
**Železniške naprave - Elektronski elektroenergetski pretvornik za fiksne postroje -
1. del: Splošne zahteve**

Railway applications - Electronic power converters for fixed installations - Part 1: General requirements

Applications ferroviaires - Convertisseurs électroniques de puissance pour installations fixes - Partie 1: Exigences générales

Ta slovenski standard je istoveten z: prEN IEC 62590-1:2024

<https://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024>

ICS:

29.200	Usmerniki. Pretvorniki. Stabilizirano električno napajanje	Rectifiers. Convertors. Stabilized power supply
45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

oSIST prEN IEC 62590-1:2024**en**



9/3043/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:

IEC 62590-1 ED1

DATE OF CIRCULATION:

2024-02-09

CLOSING DATE FOR VOTING:

2024-05-03

SUPERSEDES DOCUMENTS:

9/2813/CD, 9/2872A/CC

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS

SECRETARIAT:

France

SECRETARY:

Mr Denis MIGLIANICO

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY☒ SUBMITTED FOR CENELEC PARALLEL VOTING☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING**Attention IEC-CENELEC parallel voting**

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

oSIST prEN IEC 62590-1:2024

<https://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024>

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE AC/22/2007 OR NEW GUIDANCE DOC).

TITLE:

Railway applications - Electronic power converters for fixed installations - Part 1: General requirements

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

Copyright © 2023 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitionsFor the purposes of this document, the following terms and definitions apply.	9
3.1 Electrical Circuits.....	9
3.2 Semiconductor devices and combinations	11
3.3 Rated values.....	12
3.4 Cooling	13
3.5 Principal letter symbols	13
3.6 Abbreviated Terms.....	14
4 System Configurations.....	14
4.1 General Configurations	14
4.2 Components of an electronic power converter	14
4.3 Types of converters	15
4.3.1 General overview.....	15
4.3.2 AC/DC converter	16
4.3.3 DC converter	16
4.3.4 3AC to 1AC converters.....	16
4.3.5 1AC to 1AC converter	17
4.3.6 1AC converter	17
4.3.7 3AC converter	18
5 Performance requirements	18
5.1 Environmental conditions.....	18
5.1.1 General	18
5.1.2 Storage	18
5.1.3 Transportation and Handling.....	18
5.1.4 Normal conditions for operation including off-load periods	18
5.1.5 Vibrations	19
5.2 Insulation coordination.....	19
5.2.1 Electric traction power supply system	19
5.2.2 3AC power network	20
5.2.3 LV systems.....	20
5.3 Voltage conditions	20
5.4 Frequency conditions.....	20
5.5 Harmonics in connected systems	20
5.5.1 General	20
5.5.2 3AC power network side	20
5.5.3 Traction power supply side	21
5.6 Losses and efficiency.....	21
5.7 Load requirements, duty class and load cycles	21
5.7.1 General	21
5.7.2 Rated current and duty class	22
5.7.3 Load Cycle	22

5.8	Short time withstand current	22
5.9	Cooling Methods	22
5.9.1	General	22
5.9.2	Letters to be used	22
5.9.3	Arrangement of letters	23
5.10	Interlocking	24
5.11	Mechanical conditions	24
5.11.1	General	24
5.11.2	Earthing	24
5.11.3	Degree of protection	25
5.12	Failure modes	25
5.13	Audible Sound	26
5.14	Marking	26
5.14.1	Rating plate	26
5.14.2	Main circuit terminals	26
6	Tests	26
6.1	General requirements	26
6.1.1	General	26
6.1.2	Type test	26
6.1.3	Routine test	27
6.1.4	Overview of tests	27
6.2	Test items	27
6.2.1	Visual inspection	27
6.2.2	Test of accessory and auxiliary components	28
6.2.3	Insulation test	28
6.2.4	Operational Sequence test	29
6.2.5	Checking of protective functions	29
6.2.6	Control function test	29
6.2.7	Light Load functional test	30
6.2.8	Load test	30
6.2.9	Inherent voltage drop	30
6.2.10	Temperature rise test	30
6.2.11	Short time withstand current	34
6.2.12	Power loss determination	34
6.2.13	Audible Sound	34
6.2.14	EMC test	34
6.2.15	Harmonic test	34
6.2.16	Power factor measurement	34
6.2.17	Mechanical Test	34
Annex A (normative)	Standardized duty classes	35
Annex B (informative)	Duty cycle test with limited rate of rise	36
B.1	Comparison of duty cycle with the test cycle	36
Annex C (informative)	Traction load and duty cycle	38
C.1	Background	38
C.2	Evaluation of traction load	38
C.3	Transformation of time-weighted RMS into rated current and duty class	40
C.4	Examples	40
C.4.1	Evaluation of traction load	40

