC 60216 (series)	NOTE	Approved as EN 60216 (series)
IEC 60320-1	NOTE	Approved as EN IEC 60320-1
IEC 60335-1:2020	NOTE	Approved as EN IEC 60335-1:—[2] (not modified)
IEC 60364 (series)	NOTE	Approved as HD 60364 (series)
IEC 60364-1:2005	NOTE	Approved as HD 60364-1:2008 + A11:2017
IEC 60364-4-44:2007	NOTE	Approved as HD 60364-4-444:2010
IEC 60364-4-44:2007/A1:2015	NOTE	Approved as HD 60364-4-443:2016
IEC 60364-5-52:2009	NOTE	Approved as HD 60364-5-52:2011 + A11:2017
IEC 60445:2021	NOTE	Approved as EN IEC 60445:2021 (not modified)
IEC 60664 (series)	NOTE	Approved as EN 60664 (series)
IEC 60695-10-3:2016	NOTE	Approved as EN 60695-10-3:2016 (not modified)
IEC 60695-11-5:2016	NOTE	Approved as EN 60695-11-5:2017 (not modified)
IEC 60721 (series)	NOTE	Approved as EN 60721 (series)
IEC 60947-2:2016	NOTE	Approved as EN 60947-2:2017 (not modified)
IEC 60947-7-2:2009	NOTE	Approved as EN 60947-7-2:2009 (not modified)
IEC 61082-1:2014	NOTE	Approved as EN 61082-1:2015 (not modified)
IEC 61140:2016	NOTE	Approved as EN 61140:2016 (not modified)
IEC 61148:2011	NOTE	Approved as EN 61148:2012 (not modified)
IEC 61439-1:2020	NOTE	Approved as EN IEC 61439-1:2021 (not modified)
IEC 61508 (series)	NOTE	Approved as EN 61508 (series)
IEC 61643-11:2011	NOTE	Approved as EN 61643-11:2012 + A11:2018
IEC 61643-12	NOTE	Approved as CLC/TS 61643-12
IEC 61800-1:2021	NOTE	Approved as EN IEC 61800-1:2021 (not modified)
IEC 61800-2:2021	NOTE	Approved as EN IEC 61800-2:2021 (not modified)
IEC 61800-3:2017	NOTE	Approved as EN IEC 61800-3:2018 (not modified)
IEC 61800-5-1:2007	NOTE	Approved as EN 61800-5-1:2007 (not modified) + A11:2021
IEC 61800-5-1:2007/A1:2016	NOTE	Approved as EN 61800-5-1:2007/A1:2017 (not modified)
IEC 61800-5-2	NOTE	Approved as EN 61800-5-2
IEC 61800-5-3	NOTE	Approved as EN IEC 61800-5-3
IEC/TR 61800-6:2003	NOTE	Approved as CLC/TR 61800-6:2007 (not modified)
IEC 61800-7 (series)	NOTE	Approved as EN 61800-7 (series)

[2] To be published. Stage at the time of publication: FprEN IEC 60335-1:2023.

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IEC 61800-9 (series)	NOTE	Approved as EN 61800-9 (series)
IEC 61936-1:2021	NOTE	Approved as EN IEC 61936-1:2021 (not modified)
IEC 62311:2019	NOTE	Approved as EN IEC 62311:2020 (not modified)
IEC/IEEE 82079-1:2019	NOTE	Approved as EN IEC/IEEE 82079-1:2020 (not modified)
IEC 60076-1:2011	NOTE	Approved as EN 60076-1:2011 (not modified)
IEC 60127 (series)	NOTE	Approved as EN IEC 60127 (series)
IEC 60309-1	NOTE	Approved as EN IEC 60309-1
IEC 60317 (series)	NOTE	Approved as EN IEC 60317 (series)
IEC 60384-14:2013	NOTE	Approved as EN 60384-14:2013 (not modified)
IEC 60691:2015	NOTE	Approved as EN 60691:2016 (not modified)
IEC 60730 (series)	NOTE	Approved as EN IEC 60730 (series)
IEC 60738-1:2006	NOTE	Approved as EN 60738-1:2006 (not modified)
IEC 60747-5-5:2020	NOTE	Approved as EN IEC 60747-5-5:2020 (not modified)
IEC 60825 (series)	NOTE	Approved as EN 60825 (series)
IEC 60940:2015	NOTE	Approved as EN 60940:2015 (not modified)
IEC 60947 (series)	NOTE	Approved as EN IEC 60947 (series)
IEC 60947-7-1:2009	NOTE	Approved as EN 60947-7-1:2009 (not modified)
IEC 61008 (series)	NOTE	Approved as EN 61008 (series)
IEC 61009 (series)	NOTE	Approved as EN 61009 (series)
IEC 61010-1:2010	NOTE	Approved as EN 61010-1:2010 (not modified)
IEC 61051-2:2021	NOTE	Approved as EN IEC 61051-2:2021 (not modified)
IEC 61058-1:2016	NOTE	Approved as EN IEC 61058-1:2018 (not modified)
IEC 61071:2017	NOTE	Approved as EN 61071:—[3] (not modified)
IEC 61204-7:2016	NOTE	Approved as EN IEC 61204-7:2018 (not modified)
IEC 61558-2-16:2021	NOTE	Approved as EN IEC 61558-2-16:—[4] (not modified)
IEC 61810-1:2015	NOTE	Approved as EN 61810-1:2015 (not modified)
IEC 61984:2008	NOTE	Approved as EN 61984:2009 (not modified)
IEC 62368-1:2018	NOTE	Approved as EN IEC 62368-1:2020 (not modified) + A11:2020
IEC 62423:2009	NOTE	Approved as EN 62423:2012 + A11:2021

[3] To be published. Stage at the time of publication: FprEN 61071:2017.

[4] To be published. Stage at the time of publication: FprEN IEC 61558-2-16:2021.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60034	series	Rotating electrical machines	-	series
IEC 60034-1	2022	Rotating electrical machines - Part 1: Rating and performance	-	-
IEC 60034-5	2020	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification	EN IEC 60034-5	2020
IEC 60050-112	-	International Electrotechnical Vocabulary - Part 112: Quantities and units	-	-
IEC 60050-113	-	International Electrotechnical Vocabulary - Part 113: Physics for electrotechnology	-	-
IEC 60050-114	-	International Electrotechnical Vocabulary - Part 114: Electrochemistry	-	-
IEC 60050-131	-	International Electrotechnical Vocabulary - Part 131: Circuit theory	-	-
IEC 60050-151	-	International Electrotechnical Vocabulary - Part 151: Electrical and magnetic devices	-	-
IEC 60050-161	-	International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility	-	-
IEC 60050-192	-	International electrotechnical vocabulary - Part 192: Dependability	-	-
IEC 60050-426	-	International Electrotechnical Vocabulary (IEV) - Part 426: Explosive atmospheres	-	-
IEC 60050-441	-	International Electrotechnical Vocabulary. Switchgear, controlgear and fuses	-	-
IEC 60050-442	-	International Electrotechnical Vocabulary - Part 442: Electrical accessories	-	-
IEC 60050-551	-	International Electrotechnical Vocabulary - Part 551: Power electronics	-	-

