SLOVENSKI STANDARD
SIST-TS CLC/TS 50535:2011

01-junij-2011

Železniške naprave - Pomožni sistemi močnostnih pretvornikov na tirnih vozilih

Railway applications - Onboard auxiliary power converter systems

Bahnanwendungen - Hilfsbetriebeumrichtersystem für Schienenfahrzeuge

Applications ferroviaires - Convertisseur auxiliaire pour les véhicules ferroviaires

Ta slovenski standard je istoveten z: **CLC/TS 50535:2010**

ICS:

45.060.01	Železniška vozila na splošno	Railway rolling stock in general

SIST-TS CLC/TS 50535:2011 **en**

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CLC/TS 50535

April 2010

ICS 45.060.01

English version

Railway applications - Onboard auxiliary power converter systems

Applications ferroviaires - Convertisseur auxiliaire pour les véhicules ferroviaires

Bahnanwendungen - Hilfsbetriebeumrichtersystem für Schienenfahrzeuge

This Technical Specification was approved by CENELEC on 2010-03-26.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. CLC/TS 50535:2010 E

Foreword

This Technical Specification was prepared by SC 9XB, Electromechanical material on board rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

It was circulated for voting in accordance with the Internal Regulations, Part 2, Subclause 11.3.3.3 and was accepted as a CENELEC Technical Specification on 2010-03-26.

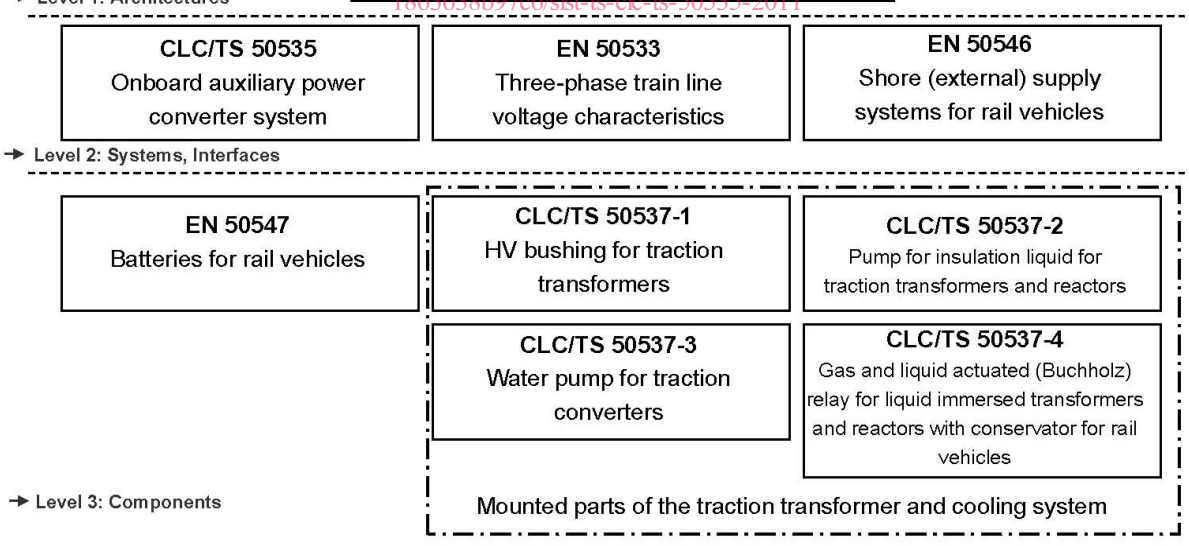
Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following date was fixed:

– latest date by which the existence of the CLC/TS has to be announced at national level (doa) 2010-06-26

This standardization project was derived from the EU-funded Research project MODTRAIN (MODPOWER). It is part of a series of standards, referring to each other. The hierarchy of the standards is intended to be as follows:

Overview on the technical framework
CLC/TS 50534 defines the basis for other depending standards



Annexes defined to be normative belong to the content of this Technical Specification; annexes defined as informative are used only for information.

Annex A is normative and Annexes B, C and D are informative.