C.4.2	Benefit of using rated current I_N and duty class	41
C.5	Transformation of traction load into a rated current in conjunction with a duty class	43
Annex D (informative)	Typical load cycles	46
D.1	General	46
D.2	Cycle Examples	46
Annex E (informative)	Relationship between user and manufacturer	48
Bibliography	50
Figure 1	– General configuration	14
Figure 2	– General configuration of 3AC to DC converters	16
Figure 3	– General configurations of DC converters	16
Figure 4	– General configuration of 3AC to 1AC converters	17
Figure 5	– General configuration of 1AC to 1AC converters	17
Figure 6	– General configuration of 1AC converters	17
Figure 7	– General configuration of 3AC converters	18
Figure 8	– Test cycle for a duty class	32
Figure 9	– Determination of rise times	33
Figure B.1	– comparison of duty cycle and test cycle	36
Figure C.1	– Moving window in the time domain demonstrated on a theoretical traction load 1 with 60 min cycle time	40
Figure C.2	– Transfer of highest values from moving window calculation into the time-weighted RMS graph	41
Figure C.3	– Theoretical traction load 2, 10 min cycle time	42
Figure C.4	– Time-weighted RMS values of theoretical traction load 1 and 2	43
Figure C.5	– Typical load current of a mass transit traction load	44
Figure C.6	– Time-weighted RMS graph of the traction load in Figure C.5	45
Figure C.7	– Comparison of traction load with duty classes	45
Figure D.1	– Examples for load cycles	47
Figure E.1	– Relationship between user and manufacturer	48
Table 1	– Converter Types	15
Table 2	– Minimum insulation level	20
Table 3	– Letter symbols for cooling mediums and heat transfer agents	22
Table 4	– Letter symbols for methods of circulation	23
Table 5	– Summary of tests	27
Table A.1	– Standardized duty classes	35
Table B.1	– Example values	37

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS – ELECTRONIC POWER CONVERTERS FOR
FIXED INSTALLATIONS
Part 1 GENERAL 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) 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.

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

FDIS	Report on voting
9/XXXX/FDIS	9/XXXX/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 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

This document in conjunction with the other parts of IEC 62590 will replace the IEC 62589 and the former IEC 62590.

- a) Split into common requirements and special requirements for different converters
- b) Interface Model for the different Systems connected
- c) Split into circuits with their requirements like insulation coordination
- d) Energy efficiency addressed
- e) More to be added

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

[oSIST prEN IEC 62590-1:2024](https://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024)

<https://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024>

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 series does not fully cover the requirements of railway applications and the decision was taken to have a specific series of standards for this use.

Specific requirements for the design of converter transformers for fixed installations of railway applications are specified in IEC 62695.

This document defines common vocabulary and requirements. Other parts will cover different applications.