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Full document details: BS EN IEC 61800-5-1:2023

Publication	Year	Title	EN/HD	Year
IEC 60050-601	-	International Electrotechnical Vocabulary. Chapter 601: Generation, transmission and distribution of electricity - General	-	-
IEC 60050-826	-	International Electrotechnical Vocabulary - Part 826: Electrical installations	-	-
IEC 60050-903	-	International electrotechnical vocabulary_- Part_903: Risk assessment	-	-
IEC 60068-2-1	2007	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	2007
IEC 60068-2-2	2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	2007
IEC 60068-2-6	2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	-
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 60068-2-52	2017	Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)	EN IEC 60068-2-52	2018
IEC 60068-2-68	1994	Environmental testing - Part 2-68: Tests - Test L: Dust and sand	EN 60068-2-68	1996
IEC 60068-2-78	2012	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	2013
IEC 60204-11	2018	Safety of machinery - Electrical equipment of machines - Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV	EN IEC 60204-11	2019
IEC 60320	-	Appliance couplers for household and similar general purposes	-	-
IEC 60364	series	Low-voltage electrical installations	HD 60364	series
+ A1	2017		-	-
IEC 60364-4-41 (mod)	2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41	2017
-	-		+ A11	2017
-	-		+ A12	2019
IEC 60364-5-54	2011	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors	HD 60364-5-54	2011
-	-		+ A11	2017
IEC 60417	-	Graphical symbols for use on equipment. Index, survey and compilation of the single sheets.	-	-

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Publication	Year	Title	EN/HD	Year
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
-	-		+ corrigendum May	1993
+ A1	1999		+ A1	2000
+ A2	2013		+ A2	2013
IEC 60617	-	Standard data element types with associated classification scheme for electric components - Part 4: IEC reference collection of standard data element types and component classes	-	-
IEC 60664-1	2020	Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests	EN IEC 60664-1	2020
IEC 60664-3	2016	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2017
IEC 60664-4	2005	Insulation coordination for equipment within low-voltage systems - Part 4: Consideration of high-frequency voltage stress	EN 60664-4	2006
-	-		+ corrigendum Oct.	2006
IEC 60695-2-10	2021	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN IEC 60695-2-10	2021
IEC 60695-2-11	2021	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end products (GWEPT)	EN IEC 60695-2-11	2021
IEC 60695-2-13	2021	Fire hazard testing - Part 2-13: Glowing/hot-wire based test methods - Glow-wire ignition temperature (GWIT) test method for materials	EN IEC 60695-2-13	2021
IEC 60695-10-2	2014	Fire hazard testing - Part 10-2: Abnormal heat - Ball pressure test method	EN 60695-10-2	2014
IEC 60695-11-10	2013	Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods	EN 60695-11-10	2013
IEC 60695-11-20	2015	Fire hazard testing - Part 11-20: Test flames - 500 W flame test method	EN 60695-11-20	2015
+ A1	1995		-	-
+ A2	1996		-	-
IEC 60721-3-3	1994	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weatherprotected locations	-	-

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Publication	Year	Title	EN/HD	Year
IEC 60721-3-4	2019	Classification of environmental conditions - Part 3-4: Classification of groups of environmental parameters and their severities - Stationary use at non-weatherprotected locations	EN IEC 60721-3-4	2019
IEC 60730-1 (mod)	2013	Automatic electrical controls - Part 1: General requirements	EN 60730-1	2016
+ A1	2015		+ A1	2019
+ A2	2020		+ A2	2022
IEC 60755	2017	General safety requirements for residual current operated protective devices	-	-
IEC 60799	2018	Electrical accessories - Cord sets and interconnection cord sets	EN IEC 60799	2021
IEC 60947-4-1	2018	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	EN IEC 60947-4-1	2019
IEC 60990	2016	Methods of measurement of touch current and protective conductor current	EN 60990	2016
IEC 61032	1997	Protection of persons and equipment by enclosures - Probes for verification	EN 61032	1998
IEC 61084	series	Cable trunking systems and cable ducting systems for electrical installations	-	series
IEC 61180	2016	High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment	EN 61180	2016
IEC 61189-3	2007	Test methods for electrical materials, printed boards and other interconnection structures and assemblies - Part 3: Test methods for interconnection structures (printed boards)	EN 61189-3	2008
IEC 61230	2008	Live working - Portable equipment for earthing or earthing and short-circuiting	EN 61230	2008
IEC 61386	series	Conduit systems for cable management	EN 61386	series
IEC 61558-1	2017	Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests	EN IEC 61558-1	2019
IEC 62109-1	2010	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements	EN 62109-1	2010
IEC 62271-102	2018	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches	EN IEC 62271-102	2018
IEC 62477-1	2022	Safety requirements for power electronic converter systems and equipment - Part 1: General	EN IEC 62477-1	2023
IEC 62477-2	2018	Safety requirements for power electronic converter systems and equipment - Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC	EN IEC 62477-2	2018

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Publication	Year	Title	EN/HD	Year
ISO 3746	-	Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane	EN ISO 3746	-
ISO 3864-1	2011	Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings	-	-
ISO 7000	-	Graphical symbols for use on equipment - Registered symbols	-	-
ISO 7010	-	Graphical symbols - Safety colours and safety signs - Registered safety signs	-	-
ISO 9614-1	-	Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 1: Measurement at discrete points	EN ISO 9614-1	2009

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INTERNATIONAL STANDARD

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Entraînements électriques de puissance à vitesse variable – Partie 5-1: Exigences de sécurité – Électrique, thermique et énergétique

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 5-1: Safety requirements – Electrical, thermal and energy

FOREWORD

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IEC 61800-5-1 has been prepared by subcommittee 22G: Adjustable speed electric power drive systems (PDS), of IEC technical committee 22: Power electronic systems and equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 2007 and Amendment 1:2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) harmonization with IEC 62477-1:2022;
b) harmonization with UL 61800-5-1 and CSA C22.2 No. 274, including an annex with a list of national deviation which was considered not possible to harmonize within a reasonable timeframe;
c) more detailed information about the evaluation of components according to this document and relevant safety component standards;
d) updated requirement for mechanical hazards including multiple IP ratings.

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The text of this International Standard is based on the following documents:

Draft	Report on voting
22G/455/FDIS	22G/457/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

In this document, terms in *italic* are defined in Clause 3.

The reader's attention is drawn to the fact that

- Annex S and Annex T list all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.
- Due to the rules of ISO/IEC Directives, Part 2, the term "must" instead of the term "shall" is used in Annex S and Annex T.

A list of all parts of the IEC 61800 series, published under the general title *Adjustable speed electrical power drive systems,* is available on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

The contents of the corrigendum 1 (2023-09) have been included in this copy.

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INTRODUCTION

0.1 General

This document contains the revision of IEC 61800-5-1:2007 and IEC 61800-5-1:2007/AMD1:2016.

Several important issues have influenced the scope and the chosen approach of the maintenance of IEC 61800-5-1:2007 in the development of this document.

