

Semiconductor converters – Part 2: Self-commutated semiconductor converters including direct d.c. converters (IEC 60146-2:1999)

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**Semiconductor converters**  
**Part 2: Self-commutated semiconductor converters**  
**including direct d.c. converters**  
(IEC 60146-2:1999)

Convertisseurs à semiconducteurs  
Partie 2: Convertisseurs autocommutés  
à semiconducteurs y compris les  
convertisseurs à courant continu directs  
(CEI 60146-2:1999)

Halbleiter-Stromrichter  
Teil 2: Selbstgeführte  
Halbleiter-Stromrichter einschließlich  
Gleichstrom-Direktumrichter  
(IEC 60146-2:1999)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Ref. No. EN 60146-2:2000 E

### Foreword

The text of document 22B/126/FDIS, future edition 2 of IEC 60146-2, prepared by SC 22B, Semiconductor converters, of IEC TC 22, Power electronics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60146-2 on 2000-01-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2000-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-01-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annex ZA is normative and annex A is informative.

Annex ZA has been added by CENELEC.

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### Endorsement notice

The text of the International Standard IEC 60146-2:1999 was approved by CENELEC as a European Standard without any modification.

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Annex ZA (normative)

Normative references to international publications  
with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-101	1998	International Electrotechnical Vocabulary (IEV) Part 101: Mathematics	-	-
IEC 60050-161	1990	Chapter 161: Electromagnetic compatibility	-	-
IEC 60050-551	1998	Part 551: Power electronics	-	-
IEC 60146-1-1	1991	Semiconductor convertors - General requirements and line commutated convertors Part 1-1: Specifications of basic requirements	EN 60146-1-1	1993
IEC 60146-1-2	1991	Semiconductor convertors - General requirements and line commutated convertors Part 1-2: Application guide	-	-
IEC 60664-1 (mod)	1992	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests	HD 625.1 S1 + corr. November 1996	1996
IEC 60747-1 A3	1983 1996	Semiconductor devices - Discrete devices Part 1: General	-	-
IEC 61000-2-2 (mod)	1990	Electromagnetic compatibility (EMC) Part 2: Environment Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	ENV 61000-2-2	1993

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-2-4 + corr. August	1994 1994	Section 4: Compatibility levels in industrial plants for low-frequency conducted disturbances	EN 61000-2-4	1994
IEC 61000-4	series	Part 4: Testing and measurement techniques	EN 61000-4	series
IEC 61010-1 (mod)	1990	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements		
+ A1 (mod)	1992		EN 61010-1	1993

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**Convertisseurs à semiconducteurs –**

**Partie 2:**

**Convertisseurs autocommutés à semiconducteurs  
y compris les convertisseurs à courant continu  
directs**

**(standards.iteh.ai)**

**Semiconductor converters –**

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**Part 2:**

**Self-commutated semiconductor converters  
including direct d.c. converters**

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International Electrotechnical Commission  
Международная Электротехническая Комиссия

CODE PRIX  
PRICE CODE

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For price, see current catalogue

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## SEMICONDUCTOR CONVERTERS –

Part 2: Self-commutated semiconductor converters  
including direct d.c. converters

## FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60146-2 has been prepared by subcommittee 22B: Semiconductor converters, of IEC technical committee 22: Power electronics.

This second edition of IEC 60146-2 cancels and replaces the first edition of IEC 60146-2 published in 1974 and the first edition of IEC 60146-3 published in 1977, and constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
22B/126/FDIS	22B/129/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annex A is for information only.

The committee has decided that this publication remains valid until 2005. At this date, in accordance with the committee's decision, the publication will be

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

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## SEMICONDUCTOR CONVERTERS –

### Part 2: Self-commutated semiconductor converters including direct d.c. converters

#### 1 Scope

This part of IEC 60146 applies to all types of semiconductor converters of the self-commutated type including power converters which contain at least one part of a self-commutated type, for example a.c. converters, indirect d.c. converters, direct d.c. converters.

The requirements of IEC 60146-1-1 apply also to self-commutated converters as far as they are not in contradiction with this standard. For some special applications, for example, uninterruptible power systems, variable speed a.c. and d.c. drives and electric traction equipment, additional standards may apply.

NOTE Test restrictions may apply to special applications, for example high-power reactive power converters.

#### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60146. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60146 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60050-101:1998, *International Electrotechnical Vocabulary (IEV) – Part 101: Mathematics*

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60050-551:1998, *International Electrotechnical Vocabulary (IEV) – Part 551: Power electronics*

IEC 60146-1-1:1991, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specifications of basic requirements*  
Amendment 2<sup>1)</sup>

IEC 60146-1-2:1991, *Semiconductor converters – General requirements and line commutated converters – Part 1-2: Application guide*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

<sup>1)</sup> To be published.

IEC 60747-1:1983, *Semiconductor devices – Discrete devices – Part 1: General*  
Amendment 3 (1996)

IEC 61000-2-2:1990, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-2-4:1994, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 4: Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61000-4 (all parts), *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques*

IEC 61010-1:1990, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*  
Amendment 1 (1992)

### 3 Definitions

For the purpose of this part of IEC 60146, the terms and definitions given in IEC 60146-1-1, in IEC 60050-551 (some of which are repeated below for convenience) and the following apply.

#### 3.1 Functions of converters

##### 3.1.1

##### **(electronic) (power) conversion**

change of one or more of the characteristics of an electric power system essentially without appreciable loss of power by means of electronic valve devices

[IEV 551-11-02]

NOTE Characteristics are, for example, voltage, number of phases and frequency including zero frequency.

##### 3.1.2

##### **(electronic) a.c./d.c. (power) conversion**

electronic conversion from a.c. to d.c. or vice versa

[IEV 551-11-05]

##### 3.1.3

##### **(electronic) (power) rectification**

electronic conversion from a.c. to d.c.

[IEV 551-11-06]

##### 3.1.4

##### **(electronic) (power) inversion**

electronic conversion from d.c. to a.c.

[IEV 551-11-07]

##### 3.1.5

##### **(electronic) a.c. (power) conversion**

electronic conversion from a.c. to a.c.

[IEV 551-11-08]

**3.1.6****(electronic) d.c. (power) conversion**

electronic conversion from d.c. to d.c.

[IEV 551-11-09]

**3.1.7****direct (power) conversion**

electronic conversion without a d.c. or a.c. link

[IEV 551-11-10]

**3.1.8****indirect (power) conversion**

electronic conversion with one or more d.c. or a.c. link(s)

[IEV 551-11-11]

**3.1.9****commutation**

in an electronic power converter the transfer of current from one conducting arm to the next to conduct in sequence, without interruption of the current, both arms conducting simultaneously during a finite time interval

[IEV 551-16-01]

**3.1.10****commutating voltage**

the voltage which causes the current to commute

[IEV 551-16-02]

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**3.1.11****line commutation**

an external commutation where the commutating voltage is supplied by the line

[IEV 551-16-12]

**3.1.12****self-commutation**

a commutation where the commutating voltage is supplied by components within the converter or the electronic switch

[IEV 551-16-15]

**3.1.13****phase control**

the process of varying the instant within the cycle at which current conduction in an electronic valve device or a valve arm begins

[IEV 551-16-23]

**3.1.14****pulse control**

the process of varying the starting or termination instants or both of a repeated current conduction in a principal arm

[IEV 551-16-27]