

INTERNATIONAL STANDARD



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

Document Preview

[IEC 60146-1-1:2024](https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bee1-5a2d4ee8e292/iec-60146-1-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bee1-5a2d4ee8e292/iec-60146-1-1-2024>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

International
Standards
Document Preview
standards.iteh.ai

[IEC 60146-1-1:2024](https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bce1-5a2d4ee8e292/iec-60146-1-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bce1-5a2d4ee8e292/iec-60146-1-1-2024>



IEC 60146-1-1

Edition 5.0 2024-03
COMMENTED VERSION

INTERNATIONAL STANDARD



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

Document Preview

[IEC 60146-1-1:2024](https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bce1-5a2d4ee8e292/iec-60146-1-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bce1-5a2d4ee8e292/iec-60146-1-1-2024>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.200, 29.045

ISBN 978-2-8322-8575-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	5
INTRODUCTION	7
1 Scope and object	8
2 Normative references	8
3 Terms and definitions	10
3.1 Semiconductor devices and combinations	11
3.2 Arms and connections	15
3.3 Controllability of converter arms and quadrants of operation (on DC side)	17
3.4 Commutation, quenching and commutation circuitry	19
3.5 Commutation characteristics	22
3.6 Rated values	24
3.7 Specific voltages, currents and factors	27
3.8 Cooling	30
3.9 Service conditions tolerances and electromagnetic compatibility	31
3.10 Harmonic distortion	33
3.11 Definitions related to insulation co-ordination	38
3.12 Principal letter symbols and subscripts	42
4 Operation of semiconductor power equipment and valve devices	44
4.1 Classification	44
4.1.1 Semiconductor converter	44
4.1.2 Semiconductor valve devices	45
4.2 Basic operation of semiconductor converters	46
4.2.1 Commutation	46
4.2.2 Basic calculation factors for line commutated converters	49
4.2.3 Disturbances and fault conditions	51
5 Service conditions	53
5.1 Code of identification for cooling method	53
5.2 Environmental conditions	54
5.2.1 Ambient air circulation	54
5.2.2 Normal service conditions – Temperatures	54
5.2.3 Other normal service conditions	54
5.2.4 Unusual service conditions	55
5.3 Characteristics of the load	55
5.4 Service condition tolerances	56
5.4.1 Steady state and short time conditions	56
5.4.2 Repetitive and non-repetitive transients	59
6 Power conversion equipment and assemblies	59
6.1 Electrical connections	59
6.2 Calculation factors	60
6.2.1 Essential variables	60
6.2.2 Losses and efficiency	66
6.2.3 Power factor	67
6.2.4 Voltage regulation	67
6.3 Electromagnetic compatibility	69
6.3.1 Harmonics	69
6.3.2 Other EMC aspects	70

6.4	Rated values	71
6.4.1	General.....	71
6.4.2	Rated output voltage	71
6.4.3	Rated current values	72
6.5	Duty classes.....	72
6.5.1	Principles	72
6.5.2	Selection of duty class and rated current value	73
6.5.3	Particular remarks for double converters	75
6.6	Markings	75
6.6.1	General.....	75
6.6.2	Rating plate.....	75
7	Tests for valve device assemblies and power conversion equipment.....	76
7.1	General.....	76
7.1.1	Methods of testing	76
7.1.2	Kinds of tests	77
7.1.3	Performance of tests	77
7.2	Insulation tests	78
7.2.1	General.....	78
7.2.2	Routine insulation tests of power conversion equipment	78
7.2.3	Additional tests.....	82
7.3	Functional test.....	83
7.3.1	Light load test and functional test.....	83
7.3.2	Rated current test.....	83
7.3.3	Over-current capability test.....	83
7.3.4	Measurement of the inherent voltage regulation.....	83
7.3.5	Measurement of ripple voltage and current.....	84
7.3.6	Measurement of harmonic currents	84
7.4	Losses, temperature and power factor.....	84
7.4.1	Power loss determination for assemblies and equipment.....	84
7.4.2	Temperature rise test	85
7.4.3	Power factor measurements.....	86
7.5	Auxiliaries Auxiliary device and control equipment.....	86
7.5.1	Checking of auxiliary devices.....	86
7.5.2	Checking the properties of the control equipment	86
7.5.3	Checking the protective devices.....	86
7.6	EMC tests	87
7.7	Measurement of audible noise and additional tests	87
7.8	Tolerances	87
Annex A	(normative) Harmonics and interharmonics.....	89
A.1	Non-sinusoidal voltages and currents	92
A.2	Two approaches for definitions related to harmonics.....	92
Annex B	(informative) Electrical environment – Short-circuit ratio	93
B.1	Electrical environment specification.....	93
B.2	Point of coupling of the converter	94
B.2.1	Systems and installations	94
B.2.2	Short-circuit ratio of the source in the installation	95
B.2.3	Short-circuit ratio.....	96
Annex C	(normative) Protection against electric shock and energy hazards.....