The most significant changes compared to IEC 61800-5-1:2007 are the following.

a) Structure and content is based on IEC 62477-1 considering modifications and new topics such as the following

- Clause 1: Scope updated to include radio emitting/transmitting *BDM/CDM/PDS*.
- 4.1, 5.1, 6.1: "Intended use" included.
- 4.2: Single fault/abnormal operation analysis (significantly reworked).
- 4.3: Short-circuit and overload protection included as new subclause.
- 4.4 and Annex A: Protection against electric shock updated according to IEC 61140:2016 and IEC 60364-4-41, including insulation coordination according to IEC 60664 (all parts) considering the following:
  - 4.4.2 – Decisive voltage classification (especially DVC As for dry, wet and salt-water wet); Table 2 and Table 3 reworked;
  - 4.4.3 – Basic protection (reworked);
  - 4.4.4 – Fault protection (reworked);
  - 4.4.5 – Enhanced protection (reworked);
  - 4.4.7 – Insulation (reworked):
    - 4.4.7.1.2 – Working voltage (new);
    - 4.4.7.1.8 – Components bridging insulation (new);
    - 4.4.7.7 – *clearance* and *creepage distances* for functional insulation on PWB and component assemblies (reworked);
    - 4.4.7.8 – Solid insulation (new/reworked);
    - 4.4.7.9 – Connection of parts of solid insulation (cemented joints) (new);
  - 4.4.8/Annex H – Compatibility with RCD (reworked);
  - 4.4.10 – Access conditions for *high-voltage PDS* (new).
- 4.5: Protection against energy hazards (new).
- 4.6: Protection against fire and thermal hazards (new).
- 4.7: Protection against mechanical hazards (new).
- 4.8: *BDM/CDM/PDS* with multiple sources of supply (new).
- 4.9: Protection against environmental stresses (new) (in alignment with IEC 61800-2).
- 4.11: Wiring and connections updated (significantly reworked).
- 4.12: Enclosure updated (significantly reworked).
- 4.13 Bibliography: Evaluation of components (new).
- 4.14 Annex P: Protection against electromagnetic fields (new).
- Clause 5: Updated with some additional/modified test requirement:
  - 5.2.2.2 – Non-accessibility test (significantly reworked);
  - 5.2.2.3 – Ingress protection test (IP rating) (significantly reworked);

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- 5.2.2.4 – Enclosure integrity tests (new);
- 5.2.2.5 – Wall or ceiling mounted *BDM/CDM/PDS* test (new);
- 5.2.2.6 – Handles and manual control securement test (new);
- 5.2.2.7 – Strain relief test (new);
- 5.2.3.7 – Touch current measurement test (reworked);
- 5.2.3.9 – Limited power source (new);
- 5.2.3.11 – Protective equipotential bonding test (new);
- 5.2.3.12 – Input test (new);
- 5.2.3.13 – Thin sheet material test (new);
- 5.2.3.14 – Test procedure for determination of working voltage (new);
- 5.2.3.16 – Preconditoning of material (reworked);
- 5.2.4.4 – Protective equipotential bonding short-circuit test (new);
- 5.2.4.9 – Output overload test (new);
- 5.2.4.13.5 – Covering of openings for cooling air test (type test) (new);
- 5.2.5.6 – Cemented joints test (new);
- 5.2.7 – Hydrostatic pressure test (new);
- 5.2.8 – Electromagnetic fields (EMF) test (new).

- Clause 6: – Update with more specific marking.
  - Structure aligned with IEC 62477-1 as close as possible;
  - Table 48 simplified.
- Annex A – Additional information for protection against electric shock (reworked).
- Annex C – Symbols referred (reworked).
- Annex E – Altitude correction for *clearance*s (reworked).
- Annex F – *Clearance* and *creepage distance* determination for frequencies greater than 30 kHz (reworked).
- Annex H – Guidelines for RCD compatibility (reworked).
- Annex M – Test probes for determining access (new).
- Annex O – Guidance for determination of *clearance* and *creepage distance* (new).
- Annex P – Protection of persons against electromagnetic fields for frequencies from 0 Hz up to 300 GHz (new).
- Annex Q – Automatic disconnection of supply (new).
- Annex R – Guide 116 risk evaluation included (new).
- Bibliography – Relevant component safety standards (new).

b) Harmonization with UL 61800-5-1

Complete document is modified taken into consideration UL 61800-5-1 US National deviations. US National deviations from UL 61800-5-1 not possible to harmonize have been placed in Annex S.

c) Harmonization with CSA C22.2 No. 274

- Due to a short time frame, only some few topics have been harmonized.
- Canadian National deviations from CSA C22.2 No. 274 not possible to harmonize have been placed in Annex T.

d) Harmonization with UL 347A

- Some few relevant topics have been harmonized considering safety aspects related to *high-voltage BDM/CDM/PDS.*

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Further harmonization is expected to be adopted in IEC 61800-5-1 considering the content of UL 61800-5-1, CSA C22.2 No 274 and UL 347A in future editions of IEC 61800-5-1.

0.2 Feedback from industry and national committees

The use of IEC 61800-5-1:2007 by manufacturers and test institutes since its release has identified several topics which are considered useful to implement, or topics which need further information for a better understanding of the intent of the specific requirement. These topics are also implemented in this document.

0.3 Requirement covered by other relevant parts of the IEC 61800 series

- general requirements for DC *power drive systems* are covered in IEC 61800-1;
- general requirements for AC *power drive systems* are covered in IEC 61800-2;
- EMC aspects are covered in IEC 61800-3;
- functional safety aspects are covered in IEC 61800-5-2;
- functional safety aspects for encoders are covered in IEC 61800-5-3;
- type of load duty aspects are covered in IEC TR 61800-6;
- communication profiles aspects are covered in IEC 61800-7 (all parts);
- *power interface* voltage aspects are covered in IEC TS 61800-8;
- ecodesign aspects are covered in IEC 61800-9 (all parts);

The following document is not part of the IEC 61800 series, but is used often as part of the BDM:

- active infeed converters in IEC TS 62578.

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 5-1: Safety requirements – Electrical, thermal and energy

1 Scope

This part of IEC 61800 specifies requirements for adjustable speed electrical *power drive systems (PDS)* or their elements, with respect to electrical, thermal, fire, mechanical, energy and other relevant hazards. It does not cover the driven equipment except for interface requirements. It applies to adjustable speed electrical *PDS* which include the power conversion, *basic drive module (BDM)/complete drive module (CDM)* control, and a motor or motors.

Excluded are traction and electric vehicle *BDM/CDM*.

It applies to low-voltage adjustable speed electrical *PDS* intended to feed a motor or motors from a *BDM/CDM* connected to phase-to-phase voltages of up to and including 1,0 kV AC (50 Hz or 60 Hz) and up to and including 1,5 kV DC.

It also applies to high-voltage adjustable speed electrical *PDS* intended to feed a motor or motors from a *BDM/CDM* connected to phase-to-phase voltages of up to and including 35 kV AC (50 Hz or 60 Hz) and up to and including 52 kV DC.

NOTE 1 At the time of publication of this document, the technical upper voltage limit for DC motors is 2,25 kV DC.

