

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

01-oktober-2024

Železniške naprave - Elektronski elektroenergetski pretvornik za fiksne postroje - 2-2. del: Enosmerno napajanje - Krmiljeni konverter

Railway applications - Electronic power converters for fixed installations - Part 2-2: DC Applications - Controlled converters

## iTeh Standards

Applications ferroviaires - Convertisseurs électroniques de puissance pour installations fixes - Partie 2-2 : Applications de traction en courant continu - Convertisseurs commandés

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napajanje

45.040 Materiali in deli za železniško Materials and components

tehniko for railway engineering

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## 9/3105/CDV

### COMMITTEE DRAFT FOR VOTE (CDV)

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| IEC TC 9 : ELECTRICAL EQUIPMENT AND   | ) SYSTEMS FOR RAILW  | VAYS |                                     |  |  |  |
| SECRETARIAT:<br>France  | SECRETARY: Mr Denis MIGLIANICO   |      |                                     |  |  |  |
| OF INTEREST TO THE FOLLOWING COMMI  | 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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| 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.   |  |      |                                     |  |  |  |
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| T   |  |      |                                     |  |  |  |
| TITLE:  Railway applications - Electronic power converters for fixed installations - Part 2-2: DC  Applications - Controlled converters   |  |      |                                     |  |  |  |
| PROPOSED STABILITY DATE: 2027   |  |      |                                     |  |  |  |
| Note from TC/SC officers:   |  |      |                                     |  |  |  |

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RAILWAY APPLICATIONS -ELECTRONIC POWER CONVERTERS FOR

**FIXED INSTALLATIONS** 

Part 2-2: DC TRACTION APPLICATIONS – CONTROLLED CONVERTERS

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  - 133

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- replaced by a revised edition, or
- 140 amended.

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| 143                      | INTRODUCTION  |
|--------------------------|---|
| 144<br>145<br>146        | Semiconductor converters for traction power supply differ from other electronic power 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.   |
| 147<br>148<br>149<br>150 | Controlled rectifiers are supplying a DC traction network from a three-phase power network using controllable semiconductor valves. Inverters enable to recuperate power from a DC traction network into a three-phase power network. Reversible converters combine the functions of a rectifier and an inverter. |
| 151<br>152               | DC converters are self-commutated converters for connecting of the DC traction network with other DC networks or storage devices.   |
| 153                      | The series of IEC 62590 consists of the following parts:  |
| 154<br>155               | IEC 62590-1 Railway applications – Electronic power converters for fixed installations – Part 1: General requirements   |
| 156<br>157               | IEC 62590-2-1 Railway applications – Electronic power converters for fixed installations – Part 2-1: DC traction applications - Uncontrolled rectifiers   |
| 158<br>159               | IEC 62590-2-2 Railway applications – Electronic power converters for fixed installations – Part 2-2: DC traction applications – Controlled converters   |
| 160<br>161               | IEC 62590-3-1 Railway applications – Electronic power converters for fixed installations – Part 3-1: AC traction applications – Electronic power compensators   |
| 162<br>163               | IEC 62590-3-2 Railway applications – Electronic power converters for fixed installations – Part 3-2: AC traction applications – Static frequency converters   |
|                          |   |

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# RAILWAY APPLICATIONS – ELECTRONIC POWER CONVERTERS FOR FIXED INSTALLATIONS PART 2-2: DC TRACTION APPLICATIONS - CONTROLLED CONVERTERS

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### 1 Scope

- This document describes functions and working principles, specifies requirements, interfaces, and test methods for controlled converters for DC electric traction power supply systems:
- AC/DC converters
- 175 Rectifiers
- 176 Inverters
- 177 Combinations
- 178 DC converters
- Purpose of the converters can be a power connection to other power networks or energy storages.
- 181 Common characteristic of this equipment is the possibility to influence the power flow in the DC electric traction power supply system. The converters can be:
- Line commutated
- 184 Self-commutated

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- 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.

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#### 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.
- 194 For undated references, the latest edition of the referenced document (including any
- 195 amendments) applies.
- 196 IEC 60529, Degrees of protection provided by enclosures (IP code)
- 197 IEC 62590-1, Railway applications Fixed installations Electronic power converters Part 1:
- 198 General requirements
- 199 IEC 62695, Railway applications Fixed installations Traction transformers
- 200 IEC 60850, Railway applications Supply voltages of traction systems
- 201 IEC 62236-5, Railway applications Electromagnetic compatibility Part 5: Emission and
- 202 immunity of fixed power supply installations and apparatus / Applies in conjunction with IEC
- 203 62236-1 (2008-12)
- 204 IEC 60071-1, Insulation co-ordination Part 1: Definitions, principles and rules

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| 205 <b>3</b> | Terms | and | defin | itions |
|--------------|-------|-----|-------|--------|
|--------------|-------|-----|-------|--------|