Annex C (informative) Introduction to safety standards for power conversion equipment.....	102
C.1 General.....	102
C.2 Brief introduction to IEC 62477 series with reference to IEC 60146 series	102
C.3 Purposes or intentions of IEC 60146 series and IEC 62477 series.....	102
Bibliography.....	103
List of comments.....	112
Figure 1 – Types of commutation.....	48
Figure 2 – Illustration of angles.....	49
Figure 3 – Voltage regulation.....	51
Figure 4 – AC voltage waveform.....	59
Figure B.1 – PCC, IPC, installation current ratio and R_{SI}	96
Figure B.2 – PCC, IPC, installation current ratio and R_{SC}	98
Table 1 – List of major subscripts	42
Table 2 – Symbols	43
Table 3 – Performance criteria.....	51
Table 4 – Cooling medium or heat transfer agent	53
Table 5 – Method of circulation.....	53
Table 6 – Limit of temperature of the cooling medium for indoor equipment.....	54
Table 7 – Immunity levels to frequency and voltage amplitude for stiff AC voltage connections	57
Table 8 – Immunity levels to voltage unbalance for stiff AC voltage connections	58
Table 9 – Immunity levels to voltage waveform for stiff AC voltage connections	58
Table 10 – Connections and calculation factors.....	63
Table 11 – Standard duty classes	73
Table 12 – Examples of load cycles as guidance for selection of duty class	74
Table 13 – Summary of tests	77
Table 14 – AC or DC test voltages for equipment directly connected to low voltage mains	80
Table 15 – AC or DC test voltages for equipment directly connected to high voltage mains	81
Table 16 – Tolerances.....	88
Table C.1 – Comparison on purposes or intentions between two standards.....	102

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

This commented version (CMV) of the official standard IEC 60146-1-1:2024 edition 5.0 allows the user to identify the changes made to the previous IEC 60146-1-1:2009 edition 4.0. Furthermore, comments from IEC TC 22 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

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.

<https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bce1-5a2d4ee8e292/iec-60146-1-1-2024>

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.

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

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.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 60146-1-1:2024](https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bee1-5a2d4ee8e292/iec-60146-1-1-2024)

<https://standards.iteh.ai/catalog/standards/iec/65b37325-f9f1-41e3-bee1-5a2d4ee8e292/iec-60146-1-1-2024>

SEMICONDUCTOR CONVERTERS – GENERAL REQUIREMENTS AND LINE COMMUTATED CONVERTERS –

Part 1-1: Specification of basic requirements

1 ~~Scope and object~~

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 ~~may~~ 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 ~~should~~ 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 ~~A large part of this standard, particularly for power transformers, is covered in IEC 61378-1.~~ 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. **1**

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 60050-101:1998, International Electrotechnical Vocabulary – Part 101: Mathematics~~

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

~~IEC 60364-1, Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions~~

~~IEC 60529, Degrees of protection provided by enclosures (IP Code)~~

IEC 60664-1:2007/2020, Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests

~~IEC 60700-1, Thyristor valves for high voltage direct current (HVDC) power transmission – Part 1: Electrical testing~~

~~IEC 61000 (all parts), Electromagnetic compatibility (EMC)~~

~~IEC 61000-2-2:2002, Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems~~

IEC 61000-2-4:2002, Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances

IEC 61000-3-2:2018, Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

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

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

~~IEC 61000-3-12:2004/2011, Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current $\rightarrow \leq 16$ A and ≤ 75 A per phase~~

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 61000-6-3, Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments~~

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

~~IEC 61140, Protection against electric shock – Common aspects for installation and equipment~~

~~IEC 61180-1:1992, High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements~~

~~IEC 61204-3, Low-voltage power supplies, d.c. output – Part 3: Electromagnetic compatibility (EMC)~~

~~IEC 61204-7, Low-voltage power supplies, d.c. output – Part 7: Safety requirements~~

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

~~IEC 61800-3, Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods~~

~~IEC 61800-5-1, Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy~~

~~IEC 61954, Power electronics for electrical transmission and distribution systems – Testing of thyristor valves for static VAR compensators~~

~~IEC/PAS 61975, Guide to the specification and design evaluation of a.c. filters for HVDC systems~~

~~IEC 62040-1, Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS~~

~~IEC 62040-2, Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements~~

~~IEC 62103, Electronic equipment for use in power installations~~

~~IEC 62310-1, Static transfer systems (STS) – Part 1: General and safety requirements~~

~~IEC 62310-2, Static transfer systems (STS) – Part 2: Electromagnetic compatibility (EMC) requirements~~

IEC 60146-1-1:2024

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 **2**

~~NOTE – Some other IEC publications are quoted for information in the Bibliography.~~

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-551, IEC 60050-551-20, IEC 60664-1 and the following apply.