NOTE 2 Above voltage and frequency limits reflect the scope of IEC 61800-1 and IEC 61800-2.

NOTE 3 For adjustable speed electrical *PDS* not covered by the scope of this document, applicable requirements of other standards, for example IEC 62477-1 and IEC 62477-2, can be used.

This document also applies to *PDS* which intentionally emit or receive radio waves for the purpose of radio communication.

Motors for driven equipment (see Figure 1) are covered by IEC 60034 (all parts).

NOTE 4 In some cases, safety requirements of the *PDS* (for example, protection against access to hazardous parts) can necessitate the use of special components and/or additional measures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60034 (all parts), *Rotating electrical machines*

IEC 60034-1:2022, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-5:2020, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

IEC 60050-112, *International Electrotechnical Vocabulary (IEV) – Part 112: Quantities and units* (available at www.electropedia.org)

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IEC 60050-113, *International Electrotechnical Vocabulary (IEV) – Part 113: Physics for electrotechnology* (available at www.electropedia.org)

IEC 60050-114, *International Electrotechnical Vocabulary (IEV) – Part 114: Electrochemistry* (available at www.electropedia.org)

IEC 60050-131, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory* (available at www.electropedia.org)

IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices* (available at www.electropedia.org)

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility* (available at www.electropedia.org)

IEC 60050-192, *International Electrotechnical Vocabulary (IEV) – Part 192: Dependability* (available at www.electropedia.org)

IEC 60050-426, *International Electrotechnical Vocabulary (IEV) – Part 426: Explosive atmospheres* (available at www.electropedia.org)

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses* (available at www.electropedia.org)

IEC 60050-442, *International Electrotechnical Vocabulary (IEV) – Part 442: Electrical accessories* (available at www.electropedia.org)

IEC 60050-551, *International Electrotechnical Vocabulary (IEV) – Part 551: Power electronics* (available at www.electropedia.org)

IEC 60050-601, *International Electrotechnical Vocabulary (IEV) – Part 601: Generation, transmission and distribution of electricity – General* (available at www.electropedia.org)

IEC 60050-826, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations* (available at www.electropedia.org)

IEC 60050-903, *International Electrotechnical Vocabulary (IEV) – Part 903: Risk assessment* (available at www.electropedia.org)

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-52:2017, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-68:1994, *Environmental testing – Part 2-68: Tests – Test L: Dust and sand*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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IEC 60204-11:2018, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*
IEC 60364-5-54:2011/AMD1:2021

IEC 60417, *Graphical symbols for use on equipment* (available at https://www.graphical-symbols.info/equipment)

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60617, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-4:2005, *Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress*

IEC 60695-2-10:2021, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-13:2021, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20:2015, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

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IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations*[1]
IEC 60721-3-3:1994/AMD1:1995
IEC 60721-3-3:1994/AMD2:1996

IEC 60721-3-4:2019, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Stationary use at non-weatherprotected locations*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*
IEC 60730-1:2013/AMD1:2015
IEC 60730-1:2013/AMD2:2020

IEC 60755:2017, *General safety requirements for residual current operated protective devices*

IEC 60799:2018, *Electrical accessories – Cord sets and interconnection cord sets*

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61084 (all parts), *Cable trunking systems and cable ducting systems for electrical installations*

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61189-3:2007, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

IEC 61230:2008, *Live working – Portable equipment for earthing or earthing and short-circuiting*

IEC 61386 (all parts), *Conduit systems for cable management*

IEC 61558-1:2017, *Safety of power transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 62109-1:2010, *Safety of power converters for use in photovoltaic power systems – Part 1: General requirements*

IEC 62271-102:2018, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

[1] This publication has been withdrawn.

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IEC 62477-2:2018, *Safety requirements for power electronic converter systems and equipment – Part 2: Power electronic converters from 1 000 V AC or 1 500 V DC up to 36 kV AC or 54 kV DC*

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 3746:2010, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*

ISO 7000, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs* (available at https://www.iso.org/obp)

ISO 9614-1:1993, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-112:2010, IEC 60050-113:2011, IEC 60050-114:2014, IEC 60050-131:2002, IEC 60050-426:2020, IEC 60050-151:2001, IEC 60050-161:1990, IEC 60050-192:2015, IEC 60050-441:1984, IEC 60050-442:1998, IEC 60050-551:1998, IEC 60050-601:1985, IEC 60050-826, IEC 60050-903:2013 and IEC 60664-1:2020, and the following apply.

Table 1 provides an alphabetical cross-reference listing of terms.

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Table 1 – Alphabetical list of terms

Term	Term no.	Term	Term no.	Term	Term no.
abnormal operating condition (abnormal operation)	3.1	fault protection	3.33	protective class II	3.65
accessible part	3.2	field wiring terminal	3.34	protective class III	3.66
accessory	3.3	fire enclosure	3.35	protective earthing (PE)	3.67
adjacent circuit	3.4	functional insulation	3.36	PE conductor	3.68
ambient temperature	3.5	hand-held BDM/CDM/PDS	3.37	protective impedance	3.69
basic drive module (BDM)	3.6	general-access area	3.38	reinforced insulation	3.70
basic insulation	3.7	hazardous live part	3.39	restricted-access area	3.71
basic protection	3.8	high-voltage BDM/CDM/PDS	3.40	routine test	3.72
bypass	3.9	hinged panel	3.41	sample test	3.73
BDM/CDM rated output current	3.10	installation	3.42	SELV circuit	3.74
clearance	3.11	integrated PDS	3.43	service-access area	3.75
control circuit	3.12	interlock	3.44	short-circuit backup protection	3.76
commissioning test	3.13	live part	3.45	short-circuit protective device (SCPD)	3.77
complete drive module (CDM)	3.14	low-voltage (LV)	3.46	short time withstand current (I_{cw})	3.78
component	3.15	low-voltage BDM/CDM/PDS	3.47	skilled person	3.79
conditional short-circuit current (I_{cc})	3.16	mains supply	3.48	single-fault condition	3.80
cover	3.17	minimum required prospective short-circuit current ($I_{cp,mr}$)	3.49	solid insulation	3.81
creepage distance	3.18	movable	3.50	surrounding air temperature	3.82
decisive voltage class (DVC)	3.19	non-mains supply	3.51	surroundings	3.83
door	3.20	open type	3.52	supplementary insulation	3.84
double insulation	3.21	ordinary person	3.53	surge protective device (SPD)	3.85
direct plug-in BDM/CDM/PDS	3.22	output short-circuit current	3.54	system	3.86
DVC As	3.23	overcurrent	3.55	system voltage	3.87
electrical breakdown	3.24	PELV circuit	3.56	temporary overvoltage	3.88
electrical insulation (insulation)	3.25	permanently connected equipment	3.57	thermal memory	3.89
electrically protective screening (protective screening)	3.26	pluggable equipment type A	3.58	thermal memory retention	3.90
electronic motor overload protection	3.27	pluggable equipment type B	3.59	touch current	3.91
electronic power output short-circuit protection (circuitry)	3.28	port	3.60	trip	3.92
enclosure	3.29	power drive system (PDS)	3.61	type test	3.93
enhanced protection	3.30	prospective short-circuit current (I_{cp})	3.62	visual inspection	3.94
expected lifetime	3.31	protective equipotential bonding	3.63	working voltage	3.95
extra-low voltage (ELV)	3.32	protective class I	3.64	zone of equipotential bonding	3.96

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3.1
abnormal operating condition
abnormal operation
temporary operating condition that is not a normal operating condition and is not a *single-fault condition* of the equipment itself

Note 1 to entry: An *abnormal operating condition* may be introduced by the equipment or by a person and may result in a failure of a *component*, a device or *insulation*.