IEC 62590-1 Railway applications – Electronic Power Converters for fixed installations– Part 1: General requirements

IEC 62590-2-1 Railway applications - Electronic Power Converters for fixed installations – Part 2-1: DC traction applications - Uncontrolled rectifiers

IEC 62590-2-2 Railway applications – Electronic Power Converters for fixed installations – Part 2-2: DC traction applications – Controlled converters

IEC 62590-3-1 Railway applications – Electronic Power Converters for fixed installations – Part 3-1: AC traction applications – Electronic power compensators

IEC 62590-3-2 Railway applications – Electronic Power Converters for fixed installations – Part 3-2: AC traction applications – Static frequency converters

RAILWAY APPLICATIONS – ELECTRONIC POWER CONVERTERS FOR FIXED INSTALLATIONS

Part 1 GENERAL REQUIREMENTS

1 Scope

This document specifies the common requirements and definitions for all power converter applications in fixed installations for power supply of railway systems.

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

- railway networks,
- metropolitan transport networks including metros, tramways, trolleybuses and fully automated transport systems, magnetic levitated transport systems, electric road systems.

This document applies to AC/DC converters, DC converters and AC converters. Converters for improvement of power quality and for energy saving are also included.

Converters connected to electric traction systems feeding 3AC, 1AC or DC systems for auxiliary purpose are not in the scope of this document but some aspects such as insulation coordination and railway specific conditions may be referred to.

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

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

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

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

IEC 60850, *Railway applications - Supply voltages of traction systems*

IEC 61000-3 (all parts), *Electromagnetic compatibility (EMC), Limits*

IEC 61936-1, *Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC*

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

58 IEC 62236-5, *Railway applications - Electromagnetic compatibility - Part 5: Emission and*
 59 *immunity of fixed power supply installations and apparatus / Applies in conjunction with IEC*
 60 *62236-1 (2008-12)*

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

63 IEC 62498-2, *Railway applications - Environmental conditions for equipment - Part 2: Fixed*
 64 *electrical installations*

65 IEC 62313, *Railway applications - Power supply and rolling stock - Technical criteria for the*
 66 *coordination between power supply (substation) and rolling stock*

67 IEC 62695, *Railway applications - Fixed installations - Traction transformers*

68 **3 Terms and definitions** For the purposes of this document, the following terms
 69 **and definitions apply.**

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

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

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

74 **3.1 Electrical Circuits**

75 **3.1.1**

76 **electric traction power supply system**

77 railway electric distribution network used to provide energy for rolling stock

78 Note 1 to entry: The system includes [oSIST prEN IEC 62590-1:2024](https://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024)

- 79 <http://standards.iteh.ai/catalog/standards/sist/5d2bb051-0fe4-4878-84e3-b01174911d65/osist-pren-iec-62590-1-2024>
- 79 • contact line systems,
 - 80 • return circuit of electric traction power supply systems,
 - 81 • electric installations in power plants and substations, which are utilized solely for generation and
 - 82 distribution of power directly to the contact line,
 - 83 • electric installations of switching stations.

84 [SOURCE: IEC 60050-811:2017 811-36-21, modified – power supply inserted, Note 1 to entry
 85 exclusion of the points “running rails of non-electrified lines in the vicinity of, and conductively
 86 connected to the running rails of an electric traction power supply system”, and “electrical
 87 installations which are supplied from contact lines either directly or via a transformer”]

88 **3.1.2**

89 **DC traction power supply system**

90 electric traction power supply system operating with DC

91 **3.1.3**

92 **single-phase traction power supply system**

93 **1AC traction power supply system**

94 electric traction power supply system operating with single phase AC

95 Note 1 to entry: Autotransformer systems are having a phase-shift of 180 electrical degrees between their poles.
 96 Therefore, they are included in 1AC traction power supply systems from the electrical point of view.

3.1.4**three phase traction power supply system****3AC traction power supply system**

electric traction power supply system operating with three phases AC

3.1.5**electric power network**

particular installations, substations, lines or cables for the transmission and distribution of electricity

Note 1 to entry: The boundaries of the different parts of this network are defined by appropriate criteria, such as geographical situation, ownership, voltage, etc.

Note 2 to entry: In this document, this term is used to indicate a power supply network from which an electric traction power supply system receives electric power.

Note 3 to entry: A lot of synonyms are used indicating special properties like distribution network, transmission network, national grid, upstream network, or others. The term electric power network is chosen because it is the most general.

