



BSI Standards Publication

Railway applications — Electronic power converters for fixed installations

Part 1: General requirements

National foreword

This British Standard is the UK implementation of EN IEC 62590-1:2025. It is identical to IEC 62590-1:2025.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Date	Text affected
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English Version

**Railway applications - Electronic power converters for fixed
installations - Part 1: General requirements
(IEC 62590-1:2025)**

Applications ferroviaires - Convertisseurs électroniques de
puissance pour installations fixes - Partie 1: Exigences
générales
(IEC 62590-1:2025)

Bahnanwendungen - Leistungselektronische Stromrichter
für ortsfeste Anlagen - Teil 1: Allgemeine Anforderungen
(IEC 62590-1:2025)

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

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European foreword

The text of document 9/3160/FDIS, future edition 1 of IEC 62590-1, prepared by TC 9 "Electrical equipment and systems for railways" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62590-1:2025.

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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2028-06-30

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The text of the International Standard IEC 62590-1:2025 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 60076-10	NOTE Approved as EN 60076-10
IEC 60146-1-1	NOTE Approved as EN IEC 60146-1-1
IEC 60146-2:1999	NOTE Approved as EN 60146-2:2000 (not modified)
IEC 61000-3 (series)	NOTE Approved as EN 61000-3 (series)
IEC 62924	NOTE Approved as EN 62924

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60071-1	-	Insulation co-ordination - Part 1: Definitions, principles and rules	EN IEC 60071-1	-
IEC 60364-1	-	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	EN 60529	-
IEC 60664-1	-	Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests	EN IEC 60664-1	-
IEC 60721	series	Classification of environmental conditions	EN 60721	series
IEC 60850	-	Railway applications - Supply voltages of traction systems	EN 50163	-
IEC 61000-2-12	-	Electromagnetic compatibility (EMC) - Part 2-12: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems	EN 61000-2-12	-
IEC 61936-1	-	Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC	EN IEC 61936-1	-
IEC 61992-7-1	2006	Railway applications - Fixed installations - DC switchgear - Part 7-1: Measurement, control and protection devices for specific use in d.c. traction systems - Application guide	EN 50123-7-1	2003
IEC 62236-2	-	Railway applications - Electromagnetic compatibility -- Part 2: Emission of the whole railway system to the outside world	EN 50121-2	-
IEC 62236-5	-	Railway applications - Electromagnetic compatibility -- Part 5: Emission and immunity of fixed power supply installations and apparatus	EN 50121-5	-

EN IEC 62590-1:2025 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62497-1	2010	Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment	EN 50124-1	-
IEC 62313	-	Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock	EN 50388	-
IEC 62695	-	Railway applications - Fixed installations - Traction transformers	EN 50329	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
ELECTRONIC POWER CONVERTERS FOR FIXED INSTALLATIONS –****Part 1: General requirements****FOREWORD**

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

This document, in conjunction with the other parts of IEC 62590, cancels and replaces IEC 62589:2010 and the former IEC 62590:2019.

This document includes the following significant technical changes with respect to IEC 62589:2010 and the former IEC 62590:2019:

- 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.

The text of this International Standard is based on the following documents:

Draft	Report on voting
9/3160/FDIS	9/3206/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 in the IEC 62590 series, published under the general title *Railway applications – Electronic power converters for fixed installations*, can be found on the IEC website.

Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

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.

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 the 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. The whole series is listed below. Requirements in the specific parts have priority over this document.

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 – Fixed installations – Electronic power converters – 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 part of IEC 62590 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 can 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 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

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

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

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

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

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

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

IEC 62236-2, *Railway applications – Electromagnetic compatibility – Part 2: Emission of the whole railway system to the outside world*

IEC 62236-5, *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*

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

IEC 62695, *Railway applications – Fixed installations – Traction transformers*

3 Terms, definitions, principal letter symbols, abbreviated terms and symbols

For the purposes of this document, the following terms, definitions, principal letter symbols, abbreviated terms and symbols apply.

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

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

3.1 Terms and definitions

3.1.1

electric traction power supply system

railway electric distribution network used to provide energy for rolling stock

Note 1 to entry: The system includes:

- contact line systems,
- return circuit of electric traction power supply systems,
- electric installations in power plants and substations, which are utilized solely for generation and distribution of power directly to the contact line,
- electric installations of switching stations.

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

3.1.2

DC traction power supply system

electric traction power supply system operating with DC

3.1.3

single-phase traction power supply system

1AC traction power supply system

electric traction power supply system operating with single phase AC

Note 1 to entry: Autotransformer systems have a phase-shift of 180 electrical degrees between their poles. Therefore, they are included in 1AC traction power supply systems.

3.1.4

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, power grid or others. The term electric power network is chosen because it is the most general.

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

3.1.5

three-phase power network

3AC power network

electric power network operating with three phases AC

3.1.6

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]

3.1.7

AC/DC converter

electronic converter for rectification or inversion or both

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

3.1.8

rectifier

AC/DC converter for rectification

Note 1 to entry: For purpose of this document 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]

3.1.9**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]

3.1.10**reversible converter**

converter in which the direction of the power flow is reversible

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

3.1.11**AC converter**

converter for AC conversion

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

3.1.12**DC converter**

converter for DC conversion

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

3.1.13**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]

3.1.14**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 adaptation to current ISO/IEC directives]

3.1.15**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" between converter and transfer replaced with ","]

3.1.16

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 has been added.]

3.1.17

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]

3.1.18

nominal voltage

U_n

<for converter> voltage by which a converter is designated

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

3.1.19

rated continuous current

I_r

<for converter> 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 rated current in conjunction with a duty class is applied.

3.1.20

rated current

I_N

<for converter>, 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.

3.1.21

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 .

3.1.22**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 load over or under the rated load the converter is expected to carry.

[SOURCE: IEC 60050-811:2017, 811-28-38, modified – "group" removed, Notes 1 and 2 to entry modified]

3.1.23**user**

<of converters>, entity which procures, installs and/or operates equipment, and agrees with the manufacturer about the equipment characteristic

Note 1 to entry: A graphical representation of the relationship between user and manufacturer is given in Annex E.

3.1.24**manufacturer**

<of converters> entity which produces and/or distributes equipment, and agrees with the user about the equipment characteristic

Note 1 to entry: A graphical representation of the relationship between user and manufacturer is given in Annex E.

3.1.25**cooling medium**

liquid (for example water) or gas (for example air) which removes the heat from the equipment

3.1.26**direct cooling**

method of cooling by which the cooling medium is in direct contact with the parts of the equipment to be cooled, i.e. no heat transfer agent is used

3.1.27**indirect cooling**

method of cooling in which a heat transfer agent is used to transfer heat from the part to be cooled to the cooling medium

3.1.28**natural cooling**

<for converters> method of circulating the cooling medium or heat transfer agent which uses the change of volumetric mass (density) with temperature

3.1.29**forced cooling**

<for converters> method of circulating the cooling medium or heat transfer agent by means of blower(s), fan(s) or pump(s)

3.2 Principal letter symbols

f_{N3AC} rated frequency on 3AC side of a converter

I_N rated current

I_r rated continuous current

U_a power frequency test voltage [SOURCE: IEC 62497-1]

U_{ac} power frequency test voltage for verification of clearances [SOURCE: IEC 62497-1]