[SOURCE: IEC 62368-1:2018, 3.3.7.1, modified – Note 1 to entry deleted, and Notes 2 and 3 to entry merged.]

3.2
accessible part
part or surface that can be touched by means of test probe B of IEC 61032, and if the part or surface is metal, any conductive part connected to it

Note 1 to entry: Test probe B is found in IEC 61032:1997, Figure 2. See also Figure M.2.

Note 2 to entry: Accessible non-metallic parts with conductive coatings are considered to be accessible metal parts.

[SOURCE: IEC 60335-1:2020, 3.6.3, modified – Note 1 to entry added.]

3.3
accessory
additional part, component or equipment intended to expand capabilities of the BDM/CDM/PDS, but not required for the general function of the BDM/CDM/PDS

Note 1 to entry: Typical examples are:

- external mains coils or RFI filters,
- external motor output filters,
- communication, control or input/output interface kits,
- external SPD for reduction of transient,
- additional *enclosure* parts or kits,
- additional ventilation kits,
- mechanical bonding or cable support kits, or
- additional measuring device, instrument etc.

Note 2 to entry: Expanded capabilities are considered to be electrical, mechanical, thermal or acoustic noise characteristics of the *BDM/CDM/PDS* when installed and operating as intended.

Note 3 to entry: *Accessories* and *accessory* kits might be factory or field installed.

3.4
adjacent circuit
circuit next to the circuit under consideration having a requirement for *functional insulation*, *basic insulation, double insulation* or *reinforced insulation* between them for protection

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3.5
ambient temperature
average temperature of air or another medium in the vicinity of the equipment

Note 1 to entry: During the measurement of the *ambient temperature* the measuring instrument/probe should be shielded from draughts and radiant heating.

Note 2 to entry: "Equipment" includes *BDM/CDM/PDS* as well a *components*, depending on the application of the term *ambient temperature*.

Note 3 to entry: In general, the *ambient temperature* is measured in vicinity to the equipment (approx. 50 mm to 100 mm distance), shielded from heat radiation and measured at a height of approximately 50 % height of the equipment in case of passively cooled equipment, or air inlet of actively cooled equipment.

[SOURCE: IEC 60050-826:2004, 826-10-03, modified – Notes 2 and 3 to entry added.]

3.6
basic drive module
BDM
electronic power converter and related control, connected between an electric supply and a motor

Note 1 to entry: The *BDM* is capable of transmitting power from the electric supply to the motor and may be capable of transmitting power from the motor to the electric supply.

Note 2 to entry: The *BDM* controls some or all of the following aspects of power transmitted to the motor and motor output: current, frequency, voltage, speed, torque, force.

[SOURCE: IEC 61800-2:2021, 3.4]

3.7
basic insulation
insulation of *hazardous live part*s which provides *basic protection*

Note 1 to entry: This concept does not apply to *insulation* used exclusively for functional purposes.

[SOURCE: IEC 60050-195:2021, 195-06-06, modified – Words "hazardous live parts" added.]

3.8
basic protection
protection against electric shock under fault-free conditions through the use of *insulation* or distance or a combination of both

[SOURCE: IEC 60050-195:2021, 195-06-01, modified – Word "normal" replaced with "fault-free" and words "through the use of *insulation* or distance or a combination of both" added.]

3.9
bypass
circuit which, when closed, creates an alternative path for current flow in parallel with the circuit being bypassed

Note 1 to entry: The *bypass* circuit typically consists of a switch or contactor.

Note 2 to entry: The *bypass* circuit allows the original circuit to be turned off while maintaining current flow to the load.

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3.10
BDM/CDM rated output current
current at the motor side of the *BDM/CDM* which can be supplied continuously without exceeding established limitations, under rated operating conditions

Note 1 to entry: For AC *BDM/CDM*, this value is expressed in RMS. For DC *BDM/CDM*, this value is expressed in average.

Note 2 to entry: This term is taken from IEC 61800-1:2021, and modified and complies with IEC 61800-2:2021.

3.11
clearance
shortest distance in air between two conductive parts

Note 1 to entry: This distance can be measured along a string stretched the shortest way between these conductive parts.

[SOURCE: IEC 60050-581:2008, 581-27-76, modified – Note to entry added.]

3.12
control circuit
circuit that carries signals directing the performance of a *BDM/CDM/PDS*, and that is not the main power circuit

3.13
commissioning test
test on a device or equipment performed on site, to prove the correctness of *installation* and operation

[SOURCE: IEC 60050-411:1996, 411-53-06, modified – Word "machine" replaced with "device".]

3.14
complete drive module
CDM
drive module consisting of, but not limited to, the *BDM* and extensions such as protection devices, transformers and auxiliaries, but excluding the motor and the sensors which are mechanically coupled to the motor shaft

[SOURCE: IEC 61800-2:2021, 3.6]

3.15
component
part of *BDM/CDM/PDS*, which cannot be physically divided into smaller parts without losing its particular function

Note 1 to entry: The term "*component"* as well as the term "sub-assembly" in this document shall be read in their context. A *component* therefore could be a single capacitor, a power supply unit, which is made of several electronic *components* as well as complete drive module inside a cabinet.

Note 2 to entry: An inverter stage (module) can also be seen as sub-assembly of a drive module.

[SOURCE: IEC 60050-151:2001, 151-11-21, modified – Words "constituent part of a device" replaced with "part of *BDM/CDM/PDS*", and notes to entry added.]

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3.16
conditional short-circuit current
I_{cc}
RMS value of a *prospective short-circuit current* available from a supply source, declared by the *BDM/CDM/PDS* manufacturer under specified conditions, using a specific type of *short-circuit protective device* (SCPD) protecting the *BDM/CDM/PDS*

Note 1 to entry: The *short-circuit protective device* may form an integral part of the *BDM/CDM/PDS* or may be a separate unit.

3.17
cover
unhinged portion of an *enclosure* that closes an opening

3.18
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.19
decisive voltage class
DVC
classification of voltage range used to determine the protective measures against electric shock and the requirements of *insulation* between circuits

3.20
door
hinged portion of an *enclosure* that covers an opening, which is intended to be opened during routine maintenance, operations and adjustments

3.21
double insulation
insulation comprising both *basic insulation* and *supplementary insulation*

[SOURCE: IEC 60050-195:2021, 195-06-08]

3.22
direct plug-in *BDM/CDM/PDS*
BDM/CDM/PDS in which the mains plug forms an integral part of the equipment *enclosure* so that the equipment is supported by the mains socket-outlet

[SOURCE: IEC 60050-903:2014, 903-04-07, modified – Word "equipment" replaced with "*BDM/CDM/PDS*".]

