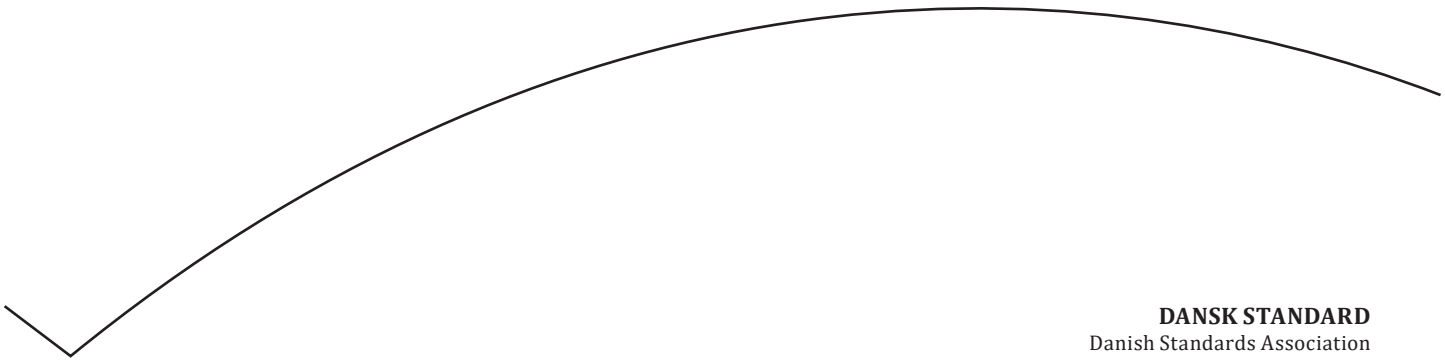
Halvlederomformere – Generelle krav og netkommuterede omformere – Del 1-1: Specifikation af grundlæggende krav

Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements



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Danish Standards Association

Göteborg Plads 1
DK-2150 Nordhavn

Tel: +45 39 96 61 01
dansk.standard@ds.dk
www.ds.dk

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Convertisseurs à semiconducteurs - Exigences générales et convertisseurs commutés par le réseau - Partie 1-1: Spécification des exigences de base (IEC 60146-1-1:2024)

Halbleiter-Stromrichter - Allgemeine Anforderungen und netzgeführte Stromrichter - Teil 1-1: Festlegung der Grundanforderungen (IEC 60146-1-1:2024)

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European foreword

The text of document 22/374/FDIS, future edition 5 of IEC 60146-1-1, prepared by IEC/TC 22 "Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60146-1-1:2024.

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) 2025-01-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2027-04-23

This document supersedes EN 60146-1-1:2010 and all of its amendments and corrigenda (if any).

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The text of the International Standard IEC 60146-1-1:2024 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 60071-1	NOTE	Approved as EN IEC 60071-1
IEC 60071-2	NOTE	Approved as EN IEC 60071-2
IEC 60076-1	NOTE	Approved as EN 60076-1
IEC 60146-2	NOTE	Approved as EN 60146-2
IEC 60364-1	NOTE	Approved as HD 60364-1
IEC 60529	NOTE	Approved as EN 60529
IEC 60664-3	NOTE	Approved as EN 60664-3
IEC 60664-4	NOTE	Approved as EN 60664-4
IEC 61000-2-2:2002	NOTE	Approved as EN 61000-2-2:2002 (not modified)
IEC 61000-3-3	NOTE	Approved as EN 61000-3-3
IEC 61000-3-11	NOTE	Approved as EN IEC 61000-3-11
IEC 61000-6-3:2020	NOTE	Approved as EN IEC 61000-6-3:2021 (not modified)
IEC 61000-6-5	NOTE	Approved as EN 61000-6-5
IEC 61000-6-8	NOTE	Approved as EN IEC 61000-6-8

IEC 61204-3:2016	NOTE	Approved as EN IEC 61204-3:2018 (not modified)
IEC 61287-1	NOTE	Approved as EN 61287-1
IEC 61439-1	NOTE	Approved as EN IEC 61439-1
IEC 61800-3:2022	NOTE	Approved as EN IEC 61800-3:2023 (not modified)
IEC/TR 61800-6	NOTE	Approved as CLC/TR 61800-6
IEC 61803:2020	NOTE	Approved as EN IEC 61803:2020 (not modified)
IEC 62040-2:2016	NOTE	Approved as EN IEC 62040-2:2018 (not modified)
IEC 62068	NOTE	Approved as EN 62068
IEC 62310-2:2006	NOTE	Approved as EN 62310-2:2007