- For the purposes of this document, the terms and definitions given in 62590-1 and the following
- 207 apply.
- 208 ISO and IEC maintain terminological databases for use in standardization at the following
- 209 addresses:
- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at https://www.electropedia.org
- 212 3.1 Semiconductor devices and combinations
- 213 **3.1.1**
- 214 rated current <of a controlled converter>
- 215 rated load <of a controlled converter>
- 216  $I_{Nc}$
- value of a DC current a controlled converter is designed for, referring to the DC electric traction
- 218 power supply system
- 219 Note 1 to entry: All rated values of the components are derived from this value
- 220 Note 2 to entry: A converter can have a rated continuous load and rated loads in conjunction with a duty classes.
- 221 **3.1.2**
- 222 rated DC power <of a controlled converter>
- 223 rated current multiplied with nominal DC voltage
- Note 1 to entry: This value refers to DC electric traction power supply system side.
- 225 3.1.3
- 226 and reversible converter and ards/sist/c50a8420-2311-4dc8-a496-81c0e3f7cecc/osist-pren-iec-62590-2-2-2024
- converter in which the direction of the power flow is reversible
- 228 [SOURCE IEC 60050-551:1998, 551-12-37]

230 3.2 Line commutated converters

231 **3.2.1** 

229

- 232 trigger delay angle
- time expressed in angular measure by which the trigger pulse is delayed with respect to the
- reference instant in the case of phase control
- 235 Note 1 to entry: With line, machine or load commutated converters the reference instant is the zero crossing instant
- 236 of the commutating voltage. With AC controllers it is the zero crossing instant of the supply voltage. For AC controllers
- 237 with inductive loads the trigger delay angle is the sum of the phase shift and the current delay angle.
- 238 [SOURCE: IEC 60050-551:1998, 551-16-33, modified "the" removed]
- 239 **3.2.2**
- 240 commutation failure
- failure to commutate the current from a conducting arm to the succeeding arm
- 242 [SOURCE: IEC 60050-551:1998, 551-16-59, modified "a" removed]

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#### 3.3 Self-commutated converters

3.3.1 245

switched valve device 246

- controllable valve device which can be turned on and off by a control signal 247
- [SOURCE: IEC 60050-551:1998 551-14-08, modified "a" removed, may replaced with can] 248
- 3.3.2 249
- free-wheeling diode 250
- diode parallel to a switched valve device in reverse direction fulfilling the purpose of a free-251
- wheeling arm 252
- 3.3.3 253
- 254 boost converter
- 255 direct DC converter providing an output voltage which is higher than the input voltage
- 256 [SOURCE: IEC 60050-551:1998, 551-12-32]
- 3.3.4 257
- buck converter 258
- 259 direct DC converter providing an output voltage which is lower than the input voltage
- [SOURCE: IEC 60050-551:1998, 551-12-33] 260

#### 3.4 Symbols 261

262 The following symbols are used in this document:



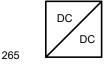




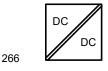
flow direction 264

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AC/DC converter with optional indication of power



DC converter



DC converter with isolation between 2 electrical circuits



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diode rectifier (valve)assembly



IGBT converter(valve device) assembly



269

thyristor converter (valve) assembly

NOTE: The symbols for the DC converters are taken from IEC 60617 while the other symbols are adapted to the need of this document.

#### 272 3.5 Principal letter symbols

- $U_a$  test voltage for power frequency withstand voltage test
- $U_{v0}$  no load transformer voltage, valve side
- $U_{\rm dN}$  nominal DC voltage

#### 276 3.6 Abbreviated Terms

- 277 ESS energy storage system, system that can take electrical energy from the DC
- 278 power supply network, store the energy, and supply the energy back to the DC electric power
- supply network when necessary
- 280 ESU energy storage unit, device to which electrical energy is charged and from which
- 281 electrical energy is discharged
- 282 ACTB apparatus to connect ESU to DC bus
- 283 IGBT insulated gate bipolar transistor
- 284 AC alternating current
- 285 3AC ... three phase AC SIST prEN IEC 62590-2-2:2024
- 286 DC direct current

#### 4 System Configurations

#### 288 **4.1 General**

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- 289 Main purpose of controlled electronic power converters for DC electric traction power supply
- 290 systems is to influence the power flow. The power can flow from a 3AC power network to the
- DC electric traction system or vice versa. This can also be a bidirectional power flow to energy
- storages or other equipment using regenerated power.
- This type of equipment has a control including processing of measured values.

#### 295 4.2 Purpose of converters

#### 296 4.2.1 AC/DC converters

#### 297 **4.2.1.1 General**

- The AC/DC converters connect a 3AC power network with a DC electric traction power supply
- 299 system as shown in Figure 1. Requirements from both networks shall be considered.