3.23
DVC As
voltage classification of a circuit providing only safe to touch voltage, under normal operating conditions and *single-fault conditions* and limited overvoltages

Note 1 to entry: For limits refer to Table 2.

[SOURCE: IEC 61204-7:2016, modified – Definition reformulated.]

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3.24
electrical breakdown
failure of *insulation* under electric stress when the discharge completely bridges the *insulation*, thus reducing the voltage across the *insulation* almost to zero

[SOURCE: IEC 60664-1:2020, 3.1.44, modified – Words "between the electrodes" replaced with "across the *insulation*".]

3.25
electrical insulation
insulation
electrical separation between circuits or conductive parts provided by *clearance* or *creepage distance* or *solid insulation* or combinations of them

Note 1 to entry: The meaning of *clearance* in this document is distance through air.

3.26
electrically protective screening
protective screening
separation of circuits from *hazardous live parts* by means of an interposed conductive screen, connected to the *PE conductor*, either directly or via *protective equipotential bonding*

Note 1 to entry: If the protective screening is used as a measure for enhanced protection, see 4.4.5.

3.27
electronic motor overload protection
BDM/CDM circuitry which protects a motor during overload conditions by reducing current to the motor

Note 1 to entry: The protection circuitry is usually a combination of hardware and software.

Note 2 to entry: This protection is typically achieved through an algorithm based on the I^2t of the current to the motor.

3.28
electronic power output short-circuit protection circuitry
circuitry integral to *BDM/CDM* that acts to significantly reduce current flow to the power output upon sensing a short-circuit condition

Note 1 to entry: The protection circuitry is usually a combination of hardware and software.

3.29
enclosure
housing affording the type and degree of protection suitable for the intended application

Note 1 to entry: This document provides requirements for the *enclosure* according to IEC 60529 as well as additional requirements for mechanical and environmental impact. The purpose of the additional requirements is to ensure the *enclosure's* ability to provide *basic protection* under the environmental conditions specified by the manufacturer.

[SOURCE: IEC 60050-151:2001, 151-13-08, modified – Note 1 to entry added.]

3.30
enhanced protection
protective provision having a reliability of protection not less than that provided by two independent protective provisions through the use of *insulation* or distance or a combination of both

[SOURCE: IEC 61140:2016, 3.19, modified – Word "protective provision" replaced with "protection" in the term, and words "through the use of *insulation* or distance or a combination of both" added to the definition.]

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3.31
expected lifetime
design duration for which the performance characteristics are valid as specified by the manufacturer

3.32
extra-low voltage
ELV
voltage not exceeding the relevant voltage limit specified in IEC 61140:2016, Table 1

Note 1 to entry: In IEC 61140, *ELV* is defined as not exceeding 50 V AC RMS and 120 V DC. Other product committees may have defined *ELV* with different voltage levels.

Note 2 to entry: In this document, protection against electric shock is dependent on the *decisive voltage class*.

3.33
fault protection
protection against electric shock under *single-fault conditions*

Note 1 to entry: For *low-voltage installation*s, *system*s and equipment, *fault protection* in IEC 60364-4-41 generally corresponds to the formerly used "protection against indirect contact", mainly with regard to failure of *basic insulation*.

[SOURCE: IEC 60050-195:2021, 195-06-02, modified – Note to entry added.]

3.34
field wiring terminal
terminal provided for connection of external conductors to the *BDM/CDM/PDS*

Note 1 to entry: See Figure 7 and Figure 8 for examples of connection of internal and external conductors.

3.35
fire enclosure
part of the equipment intended to minimize the spread of fire or flames from within the *enclosure* to outside the *enclosure*

3.36
functional insulation
insulation between conductive parts within a circuit that is necessary for the proper function of the circuit, but which does not provide protection against electric shock

Note 1 to entry: *Functional insulation* may, however, reduce the likelihood of ignition and fire.

3.37
hand-held BDM/CDM/PDS
BDM/CDM/PDS intended to be held in the hand during normal use

[SOURCE: IEC 60050-826:2004, 826-16-05, modified – Word "equipment" replaced with *"BDM/CDM/PDS"* in the term.]

3.38
general-access area
area of the *BDM/CDM/PDS* to which both *ordinary persons* and *skilled person*s are permitted to access

Note 1 to entry: *General-access areas* do not require the use of a tool or key.

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3.39
hazardous live part
live part which, under certain conditions, can give a harmful electric shock

Note 1 to entry: In this document, a hazardous live part does not meet the requirement of *DVC As* in 4.4.2.2.

[SOURCE: IEC 60050-195:2021, 195-06-05, modified – Hyphens removed from the term and note to entry replaced.]

3.40
high-voltage BDM/CDM/PDS
BDM/CDM/PDS having a *port* voltage above 1 kV AC 50 Hz or 60 Hz or above 1,5 kV DC

Note 1 to entry: "*Port*" generically applies to both input and output, and the scope of this document addresses only the range of voltages at the input power *port*.

Note 2 to entry: See IEC 61800-2:2021, Table 5.

Note 3 to entry: For *PDS* having series-connected converter sections, a sum of the series-connected phase to phase input voltages is used as the equivalent input voltage of the converter sections (see IEC 61800-2:2021, Annex A).

Note 4 to entry: In the United States of America (USA), the voltage range of this definition is considered medium voltage.

[SOURCE: IEC 61800-2:2021, 3.16, modified – Words "phase to phase" added in Note 3 to entry, "the scope of this document" replaced with "this definition" in Note 4 to entry, and Note 5 to entry deleted.]

3.41
hinged panel
portion of an *enclosure* that has hinges, but no hand-operable latching *system*, secured in the closed position by multiple bolts or other hardware requiring a tool other than a key to operate

Note 1 to entry: *Hinged panels* are not intended to be opened during normal operating conditions, routine adjustment or simple maintenance operations such as replacement of fuses.

3.42
installation
apparatus or set of devices and/or apparatuses associated in a given location to fulfil specified purposes, including all means for their satisfactory operation

Note 1 to entry: The word *installation* is also used in this document to denote the process of installing a *PDS*. In these cases, the word does not appear in italics.

[SOURCE: IEC 60050-151:2001, 151-11-26, modified – Note to entry added.]

3.43
integrated PDS
PDS where motor and *BDM/CDM* are mechanically integrated into a single unit

[SOURCE: IEC 61800-2:2021, 3.28, modified – Word "combined" replaced with "mechanically integrated".]

3.44
interlock
device(s) that prevent operation of some other device with which it is directly associated under specific conditions

Note 1 to entry: *Interlock*s may be electrical, mechanical, or a combination of both.

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3.45
live part
conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

Note 2 to entry: By convention, the PE conductor is not a live part.

[SOURCE: IEC 60050-195:2021, 195-02-19, modified – Notes to entry added.]

3.46
low-voltage
LV
set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V AC or 1 500 V DC

[SOURCE: IEC 60050-601:1985, 601-01-26, modified – Words "or 1 500 V DC" added.]

