IEC 62590

Edition 2.0 2019-08

INTERNATIONAL STANDARD

Railway applications – Fixed installations – Electronic power converters for substations

IEC 62590:2019-08(en)

IEC Central Office
3, rue de Varembé
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 It also gives information on projects, replaced and withdrawn publications.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 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.

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.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC 62590

Edition 2.0 2019-08

INTERNATIONAL STANDARD

Railway applications – Fixed installations – Electronic power converters for substations

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 45.060.01

ISBN 978-2-8322-7066-0

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

RAILWAY APPLICATIONS – FIXED INSTALLATIONS – ELECTRONIC POWER CONVERTERS FOR SUBSTATIONS

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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62590 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This standard is based on EN 50328.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

a) Incorporation of DC converters.
b) Correction of the clearances and withstand voltages due to erroneous use of PD in former edition.
c) Adaption to current ISO/IEC directive part 2, adaption of structure, adaption of vocabulary, removal of unused term and abbreviations.

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

FDIS	Report on voting
9/2502/FDIS	9/2516/RVD

Full information on the voting for the approval of this International Standard 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.

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

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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Semiconductor converters for traction power supply differ from other converters for industrial use due to special electrical service conditions and due to the large range of load variation and the peculiar characteristics of the load.

For these reasons IEC 60146-1-1 does not fully cover the requirements of railway applications and the decision was taken to have a specific standard for this use.

Converter transformers for fixed installations of railway applications are covered by IEC 62695.

Harmonization of the rated values and tests of the whole converter group are covered by IEC 62589.

RAILWAY APPLICATIONS – FIXED INSTALLATIONS – ELECTRONIC POWER CONVERTERS FOR SUBSTATIONS

1 Scope

This document specifies the requirements for the performance of all fixed installations electronic power converters, using controllable and/or non-controllable electronic valves, intended for traction power supply.

The devices can be controlled by means of current, voltage or light. Non-bistable devices are assumed to be operated in the switched mode.

This document applies to fixed installations of the following electric traction systems:

- railways,
- guided mass transport systems such as: tramways, light rail systems, elevated and underground railways, mountain railways, trolleybusses.

This document does not apply to:

- cranes, transportable platforms and similar transportation equipment on rails,
- suspended cable cars,
- funicular railways.

This document applies to diode rectifiers, controlled rectifiers, DC converters, inverters and frequency converters.

The equipment covered in this document is the converter itself.

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 60050-811:2017, *International electrotechnical vocabulary – Part 811: Electric traction*

IEC 60146 (all parts), *Semiconductor convertors*

IEC TR 60146-1-2:2011, *Semiconductor converters – General requirements and line commutated converters – Part 1-2: Application guide*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721 (all parts), *Classification of environmental conditions*

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*
AMD1:1995
AMD2:1996

IEC 60721-3-4:1995, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*
AMD1:1996

IEC 60850:2014, *Railway applications – Supply voltages of traction systems*

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

IEC 61000-2-12:2003, *Electromagnetic compatibility (EMC) – Part 2-12: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems*

IEC 61992-7-1:2006, *Railway applications – Fixed installations – DC switchgear – Part 7-1: Measurement, control and protection devices for specific use in DC traction systems – Application guide*

IEC 62236 (all parts), *Railway applications – Electromagnetic compatibility*

IEC 62236-5:2018, *Railway applications – Electromagnetic compatibility – Part 5: Emission and immunity of fixed power supply installations and apparatus*

IEC 62497-1:2010, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 An alphabetical index is given in Annex C.

3.1 Semiconductor devices and combinations

3.1.1
semiconductor device
device whose essential characteristics are due to the flow of charge carriers within a semiconductor

[SOURCE: IEC 60050-521: 2002, 521-04-01, modified – note omitted]

3.1.2
(valve device) stack
a single structure of one or more electronic valve devices with its (their) associated mounting(s) and auxiliaries if any

[SOURCE: IEC 60050-551:1998, 551-14-12]

3.1.3
(valve device) assembly
an electrically and mechanically combined assembly of electronic valve devices or stacks, complete with all its connections and auxiliaries in its own mechanical structure

[SOURCE: IEC 60050-551:1998, 551-14-13]

3.1.4
electronic power converter
operative unit for power conversion comprising one or more assemblies of semiconductor devices

Note 1 to entry: The transformers are described in IEC 62695

[SOURCE: IEC 60050-551:1998, 551-12-01, modified – "electronic" has been omitted. "electronic valve devices, transformers and filters if necessary and auxiliaries if any" has been replaced with "assemblies of semiconductor devices". The note 1 to entry has been omitted.]