~~In this standard, IEC definitions are used wherever possible, particularly those in IEC 60050 (551).~~

~~All the terms listed in this clause are not necessarily used in this International Standard, however they are necessary to establish a common understanding in the application of semiconductor converters.~~

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>

- IEC Electropedia: available at <https://www.electropedia.org>

NOTE The policy adopted is as follows:

- when an existing IEC 60050 definition needs amplification or additional information, the title, the reference and the additional text are given;
- explanations and figures are given in 4.2;
- terms used in connection with converter faults are defined in IEC TR 60146-1-2.

~~An alphabetical index is given in the Index of definitions.~~

~~NOTE For easier use of this index, a cross reference numbering is set up, noted [df n], in which n is the natural integer following the alphabetical order of the definitions.~~

3.1 Semiconductor devices and combinations

3.1.1

semiconductor device

device, the essential electric characteristics of which are due to the flow of charge carriers within one or more semiconductor materials

~~[IEV 151-13-63] [df 164]~~

[SOURCE: IEC 60050-151:2001, 151-13-63]

3.1.2

electronic (power) switch **electronic switch**

operative unit for electronic power switching comprising at least one controllable valve device

~~[IEV 551-13-01] [df 60] [df 123] [df 173]~~

[SOURCE: IEC 60050-551:1998, 551-13-01]

3.1.3

semiconductor switch

electronic power switch with semiconductor valve devices

Note 1 to entry: Similar terms are used for electronic switches or power controllers with specific electronic valve devices, for example thyristor controller, transistor switch.

~~[IEV 551-13-05] [df 165] [df 174]~~

[SOURCE: IEC 60050-551:1998, 551-13-05]

3.1.4

non-controllable valve device **rectifier diode**

reverse blocking valve device the current path of which conducts in its conducting direction without any control signal being applied

~~[IEV 551-14-04] [df 45] [df 105] [df 149]~~

[SOURCE: IEC 60050-551:1998, 551-14-04]

3.1.5

thyristor

bi-stable semiconductor device comprising three or more junctions which can be switched from the off-state to the on-state or vice versa

Note 1 to entry: Devices having only three layers but having switching characteristics similar to those of four-layer thyristors may also be called thyristors.

Note 2 to entry: The term "thyristor" is used as a generic term to cover the whole range of PNP type devices. It may be used by itself for any member of the thyristor family when such use does not result in ambiguity or misunderstanding. In particular, the term "thyristor" is widely used for reverse blocking triode thyristor, formerly called "silicon controlled rectifier".

~~[IEV 521-04-61] – [df 178]~~

[SOURCE: IEC 60050-521:2002, 521-04-61, modified – Note 2 to entry added]

3.1.6

reverse blocking triode thyristor

three-terminal thyristor which for negative anode voltage does not switch, but exhibits a reverse blocking state

~~[IEV 521-04-63] – [df 158] [df 179] [df 193]~~

[SOURCE: IEC 60050-521:2002, 521-04-63]

3.1.7

reverse conducting triode thyristor

three-terminal thyristor which for negative anode voltage does not switch and conducts large currents at voltages comparable in magnitude to the forward on-state voltage

~~[IEV 521-04-65] – [df 159]~~

[SOURCE: IEC 6005-521:2002, 521-04-65]

3.1.8

bidirectional triode thyristor

triac

three-terminal thyristor having substantially the same switching behaviour in the first and third quadrants of the current-voltage characteristic

~~[IEV 521-04-67, modified] – [df 11] [df 188]~~

[SOURCE: IEC 60050-521:2002, 521-04-67]

3.1.9

turn-off thyristor

GTO

thyristor which can be switched from the on-state to the off-state and vice versa by applying control signals of appropriate polarity to the gate terminal

~~NOTE – Also known as gate turn-off thyristor.~~

Note 1 to entry: The gate turn-off thyristor (GTO) and the integrated gate commutated thyristor (IGCT) are types of turn-off thyristor.

~~[IEV 521-04-68] [df 79] [df 81] [df 195]~~

[SOURCE: IEC 60050-521:2002, 521-04-68, modified – Note to entry added]

3.1.10

power transistor

transistor designed for switching from the on-state to the off-state and vice versa by applying control signals of appropriate polarity to the base or gate terminal ~~[df 124] [df 186]~~