SLOVENSKI STANDARD
oSIST prEN IEC 62590-2-1:2024

01-april-2024

Železniške naprave - Elektronski elektroenergetski pretvornik za fiksne postroje - 2-1. del: Enosmerni sistemi vleke - Diodni usmerniki

Railway applications - Electronic power converters for fixed installations - Part 2-1: DC traction applications - Diode rectifiers

Applications ferroviaires - Convertisseurs électroniques de puissance pour installations fixes - Partie 2-1: Applications de traction en courant continu - Redresseurs à diodes

Ta slovenski standard je istoveten z: **prEN IEC 62590-2-1:2024**

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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

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS

SECRETARIAT:	SECRETARY:
France	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

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TITLE:

Railway applications – Electronic power converters for fixed installations – Part 2-1: DC Traction applications – Diode rectifiers

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS –ELECTRONIC POWER CONVERTERS FOR FIXED INSTALLATIONS – PART 2-1: DC TRACTION APPLICATIONS – UNCONTROLLED RECTIFIERS

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

This standard is based on IEC 62590 Ed.2, IEC 62589 and IEC 62695.

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.

INTRODUCTION

Electronic power 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.

Uncontrolled rectifiers consist of a rectifier diode assembly and a transformer. Both fulfil common requirements. The transformer determines the voltage versus current characteristic.

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

The series of IEC 62590 consists of the following parts:

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 2-1: DC TRACTION APPLICATIONS – UNCONTROLLED RECTIFIERS

1 Scope

This document describes functions and working principles, specifies requirements, interfaces and test methods of uncontrolled rectifiers for DC electric traction systems. Uncontrolled rectifiers connect a 3AC power network with a DC electric traction system with an unidirectional power flow using diode assemblies.

The coordination between the transformer and the rectifier diode assembly is included.

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.

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/TR 60146-1-2:2019, *Semiconductor converters - General requirements and line commutated converters - Part 1-2: Application guide*

IEC 62695:2014, *Railway applications - Fixed installations - Traction transformers*

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; Basic EMC Publication*

IEC 62590-1 as soon as published *Railway applications – Electronic Power Converters for fixed installations – Part 1: General*

IEC 60076-1:2011*, Power transformers - Part 1: General*

3 Terms, definitions, symbols and abbreviated terms

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

3.1 Terms and definitions

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

Note 1 to entry: The definition includes devices whose essential characteristics are only in part due to the flow of charge carriers in a semiconductor but that are considered as semiconductor devices for the purpose of specification.

[SOURCE: IEC 60050-521:2002, 521-04-01]

3.1.2
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]

3.1.3
rectifier
AC/DC converter for rectification

[SOURCE: IEC 60050-551:1998 551-12-07, modified – figure not used]

3.1.4
rectifier diode assembly
valve device assembly for rectification

Note 1 to entry: Often the term rectifier is used instead of rectifier diode assembly.

3.1.5
ideal no-load direct voltage
U_{di}

theoretical no-load direct voltage of an AC/DC converter assuming no reduction by phase control, no threshold voltages of electronic valve devices, and no voltage rise at small loads

[SOURCE: IEC 60050-551:1998, 551-17-15]

3.1.6
real no-load direct voltage
U_{d00}

actual mean direct voltage at zero direct current

[SOURCE: IEC 60050-551:1998, 551-17-29, modified - “the” removed]

3.1.7
ideal crest no-load voltage
U_{iM}

crest value of the voltage, appearing between the end terminals of an arm neglecting internal and external voltage surge and voltage drops in valves, at no load

3.1.8
transition current
mean direct current of a converter connection when the direct current(s) of the commutation group(s) become(s) intermittent when decreasing the current

[SOURCE: IEC 60050-551:1998, 551-17-20, modified - “the” removed]

3.1.9
leakage reactance of the primary winding <of a three-winding transformer>
X_p
difference between the mean of the short circuit reactance values measured between the primary winding and each secondary winding and one half of the short circuit reactance measured between the two secondary windings

3.1.10
leakage reactance of each of the secondary windings <of a three-winding transformer>
X_{S1}, X_{S2}
sum of the half difference of the short circuit reactance values measured between the primary winding and each secondary winding and one half of the short circuit reactance measured between the two secondary windings

3.1.11
reactance ratio <of a three-winding transformer>
coupling factor < of a three-winding transformer>
K
ratio between the leakage reactance of the primary winding and the sum of the leakage reactances of the primary and secondary winding

Note 1 to entry: In case of a traction transformer with two secondary windings, used for a twelve-pulse reaction converter, the reactance ratio is designed to have the same no-load secondary voltages and the same impedance between the primary and each secondary winding, in order to obtain an even sharing of the current on both bridges in case the DC outputs are paralleled. Then $X_{S1} = X_{S2} = X_S$ and

$$K = X_p / (X_S + X_p)$$

3.1.12
interphase transformer
electromagnetic device enabling the operation in parallel of two or more phase displaced commutating groups through inductive coupling between the windings placed on the same core

[SOURCE: IEC 60050-551:1998, 551-14-16, modified - “an” removed]

3.1.13
rated 3AC voltage
rated voltage of the rectifier on the 3AC power network side

3.1.14
rated 3AC voltage of a rectifier diode assembly
highest value of the transformer traction side no load voltage that a rectifier diode assembly is designed for

3.1.15
rated load <of a rectifier>
rated current <of a rectifier>

I_{Nd}

value of a DC current a rectifier is designed for.

Note 1 to entry: All rated values of the components are derived from this value

Note 2 to entry: A rectifier can have a rated continuous load and rated loads in conjunction with a duty class.

3.1.16
rated power <of a rectifier>
rated direct current multiplied with DC voltage at rated current

3.1.17
rated short circuit current <of a rectifier diode assembly>
short circuit withstand current of a rectifier diode assembly for every 3AC connection

Note 1 to entry: A 12-pulse parallel connection should have 2 times the rated short circuit current as a total short circuit current.

Note 2 to entry: It is an initial short circuit current according to IEC 60909.

3.2 Symbols

d_{rN} resistive direct voltage drop of the rectifier related to U_{di} at rated current

d_{xN} inductive direct voltage drop of the rectifier related to U_{di} at rated current

$I_{dlinmax}$ maximum current value of the range of linear voltage drop

I_{Nd} rated DC current on the traction side of the rectifier

I_V transformer phase current on the valve side

K coupling factor

U_{d00} real no-load direct voltage, theoretically resulting from peak value of a symmetrical sinusoidal 3AC voltage U_{v0}

U_{di} ideal no-load direct voltage

U_{iM} ideal crest no-load voltage

u_{kt} impedance voltage of the transformer

u_{kt1}, u_{kt2} impedance voltage of a three-winding transformer with one secondary winding shorted for winding 1 respective winding 2

U_{Nd} DC voltage at rated DC current in V

U_{v0} no-load phase to phase voltage of the transformer valve side

X_p leakage reactance of the primary winding (for three winding transformer)

X_S mean value of the leakage reactance of each of the secondary windings (for three winding transformer)

X_{S1} X_{S2} leakage reactance of each of the secondary windings (for transformer with two secondary windings)

$X_{scP/S1}$ short circuit reactance between the primary winding and secondary winding 1 (for transformer with two secondary windings)

$X_{scP/S2}$ short circuit reactance between the primary winding and secondary winding 2 (for transformer with two secondary windings)

$X_{scS1/S2}$ short circuit reactance between both secondary windings (for transformer with two secondary windings)

$X_{scP/S1S2}$ short circuit reactance between the primary winding and both secondary windings (for transformer with two secondary windings)