3.1.5
trigger equipment
equipment which provides suitable trigger pulses from a control signal for controllable valve devices in a converter or power switch including timing or phase shifting circuits, pulse generating circuits and usually power supply circuits

3.1.6
system control equipment
equipment associated with a converter equipment or system which performs automatic adjustment of the output characteristics as a function of a controlled quantity

3.2 Arms and connections

3.2.1
(valve) arm
a part of the circuit of an electronic power converter or switch bounded by any two AC or DC terminals and including one or more simultaneously conducting electronic valve devices connected together and other components if any

[SOURCE: IEC 60050-551:1998, 551-15-01]

3.2.2
principal arm
a valve arm involved in the major transfer of power from one side of the converter or electronic switch to the other

Note 1 to entry: Depending on the mode of operation a principal arm may act as an auxiliary arm or vice versa.

[SOURCE: IEC 60050-551:1998, 551-15-02]

3.2.3
converter connection
the electrical arrangement of valve arms and other components essential for the function of the main power circuit of a converter

[SOURCE: IEC 60050-551:1998, 551-15-10]

3.2.4
uniform connection
a connection with either all principal arms controllable or all principal arms non-controllable

[SOURCE: IEC 60050-551:1998, 551-15-15]

3.2.5
non-uniform connection
a connection with both controllable and non-controllable principal arms

[SOURCE: IEC 60050-551:1998, 551-15-18]

3.2.6
parallel connection <for converters>
connection in which two or more converters are connected in such a way that their currents add

3.3 Controllability of converter arms

3.3.1
controllable valve device
a valve device the current path of which is bistably controlled in its conducting direction

[SOURCE: IEC 60050-551:1998, 551-14-03]

3.4 Commutation, quenching and commutation circuitry

3.4.1
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

[SOURCE: IEC 60050-551:1998, 551-16-01]

3.4.2
quenching
the termination of current flow in an arm without commutation

[SOURCE: IEC 60050-551:1998, 551-16-19]

3.4.3
direct commutation
a commutation between two principal arms without transfer through any auxiliary arms

[SOURCE: IEC 60050-551:1998, 551-16-09]

3.4.4
indirect commutation
a series of commutations from one principal arm to another or back to the original one by successive commutations via one or more auxiliary arms

[SOURCE: IEC 60050-551:1998, 551-16-10]

3.4.5
line commutation
an external commutation where the commutating voltage is supplied by the line

Note 1 to entry: In the text commutated is used instead of commutation.

[SOURCE: IEC 60050-551:1998, 551-16-12]

3.4.6
load commutation
an external commutation where the commutating voltage is taken from a load other than the line

[SOURCE: IEC 60050-551:1998, 551-16-13]

3.4.7
self commutation
a commutation where the commutating voltage is supplied by components within the converter or the electronic switch

Note 1 to entry: In the text commutated is used instead of commutation

[SOURCE: IEC 60050-551:1998, 551-16-15]

3.5 Commutation characteristics

3.5.1
commutating voltage
the voltage which causes the current to commutate

[SOURCE: IEC 60050-551:1998, 551-16-02]

3.5.2
angle of overlap
u

duration of the commutation interval between a pair of principal arms, expressed in angular measure, where the two arms carry current

[SOURCE: IEC 60050-551:1998, 551-16-05, modified – “duration of”, “between a pair of principal arms,” and “,where the two arms carry current” have been added.]

3.5.3
commutating group
a group of principal arms which commutate cyclically among themselves without intermediate commutation of the current to other principal arms

[SOURCE: IEC 60050-551:1998, 551-16-08]

3.5.4
commutation number
q
number of commutations from one principal arm to another, occurring during one period of the alternating voltage in each commutating group

[SOURCE: IEC 60050-551:1998, 551-17-03, modified – “during one elementary period” has been replaced with “occurring during one period of the alternating voltage”.]

3.5.5
pulse number
p
number of non-simultaneous symmetrical direct or indirect commutations from one principal arm to another, during one period of the alternating voltage

[SOURCE: IEC 60050-551:1998, 551-17-01, modified – “which occur during one elementary period” has been replaced with “during one period of the alternating voltage”.]

3.5.6
trigger delay angle
α
time expressed in angular measure by which the trigger pulse is delayed with respect to the reference instant (see Figure 1)

Note 1 to entry: For line, machine or load commutated converters the reference instant is the zero crossing instant of the commutating voltage.

For AC controllers it is the zero crossing instant of the supply voltage.

For AC controllers with inductive load, the trigger delay angle is the sum of the phase shift and the current delay angle

[SOURCE: IEC 60050-551:1998, 551-16-33, modified – The end of the definition “in the case of phase control” has been removed. The note 1 to entry has been changed.]