Contents

Figures

Tables

Introduction

This Technical Specification defines characteristics and interfaces for electric onboard auxiliary power converter systems. This includes auxiliary power converters and battery chargers. The following European Standards and Technical Specifications refer to the defined target energy supply system in this present Technical Specification:

CLC/TS 50534	Railway applications – Generic system architectures for onboard electric auxiliary power systems *(Characteristics and interface of generic system architectures for onboard electric auxiliary power systems)*
EN 50533 [1)]	Railway applications – Three-phase train line voltage characteristics *(Characteristics of the voltage system used for auxiliary power supply)*
EN 50546 [2)]	Railway applications – Shore (external) supply system for rail vehicles *(Interface description of the shore supply including protection functions)*
EN 50547 [2)]	Railway applications – Batteries for rail vehicles *(Standardized batteries for rail vehicles and charging characteristics)*
CLC/TS 50537 (series)	Railway applications – Mounted parts of the traction transformer and cooling system *(Standardized products used in conjunction with traction transformers and traction cooling systems)*

CLC/TS 50535 has to be understood as a basic document of a set of hierarchically structured specifications as illustrated in the foreword. This set of European Standards and Technical Specifications defines a consistent technical framework beginning on an architectural level, followed by standards belonging to important system interfaces and concluding this hierarchy with Technical Specifications on component level. The diagram in the foreword points up these different system integration levels and shows the dependencies between the documents.

One main objective of this standardisation initiative is to simplify the cooperation between concerned railway stakeholders in charge of operating onboard auxiliary power systems, designing systems able to cope with the operational requirements and stakeholders manufacturing auxiliary power system components, which provide the requested services.

---

1) At draft stage.

2) Under development.

1 Scope

This Technical Specification defines the classification of the electric onboard auxiliary power converter system and defines its basic characteristics and interfaces. The onboard auxiliary power converter system consists of the auxiliary converter and the battery charger function.

This Technical Specification applies to locomotive hauled passenger trains and electric multiple units with distributed power as well as trains with concentrated power heads. Relevant train configuration and concerned energy supply subsystems are defined in CLC/TS 50534. This Technical Specification provides a technical base for implementation of onboard auxiliary power systems on different trains.

The objective of this specification is to define the required interfaces and characteristics of the onboard auxiliary power converter system in order to enable further standardisation:

- interface between onboard auxiliary power converter system and onboard traction power system;
- interface of the onboard auxiliary power supply system to the low voltage grid and to a shore supply (stationary workshop supply or external supply);
- interfaces of the auxiliary converter and the battery charger;
- characteristics of the onboard auxiliary power converter system.

The electrical operational behaviour is defined by requirements. Requirements for the type tests as well as the routine test are referred.

2 Normative references

The following referenced documents are indispensable for the application 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.

TS 45545 (series)	2009 [3]	*Railway applications – Fire protection on railway vehicles*
CLC/TS 50534		*Railway applications – Generic system architectures for onboard electric auxiliary power systems*
EN 12663	2000	*Railway applications – Structural requirements of railway vehicle bodies*
EN 50121-3-2	2000 [4]	*Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*
EN 50125-1	1999	*Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*
EN 50163 + A1	2004 2007	*Railway applications – Supply voltages of traction systems*
EN 50238		*Railway applications – Compatibility between rolling stock and train detection systems*

---

[3] Part 5 is of CENELEC origin – Other parts are from CEN.

[4] Superseded by EN 50121-3-2:2006, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*.