3.47
low-voltage BDM/CDM/PDS
BDM/CDM/PDS having a *port* voltage less than or equal to 1 kV AC (50 Hz or 60 Hz) or 1,5 kV DC

Note 1 to entry: For *PDS* having series-connected converter sections, a sum of the series-connected input voltages is used as the equivalent input voltage of the converter sections (see IEC 61800-2:2021, Annex A).

[SOURCE: IEC 61800-2:2021, 3.30, modified – Note 2 to entry deleted.]

3.48
mains supply
low-voltage or *high-voltage* power distribution *system* for supplying power to a *BDM/CDM/PDS*

3.49
minimum required prospective short-circuit current
$I_{cp,mr}$
RMS value of a minimum *prospective short-circuit current*, which shall be available from the source to ensure operation of the specific type of *short-circuit protective device*

[SOURCE: IEC 62477-1:2022, 3.38]

3.50
movable
<*BDM*/*CDM*/*PDS*> equipment that is either:

– 18 kg or less in mass and not fixed in place, or
– provided with wheels, casters, or other means to facilitate movement by an *ordinary person* as required to perform its intended use

[SOURCE: IEC 60050-903:2014, 903-04-06, modified – Word "limited" replaced with "18 kg or less", and Note to entry deleted.]

3.51
non-mains supply
electrical source that is not connected directly to the *mains supply*

Note 1 to entry: Examples of *non-mains supplies* are those which are isolated from the *mains supply* by a transformer or supplied by a battery, generator, solar arrays, wind generator, tidal systems, wave, fuel cell or similar sources not directly connected to the AC or DC power distribution system.

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3.52
open type
<*BDM/CDM*> intended to be incorporated within an *enclosure* or *restricted-access area* that will provide protection against hazards

Note 1 to entry: Hazards are defined in 4.2.

3.53
ordinary person
person who is not a *skilled person*

EXAMPLE An operator, any person who may have access to the equipment or any person who may be in the vicinity of the equipment, when such equipment is not installed in a *restricted-access area*.

[SOURCE: IEC 60050-826:2004, 826-18-03, modified – Words "nor an instructed person" deleted, and example added.]

3.54
output short-circuit current
available current that flows at the output power *port* of the *BDM/CDM* when a short-circuit is applied by a conductor of negligible impedance

3.55
overcurrent
current in excess of the rated current

Note 1 to entry: In this document, the term *overcurrent* covers both short-circuit and overload.

3.56
PELV circuit
electric *system* in which the voltage cannot exceed the value of *extra-low voltage*:

– under normal operating conditions; and
– under *single-fault conditions*, except earth faults in other electric circuits

Note 1 to entry: *PELV* is the abbreviation for protective *extra-low voltage*.

[SOURCE: IEC 60050-826:2004, 826-12-32, modified – Word "system" replaced with "circuit" in the term, and word "operating" added to the first dash.]

3.57
permanently connected equipment
equipment that can only be connected to or disconnected from the electric power *system* by the use of a tool

[SOURCE: IEC 60050-151:2014, 151-11-29]

3.58
pluggable equipment type A
equipment that is intended for connection to the *mains supply* or *non-mains supply* via a non-industrial plug and socket-outlet or via a non-industrial appliance coupler, or both

Note 1 to entry: For non-industrial plug and socket-outlets, see IEC TR 60083 or a national equivalent. For non-industrial appliance couplers, see IEC 60320-1.

[SOURCE: IEC 60050-903:2014, 903-04-08, modified – Word "*mains*" replaced with "*mains supply or non-mains supply*".]

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3.59
pluggable equipment type B
equipment that is intended for connection to the *mains supply* or *non-mains supply* via an industrial plug and socket-outlet or via an industrial appliance coupler, or both

Note 1 to entry: For industrial plug and socket-outlets, see IEC 60309-1 or a national equivalent. For non-industrial appliance couplers, see IEC 60320-1.

[SOURCE: IEC 60050-903:2014, 903-04-09, modified – Word "*mains*" replaced with "*mains supply or non-mains supply*".]

3.60
port
access to a device or network where electromagnetic energy or signals may be supplied or received or where the device or network variables may be observed or measured

Note 1 to entry: In this document, "input", "output", "power" and "control" are indicated to define usage.

Note 2 to entry: For the evaluation of safety, ports also cover power interfaces as defined in IEC 61800-1:2021, IEC 61800-2:2021 and IEC 61800-3:2017.

[SOURCE: IEC 60050-131:2002, 131-12-60, modified – Note replaced with Note 1 to entry and Note 2 to entry.]

3.61
power drive system
PDS
system consisting of one or more *complete drive module*(s) (*CDM*) and a motor or motors

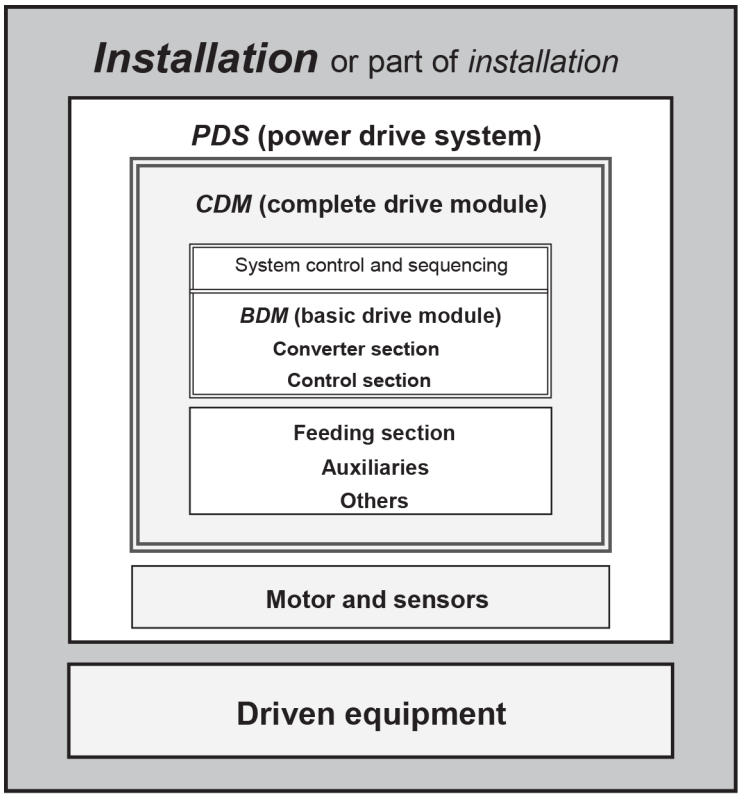


Figure 1 – *PDS* hardware configuration within an *installation*

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Note 1 to entry: See Figure 1. For more detailed information, see IEC 61800-2:2021, Figure 1.

Note 2 to entry: Any sensors which are mechanically coupled to the motor shaft are also part of the *PDS*; however, the driven equipment is not included.

[SOURCE: IEC 61800-2:2021, 3.52, modified – Note 1 to entry added.]

