

TECHNICAL REPORT



**Semiconductor converters – General requirements and line commutated converters –
Part 1-2: Application guide**

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.045; 29.200

ISBN 978-2-8322-7560-3

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR CONVERTERS – GENERAL REQUIREMENTS AND LINE COMMUTATED CONVERTERS –

Part 1-2: Application guidelines

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 60146-1-2, which is a Technical Report, has been prepared by IEC technical committee 22: Power electronic systems and equipment.

This fifth edition cancels and replaces the fourth edition published in 2011. This edition constitutes a technical revision.

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

- a) addition of annexes concerning the applications of converter transformers and of fuses for overcurrent protection;
- b) changes of calculation methods related the inductive voltage regulation and changes of description on transformer losses to be consistent with the latest transformer standards;
- c) addition and updates of references based on the latest information.

The text of this Technical Report is based on the following documents:

Draft T	Report on voting
22/306/DTR	22/310/RVDTR

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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SEMICONDUCTOR CONVERTERS – GENERAL REQUIREMENTS AND LINE COMMUTATED CONVERTERS –

Part 1-2: Application guidelines

1 Scope

This part of IEC 60146, which is a Technical Report, gives guidance on variations to the specifications given in IEC 60146-1-1:2009 to enable the specification to be extended in a controlled form for special cases. Background information is also given on technical points, which ~~should facilitate~~ facilitates the use of IEC 60146-1-1:2009.

This document primarily covers line commutated converters and is not in itself a specification, except as regards certain auxiliary components, in so far as existing standards may not provide the necessary data.

This document will not take precedence on any product specific standard according to the concept shown in IEC Guide 108. IEC Guide 108 provides the information on the relationship between horizontal standards and product publications.

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 60050-521:2002, International Electrotechnical Vocabulary – Part 521: Semiconductor devices and integrated circuits~~

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

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

IEC 60146-1-1:2009, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

~~IEC 60146-1-3:1991, Semiconductor converters – General requirements and line commutated converters Part 1-3: Transformers and reactors~~

IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*

IEC 60269-4:2009, *Low-voltage fuses – Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices*

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

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

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

IEC 61148, Terminal markings for valve device stacks and assemblies and for power ~~converter~~ conversion equipment

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

IEC/IEEE 60076-57-129, Power transformers – Part 57-129: Transformers for HVDC applications

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60146-1-1:2009, IEC 60050-551, IEC 60050-551-20, ~~several of which are repeated here for convenience~~, and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Several terms from IEC 60146-1-1:2009, IEC 60050-551, IEC 60050-551-20 are repeated here for convenience.

3.1 Terms and definitions related to converter faults

3.1.1 breakthrough

failure by which a controllable valve device or an arm consisting of such devices loses its ability to block voltage during the forward blocking interval

~~IEC TR 60146-1-2:2019~~

~~https://[IEC 60050-551:1998, 551-16-60]c/d969d640-795e-4ff9-a0e2-09b261d3bee6/iec-tr-60146-1-2-2019~~

Note 1 to entry: See Figure 1a). Breakthrough can occur in rectifier operation as well as inverter operation and for various reasons, for example excessive junction temperature, voltage surges in excess of rated peak off-state voltage, excessive rate of rise of off-state voltage or spurious gate current.

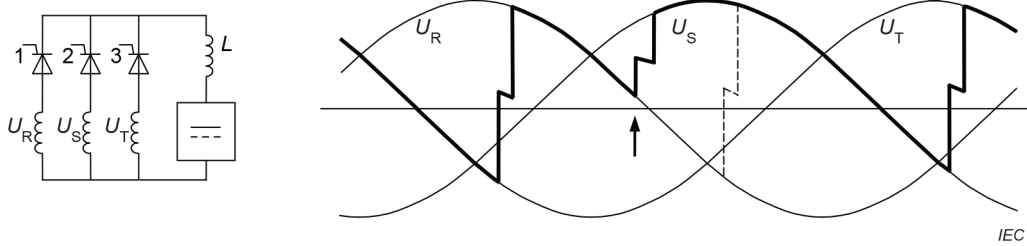


Figure 1a) Breakthrough in arm 2

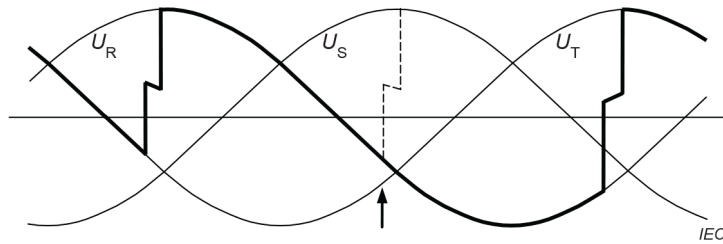


Figure 1b) Firing failure in arm 2

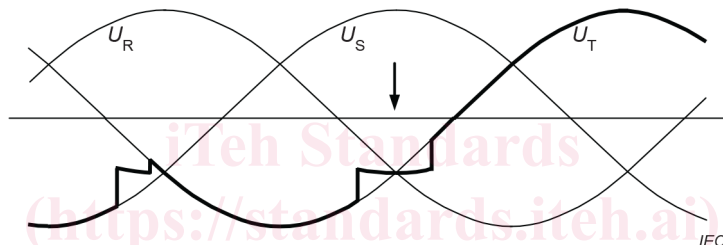


Figure 1c) Conduction through related to arm 3

Figure 1 – Voltages at converter faults

[SOURCE: IEC 60050-551:1998, 551-16-60, modified – Note 1 to entry has been added.]

3.1.2

false firing

firing of a latching valve device or an arm consisting of such devices at an incorrect instant

[SOURCE: IEC 60050-551:1998, 551-16-63]

3.1.3

breakdown

<of an electronic valve device or of a valve arm> failure that permanently deprives an electronic valve device or a valve arm of its property to block voltage

[SOURCE: IEC 60050-551:1998, 551-16-66]

3.1.4

firing failure

failure to achieve conduction in a latching valve device or an arm consisting of such devices during the conduction interval

Note 1 to entry: See Figure 1b).

[SOURCE: IEC 60050-551:1998, 551-16-65, modified – Note 1 to entry has been added.]