EN 50272-2	2001	*Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*
EN 50388		*Railway applications – Power supply and rolling stock – Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*
EN 50533	5)	*Railway applications – Three-phase train line voltage characteristics*
EN 50547	6)	*Railway applications – Batteries for rail vehicles*
EN 60077-1	2002	*Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules* (IEC 60077-1:1999, mod.)
EN 60529		*Degrees of protection provided by enclosures (IP Code)* (IEC 60529)
EN 60721-3-5		*Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations* (IEC 60721-3-5)
EN 61287-1	2006	*Railway applications – Power convertors installed on board rolling stock – Part 1: Characteristics and test methods* (IEC 61287-1:2005)
EN 61373	1999	*Railway applications – Rolling stock equipment – Shock and vibration tests* (IEC 61373)
IEC 60038	2002 7)	*IEC standard voltages*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
customer
buyer of the train, where the auxiliary power converter system is integrated

3.1.2
operator
responsible party for providing the transportation service

3.1.3
system integrator
responsible party for integrating the auxiliary power converter products or units into the overall system. This includes electrical and mechanical integration aspects

3.1.4
manufacturer
the manufacturer designs and manufactures the on-board auxiliary power converter products

---

5) At draft stage.

6) Under development.

7) IEC 60038:2002 (Ed. 6.2) combines IEC 60038:1983 (Ed. 6) + A1:1994 + A2:1997. It is superseded by IEC 60038:2009 (Ed. 7), *IEC standard voltages*.

3.1.5
system architectures
system architectures describe basic designs of systems consisting of several subsystems and functions. The description is precise in concern of essential interfaces and functions. The internal design of the subsystems itself is not part of the architecture description

3.1.6
Train Control and Monitoring System (TCMS)
overriding control and monitoring system on the train

3.1.7
active front-end converters
converters with turn-off semiconductor, which can actively control their current waveforms and their power factor

3.1.8
onboard Auxiliary Power Converter System (APCS)
onboard subsystem, which transforms converts electric energy for traction auxiliary loads and comfort loads

3.1.9
Auxiliary Converter Unit (ACU)
part of the onboard auxiliary power converter system and includes multiple power conversion functionality to supply the auxiliary converter intermediate circuit voltage (Aux DC-Link) and the 3 AC train lines

3.1.10
auxiliary converter intermediate circuit voltage
DC Link Auxiliary (DCLA)
intermediate circuit voltage in a voltage range of typically 600 V to 800 V used in auxiliary converters e.g. with 3 AC FF output

3.1.11
auxiliary power interface on coaches for international rulement
RIC interface
defines the input voltage for auxiliary converter on coaches for international rulement. The voltage and frequencies for RIC are defined in Annex B

3.1.12
auxiliary winding interface on main traction transformer (TRAF)
TRAF interface derived from the auxiliary winding on the main traction transformer

3.1.13
traction converter intermediate circuit voltage
DC Link Traction (DCLT)
intermediate circuit voltage of the traction converter

3.1.14
power train line
electric energy distribution facility (e.g. bus bars, cables) used for the distribution of auxiliary power in a train and coaches

3.1.15
3 AC FF train line voltage systems
voltage systems applied in conjunction with 3 AC power train lines using fixed frequency and consequently fixed voltage amplitude (3 AC 400 V 50 Hz or 3 AC 480 V 60 Hz in accordance with IEC 60038)

3.1.16
3 AC VF train line voltage systems
voltage systems applied in conjunction with 3 AC power train lines using variable frequency and consequently variable voltage amplitude. Variation of frequency and voltage is used e.g. for power control and noise reduction purposes

3.1.17
traction auxiliary loads
loads installed in subsystems, which are needed for the operation of the traction system and driving operation of the train or locomotive. Pumps and fans in cooling systems for traction components are representative examples of this load group. Compared to other auxiliary loads (comfort loads) a high availability is required

3.1.18
comfort loads
loads connected to the auxiliary power supply system, which are used for the provision of a comfortable environment and climate e.g. in the passenger coach interior, vestibule or other compartments for passengers and train crew. Compared to traction auxiliary loads the requested availability for comfort loads is lower and a reduced performance in degraded mode might be accepted

3.1.19
HVAC unit
facility installed in coaches or locomotives used for heating, ventilation and air-conditioning (HVAC)

3.1.20
linear load
loads with a linear dependency between supply voltage and current producing negligible harmonic content compared to rated values, e.g. heating resistors and induction motors are regarded as linear loads