3.62
prospective short-circuit current
I_{cp}
RMS value of the symmetrical current which would flow if the supply conductors to the circuit are short-circuited by a conductor of negligible impedance located as near as practicable to the supply terminals of the *BDM/CDM/PDS*

[SOURCE: IEC 61439-1:2020, 3.8.7, modified – Word "current" replaced with "RMS value of the symmetrical current", and "assembly" with "*BDM/CDM/PDS*".]

3.63
protective equipotential bonding
provision of electric connections between conductive parts, intended to minimize any difference in potential between those parts, for purposes of safety

EXAMPLE Protection against electric shock.

3.64
protective class I
equipment in which protection against electric shock does not rely on *basic protection* only, but which includes an additional safety precaution in such a way that means are provided for the connection of conductive *accessible parts* to the *PE conductor* in the fixed wiring of the *installation*, in such a way that conductive *accessible parts* cannot become live in the event of a failure of the *basic insulation*

Note 1 to entry: *Protective class I* is defined in IEC 61140:2016, 7.3.

3.65
protective class II
equipment in which protection against electric shock does not rely on *basic protection* only, but in which additional safety precautions such as *supplementary insulation* or *reinforced insulation* are provided, there being no provision for *protective earthing* or reliance upon *installation* conditions

Note 1 to entry: *Protective class II* is defined in IEC 61140:2016, 7.4.

3.66
protective class III
equipment in which protection against electric shock relies on supply at *DVC As* (or *DVC B* under certain conditions) and in which voltages higher than those of *DVC As* (*DVC B*) are not generated and there is no provision for *protective earthing*

Note 1 to entry: *Protective class III* is defined in IEC 61140:2016, 7.5.

Note 2 to entry: Other standards define *protective class III* as supplied by *ELV*.

3.67
protective earthing
PE
earthing of a point in a *system*, or equipment, for protection against electric shock in case of a fault

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3.68
PE conductor
conductor in the *installation* wiring or in the power supply cord, connecting a main protective earthing terminal in the equipment to an earthing point in the *installation* for safety purposes

Note 1 to entry: In the USA and Canada, the term "ground" is used instead of "earth".

3.69
protective impedance
impedance connected between *hazardous live parts* and conductive *accessible parts*, of such value that the current, under normal operating conditions and under *single-fault conditions*, is limited to a safe value, and which is constructed so that its ability is maintained throughout the life of the equipment

[SOURCE: IEC 60050-442:1998, 442-04-24, modified – Definition reformulated.]

3.70
reinforced insulation
insulation of *hazardous live parts* which provides a degree of protection against electric shock equivalent to *double insulation*

[SOURCE: IEC 60050-826:2004, 826-12-17, modified – Note to entry deleted.]

3.71
restricted-access area
enclosed electrical area not intended for service, maintenance or commissioning while the *BDM/CDM/PDS* is energized and to which only *skilled person*s are permitted to access

Note 1 to entry: *Restricted-access areas* require the use of a tool or key to get access.

3.72
routine test
conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.73
sample test
test on a number of devices taken at random from a batch

[SOURCE: IEC 61800-2:2021, 3.85]

3.74
SELV circuit
electric *system* in which the voltage cannot exceed the value of *extra-low voltage*:

– under normal conditions; and
– under *single-fault conditions*, including earth faults in other electric circuits

Note 1 to entry: *SELV* is the abbreviation for safety *extra-low voltage*.

[SOURCE: IEC 60050-826:2004, 826-12-31, modified – Word "system" replaced with "circuit" in the term.]

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3.75
service-access area
enclosed electrical area intended for service, maintenance and commissioning while the *BDM/CDM/PDS* is energized and to which only *skilled person*s have permitted to access

Note 1 to entry: *Service-access areas* require the use of a tool or key to get access.

Note 2 to entry: *Service-access area* can be a place within a building or a space within an *enclosure*.

3.76
short-circuit backup protection
protection that is intended to operate when other protective measures within a *system* or equipment fail to clear a fault

[SOURCE: IEC 62477-1:2022, 3.67]

3.77
short-circuit protective device
SCPD
device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them

Note 1 to entry: A *short-circuit protective device* is suitable for protection against short-circuit only, not for protection against overload. An *overcurrent* protective device may also incorporate the function of a *SCPD*.

[SOURCE: IEC 61439-1:2020, 3.1.11, modified – Note to entry added.]

3.78
short time withstand current
I_{cw}
RMS value of short time current, declared by the *BDM*/*CDM*/*PDS* manufacturer, which can be withstood under specified conditions, defined in terms of current and time

3.79
skilled person
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which the equipment can create

[SOURCE: IEC 60050-826:2004, 826-18-01, modified – Word "(electrically)" deleted from the term, and "electricity" replaced with "the equipment" in the text.]

3.80
single-fault condition
condition in which one failure is present which could cause a hazard covered by this document

Note 1 to entry: If a *single-fault condition* results in other subsequent failures, the set of failures is considered as one *single-fault condition*.

Note 2 to entry: Examples of hazards include, but are not limited to, electric shock, fire, energy, mechanical, acoustic noise etc.

Note 3 to entry: IEC Guide 116 provides examples of hazards.

3.81
solid insulation
solid insulating material, or a combination of solid insulating materials, placed between two conductive parts or between a conductive part and a body part

Note 1 to entry: In this document, *solid insulation* does not cover liquid *insulation*.

[SOURCE: IEC 60050-903:2015, 903-04-14, modified – Example replaced with note to entry.]

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3.82
surrounding air temperature
<open type> maximum *ambient temperature* of air immediately surrounding *open type* equipment inside of the ultimate *enclosure*

3.83
surroundings
parts of the *BDM/CDM/PDS* adjacent to the circuit or part under consideration

3.84
supplementary insulation
independent insulation applied in addition to basic insulation for *fault protection*

Note 1 to entry: *Basic insulation* and *supplementary insulation* are separate, each designed for *basic protection* against electric shock.

[SOURCE: IEC 60664-1:2020, 3.1.31, modified – Note to entry added.]

3.85
surge protective device
SPD
device that contains at least one non-linear *component* that is intended to limit surge voltages and divert surge currents

Note 1 to entry: An SPD is a complete assembly, having appropriate connecting means.

[SOURCE: IEC 61643-11:2011, 3.1.1]

3.86
system
set of interrelated and/or interconnected independent elements

Note 1 to entry: A *system* is generally defined with the view of achieving a given objective, for example by performing a definite function, such as grounding *system*s, wiring *system*s, power *system*s, *insulation system*s.

3.87
system voltage
voltage used to determine *insulation* requirements

Note 1 to entry: See 4.4.7.1.7 for further consideration of *system voltage*.

3.88
temporary overvoltage
overvoltage at power frequency of relatively long duration

[SOURCE: IEC 60664-1:2020, 3.1.12]

3.89
thermal memory
ability of an overload protective *system* to approximate the heating and cooling of a protected motor during operation

3.90
thermal memory retention
ability to retain a representation of the thermal state of a motor prior to tripping or loss of power

Note 1 to entry: Typically, the thermal memory retention will be used by the overload protective *system* to approximate the thermal state of the motor upon restart.

Note 2 to entry: The thermal memory retention may include an ongoing reduction of the thermal representation to reflect cooling of the motor during tripping or loss of power.

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