(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 60050-551	1998	International Electrotechnical Vocabulary - Part 551: Power electronics	-	-
IEC 60050-551-20	2001	International Electrotechnical Vocabulary - Part 551-20: Power electronics - Harmonic analysis	-	-
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 61000-2-4	2002	Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances	EN 61000-2-4	2002
IEC 61000-3-2	2018	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN IEC 61000-3-2	2019
IEC 61000-3-12	2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and <=; 75 A per phase	EN 61000-3-12	2011
IEC 61000-4-7	2002	Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto	EN 61000-4-7	2002
IEC 61000-6-1	2016	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments	EN IEC 61000-6-1	2019

		6-2: Generic standards - Immunity standard for industrial environments		
IEC 61000-6-4	2018	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	EN IEC 61000-6-4	2019
IEC 61378-1	2011	Converter transformers - Part 1: Transformers for industrial applications	EN 61378-1	2011
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

Edition 5.0 2024-03

INTERNATIONAL STANDARD

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Semiconductor converters – General requirements and line commutated converters –
Part 1-1: Specification of basic requirements

Convertisseurs à semiconducteurs – Exigences générales et convertisseurs commutés par le réseau –
Partie 1-1: Spécification des exigences de base

IEC 60146-1-1:2024-03(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL STANDARD

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Semiconductor converters – General requirements and line commutated converters –
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SEMICONDUCTOR CONVERTERS – GENERAL REQUIREMENTS AND LINE COMMUTATED CONVERTERS –

Part 1-1: Specification of basic requirements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60146-1-1 has been prepared by IEC technical committee 22: Power electronic systems and equipment. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2009. This fifth edition constitutes a technical revision.

This fifth edition introduces four main changes:

a) re-edition of the whole standard according to the current directives;
b) deletion of safety-related descriptions considering coordination with IEC 62477 series;
c) changes of calculation methods of inductive voltage regulation;
d) changes considering coordination with IEC 61378 series.

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

Draft	Report on voting
22/374/FDIS	22/378/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.

A list of all parts of the IEC 60146 series, under the general title *Semiconductor converters – General requirements and line commutated converters*, can be found 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, or
- revised.

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INTRODUCTION

The main purposes of the IEC 60146-1 series are as follows.

IEC 60146-1-1, Specification of basic requirements:

- to establish basic terms and definitions;
- to specify service conditions which influence the basis of rating;
- to specify test requirements for electronic power converters and assemblies, standard design (for special design, see IEC TR 60146-1-2);
- to specify basic performance requirements;
- to give application oriented requirements for semiconductor power converters.

IEC TR 60146-1-2, Application guidelines:

- to give additional information on test conditions and components (for example: semiconductor valve devices), when required for their use in semiconductor power converters, in addition to or as a modification on existing standards;
- to provide useful reference, calculation factors, formulae and diagrams pertaining to power converter practice.

SEMICONDUCTOR CONVERTERS – GENERAL REQUIREMENTS AND LINE COMMUTATED CONVERTERS –

Part 1-1: Specification of basic requirements

1 Scope

This part of IEC 60146 specifies the requirements for the performance of all semiconductor power converters and semiconductor power switches using controllable and/or non-controllable electronic valve devices.

The electronic valve devices mainly comprise semiconductor devices, either not controllable (i.e. rectifier diodes) or controllable (i.e. thyristors, triacs, turn-off thyristors and power transistors). The controllable devices can be reverse blocking or reverse conducting and controlled by means of current, voltage or light. Non-bistable devices are assumed to be operated in the switched mode.

This document is primarily intended to specify the basic requirements for converters in general and the requirements applicable to line commutated converters for conversion of AC power to DC power or vice versa. Parts of this document are also applicable to other types of electronic power converter provided that they do not have their own product standards.

These specific equipment requirements are applicable to semiconductor power converters that either implement power conversion or use commutation (for example semiconductor self-commutated converters) or involve particular applications (for example semiconductor converters for DC motor drives) or include a combination of said characteristics (for example direct DC converters for electric rolling stock).

This document is applicable to all power converters not covered by a dedicated product standard, or if special features are not covered by the dedicated product standard. Generally dedicated product standards for power converters refer to this document.

NOTE 1 This document is not intended to define EMC requirements. It covers all phenomena and therefore introduces references to dedicated standards which are applicable according to their scope.

NOTE 2 For the information on converter transformers, related to this document, see IEC 61378-1.

NOTE 3 All the terms listed in Clause 3 are not necessarily used in this document, however they are necessary to establish a common understanding in the application of semiconductor converters.

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 60050-551:1998, *International Electrotechnical Vocabulary (IEV) – Part 551: Power electronics*, available at www.electropedia.org

IEC 60050-551-20:2001, *International Electrotechnical Vocabulary (IEV) – Part 551-20: Power electronics – Harmonic analysis,* available at www.electropedia.org

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IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61378-1:2011, *Converter transformers – Part 1: Transformers for industrial applications*

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

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*