[SOURCE: IEC 60050-601:1985 601-01-02, modified – The notes 2 and 3 to entry have been added]

3.1.6**three-phase power network****3AC power network**

electric power network operating with three phases AC

3.1.7**electronic power converter**

operative unit for electronic power conversion, comprising one or more electronic valve devices, transformers and filters if necessary and auxiliaries if any

Note 1 to entry: In English, the two spellings "convertor" and "converter" are in use, and both are correct. In this document, the spelling "converter" is used in order to avoid duplications.

[SOURCE: IEC 60050-551:1998 551-12-01, modified – figure not used, and parentheses removed]

3.1.8**AC/DC converter**

electronic converter for rectification or inversion or both

[SOURCE: IEC 60050-551:1998 551-12-02]

3.1.9**rectifier**

AC/DC converter for rectification

Note 1 to entry: For purpose of this standard the rectifier includes the transformer. This is contradictory to common language in which rectifier means only the valve device assembly and does not include the transformer.

[SOURCE: IEC 60050-551:1998: 551-12-07, modified - Note 1 to entry added]

3.1.10**inverter**

AC/DC converter for inversion

Note 1 to entry: – In English, the two spellings "invertor" and "inverter" are in use, and both are correct. In this document the spelling "inverter" is used in order to avoid duplications.

[SOURCE: IEC 60050-551:1998 551-12-10]

3.1.11

reversible converter

converter in which the direction of the power flow is reversible

[SOURCE: IEC 60050-551:1998 551-12-37]

3.1.12

AC converter

converter for AC conversion

[SOURCE: IEC 60050-551:1998 551-12-17]

3.1.13

DC converter

converter for DC conversion

[SOURCE: IEC 60050-551:1998 551-12-27]

3.2 Semiconductor devices and combinations

3.2.1

control equipment

entirety of devices and programs and, in a broader sense, all instructions and programs used for the task of controlling

Note 1 to entry: Control equipment also comprises the process control station and instructions include operating manuals.

[SOURCE: IEC 60050-351:2013 351-56-24]

3.2.2

valve device assembly

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, modified – note omitted and adaption to current ISO directive]

3.2.3

commutation

in an electronic power converter 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, modified – the word “the” between converter and transfer removed]

3.2.4

line-commutation

line-commutated

external commutation where the commutating voltage is supplied by the line

Note 1 to entry: The term line refers to the line to line voltage of the feeding 3AC power network.

[SOURCE: IEC 60050-551:1998 551-16-12, modified – note 1 to entry added, “an” at the beginning removed]

3.2.5**self-commutation****self-commutated**

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

[Source: IEC 60050-551: 1998 551-16-15, modified – “a” at the beginning removed]

3.3 Rated values**3.3.1****nominal voltage <for converter>**

voltage by which a converter is designated

Note 1 to entry: Standardized values are given in IEC 60850

3.3.2**rated continuous current** **I_r**

value of current which a converter is capable of carrying continuously without damage, for specified service conditions

Note 1 to entry: The rated continuous current does not include overloads. If a specified overload is needed a derating is necessary and a duty class is applied.

3.3.3**rated current <for converter>** **I_N**

current value the converter and parts of it is designed for in conjunction with a duty class

Note 1 to entry: A converter and parts of it can have several pairs of rated current and duty class.

Note 2 to entry: The rated current for DC applications is always a mean value. The rated current for AC applications is always an RMS value.

3.3.4**duty class**

tabled representation of current capability and test values for standard design converters in terms of current values and duration selected to represent a characteristic group of practical applications

Note 1 to entry: The current values are expressed in per unit of the rated current I_N .

3.3.5**load cycle**

conventional representation of the current demand to a converter

Note 1 to entry: The current values are expressed in A or in per unit of the rated current.

Note 2 to entry: The load cycle shows the repetitive variation of the loads with time and, hence, the overloads and underloads the converter is expected to carry.

[SOURCE: IEC 60050-811:2017, 811-28-38, modified, Note 1 to entry is modified, Note 2 to entry modified]