3.1.21
non-linear load
in contrast to linear loads, non-linear loads generate significant harmonic current or voltage content. This kind of loads connected to a supply system with significant internal impedance will produce significant harmonic voltages, e.g. uncontrolled rectifiers and active front-end converters belong to this load group

3.1.22
unbalanced load
loads, which will cause unsymmetrical phase currents, i.e. currents that have different amplitudes and/or phase angles in the three phases of a 3 AC supply system. Single phase loads connected to a 3 AC system are a representative example of unbalanced loads

3.1.23
Power Factor (*PF*)
under periodic conditions, ratio of the absolute value of the active power P to the apparent power S

$$\lambda = \frac{|P|}{S}$$

3.1.24
Displacement Power Factor (*DPF*)
under periodic conditions, ratio of the absolute value of the active power of the P to the apparent power S, but only calculated for the fundamental values

$$DPF = \cos(\varphi_1) = \frac{|P_1|}{S_1}$$

3.1.25
Total Harmonic Distortion (*THD*)
ratio of the r.m.s. value of the harmonic content of an alternating quantity to the r.m.s. value of the fundamental component of the quantity

$$THD = \sqrt{\frac{\sum_{h=2}^{h=40} U_h^2}{U_1^2}}$$

where

U represents a voltage;

U_1 is the r.m.s. value of the fundamental voltage component;

h is the harmonic order;

U_h is the r.m.s. value of the harmonic voltage component of order h

NOTE The total harmonic ratio may be restricted to a certain harmonic order. This is to be stated.

3.1.26
Total Distortion Content (*TDC*)
quantity remaining when the fundamental component is subtracted from an alternating quantity, all being treated as functions of time

$$TDC = \sqrt{Q^2 - Q_1^2}$$

where

Q_1 is the r.m.s. value of the fundamental component;

Q is the total r.m.s. value;

Q can represent either current or voltage. It includes both harmonic and interharmonic components

3.1.27
Total Distortion Ratio (*TDR*)
ratio of the r.m.s. value of the total distortion content of an alternating quantity to the r.m.s. value of the fundamental component of the quantity

$$TDR = \frac{TDC}{Q_1} = \frac{\sqrt{Q^2 - Q_1^2}}{Q_1}$$

3.1.28
Battery Charger (BC)
power electronic converter (AC-DC or DC-DC) used to supply low voltage loads and to charge rechargeable batteries in the low voltage grid

3.1.29
low voltage supply systems
LV-DC system
low voltage supply system encompasses DC voltage supplies for control units, lighting and other loads, which need an uninterruptible, and highly available electric energy supply. In most applications, the low voltage supply system is fed by the auxiliary power supply system and supported e.g. by a rechargeable battery

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

3 AC	Three-phase Alternative Current or voltage
ACU	Auxiliary Converter Unit
APCS	onboard Auxiliary Power Converter System
BC	Battery Charger
DC	Direct Current
DCCA	DC CAtenary
DCLA	DC Link Auxiliary
DCLT	DC Link Traction
DPF	displacement power factor
EMC	Electro-Magnetic Compatibility
IC	Common Isolation
IS	Separate Isolation
FF	Fixed Frequency
HVAC	Heating, Ventilation and Air Conditioning
LV-DC	Low voltage supply system
N	Neutral
NO	No galvanic isolation
PF	Power Factor
PWM	Pulse Width Modulated
r.m.s.	Root Mean Square
RIC	Regolamento Internazionale delle Carrozze
SIN	Sinusoidal waveform
TCMS	Train Control and Monitoring System
TDC	Total Distortion Content
TDR	Total Distortion Ratio
THD	Total Harmonic Distortion
TLI	Train Line Interconnection
TRAF	Auxiliary winding of the main transformer
U_{CM}	Common mode voltage at star point
VF	Variable Frequency

4 Onboard auxiliary power converter systems

4.1 Definitions for onboard auxiliary power converter systems

General requirements of the electronics systems installed in the rail vehicles are defined in EN 61287-1. Onboard auxiliary power converter systems are an integral part of the electrical system in trains. They are a collection of power components that convert, manage and distribute electrical power from the input source(s) to the auxiliary loads.