SLOVENSKI STANDARD
SIST EN 50155:2007

01-oktober-2007

Nadomeġļa:
SIST EN 50155:2002
SIST EN 50155:2002/A1:2003

Železniške naprave – Elektronska oprema na voznih sredstvih

Railway applications - Electronic equipment used on rolling stock

Bahnanwendungen - Elektronische Einrichtungen auf Schienenfahrzeugen

Applications ferroviaires - Equipements électroniques utilisés sur le matériel roulant

Ta slovenski standard je istoveten z: EN 50155:2007

ICS:

29.280	Elektriļ na vleļ na oprema	Electric traction equipment
45.060.10	Vleļ na vozila	Tractive stock

SIST EN 50155:2007 **en,fr,de**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 50155

July 2007

ICS 45.060.10

Supersedes EN 50155:2001 + A1:2002

English version

Railway applications - Electronic equipment used on rolling stock

Applications ferroviaires - Equipements électroniques utilisés sur le matériel roulant

Bahnanwendungen - Elektronische Einrichtungen auf Schienenfahrzeugen

This European Standard was approved by CENELEC on 2007-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, 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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50155:2007 E

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50155 on 2007-03-01.

This European Standard supersedes EN 50155:2001 + A1:2002.

This EN 50155:2007 has been aligned with the new EN 50121 series and addresses some Portuguese comments.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2008-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2010-03-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives 96/48/EC and 2001/16/EC. See Annex ZZ.

Contents

1 Scope

This standard applies to all electronic equipment for control, regulation, protection, supply, etc., installed on rail vehicles and associated with:

- either the accumulator battery of the vehicle;
- or a low voltage power supply source with or without a direct connection to the contact system (transformer, potentiometer device, auxiliary supply);

with the exception of electronic power circuits, which conform to EN 50207.

This standard covers the conditions of operation, design, construction, and testing of electronic equipment, as well as basic hardware and software requirements considered necessary for competent, reliable equipment.

Additional requirements in other standards or individual specifications may complement this standard, if they are justified.

Specific requirements related to practices necessary to assure defined levels of functional safety are to be determined in accordance with 4.6.3.1 and 4.6.3.2 of EN 50126 and its informative Annex A.
Software safety integrity level of 1 or higher shall only be considered when it is shown that a residual safety risk remains and that it has to be carried by the software driven programmable electronic system. In such a case (i.e. software safety integrity level 1 or higher), EN 50128 is applicable.

For the purpose of this standard, electronic equipment is defined as equipment mainly composed of semiconductor devices and recognized associated components. These components will mainly be mounted on printed boards.

NOTE Sensors (current, voltage, speed, etc.) and firing unit printed board assemblies for power electronic devices are covered by this standard. Complete firing units are covered by EN 50207.

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.

EN 50121-3-2	2000	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 50126	Series	Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
EN 50128	2001	Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems
EN 50163	1995	Railway Applications - Supply voltages of traction systems
EN 50207	2000	Railway applications - Electronic power converters for rolling stock (IEC 61287-1:1995, related)
EN 60068	Series	Environmental testing (IEC 60068 series)
EN 60068-2-1	1993	Environmental testing – Part 2: Tests – Test A: Cold (IEC 60068-2-1:1990)
EN 60068-2-2	1993	Environmental testing – Part 2: Tests – Test B: Dry heat (IEC 60068-2-2:1974 + IEC 60068-2-2A:1976)
EN 60068-2-30	2005	Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle) (IEC 60068-2-30:2005)

EN 60077	Series	Railway applications – Electrotechnical equipment for rolling stock (IEC 60077 series, modified)
EN 60249-2-15	1994	Base materials for printed circuits – Part 2: Specifications -- Specification No. 15: Flexible copper-clad polyimid film, of defined flammability (publication withdrawn)
EN 60297	Series	Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series (IEC 60297 series)
EN 60352	Series	Solderless connections (IEC 60352 series)
EN 60352-1	1997	Solderless connections – Part 1: Wrapped connections - General requirements, test methods and practical guidance (IEC 60352-1:1997)
EN 60352-2	2006	Solderless connections – Part 2: Crimped connections - General requirements, test methods and practical guidance (IEC 60352-2:2006)
EN 60529	1991	Degrees of protection provided by enclosures (IP Codes) (IEC 60529:1989)
EN 61000-4-4	2004	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4:2004)
EN 61082	Series	Preparation of documents used in electrotechnology (IEC 61082 series)
EN 61249	Series	Materials for printed boards and other interconnecting structures (IEC 61249 series)
EN 61249-2-7	2002	Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials, clad and unclad - Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad (IEC 61249-2-7:2002)
EN 61249-2-10	2003	Materials for printed boards and other interconnecting structures – Part 2-10: Reinforced base materials, clad and unclad - Cyanate ester, brominated epoxide, modified or unmodified, woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad (IEC 61249-2-10:2003)
EN 61373	1999	Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373:1999)
EN 62326	Series	Printed boards
EN 123000	1991	Generic specification - Printed boards
EN 123200	1992	Sectional specification - Single and double sided printed boards with plated-through holes
EN 123300	1992	Sectional specification - Multi-layer printed boards
EN 123400	1992	Sectional specification - Flexible printed boards without through connections
EN 123500	1992	Sectional specification - Flexible printed boards with through connections
EN ISO 9000-3	1997	Quality management and quality assurance standards Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software (ISO 9000-3:1991)
EN ISO 9001		Quality management systems - Requirements (ISO 9001)
EN ISO 9002		Quality systems - Model for quality assurance in production, installation and servicing (ISO 9002)
IEC 60605	Series	Equipment reliability testing
IEC 60617	Database	Graphical symbols for diagrams

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1
printed board
base material cut to size containing all holes and bearing at least one conductive pattern. Printed boards are typically subdivided according to:
- their structure (e.g. single and double-sided, multilayers)
- the nature of the base material (e.g. rigid, flexible)

3.2
printed board assembly
printed board with electrical and mechanical components and/or other printed boards attached to it with all manufacturing processes, soldering, coating, etc., completed

3.3
plug-in unit
unit which plugs into a subrack and is supported by guides. These units can be of various types, ranging from a printed board with components mounted in a frame or box type unit, designed with a plug-in connection

3.4
subrack
structural unit for housing printed board assemblies and/or plug-in units

3.5
rack
free-standing or fixed structure for supporting electrical or electronic equipment (e.g. subracks)

3.6
cubicle
any enclosure for housing electrical and/or electronic equipment

3.7
line replaceable unit
unit designed to be exchanged as a result of on-vehicle fault diagnosis, e.g. a subrack, or plug-in unit

3.8
performance check
short form performance test which is carried out during and after environmental tests, sufficient to prove that the equipment is within its operational limits, and that it has survived an environmental test

3.9
control system voltage supply
voltage supply used to power the vehicle control equipment

The supply may be derived from a vehicle battery. The battery may be charged from battery chargers, auxiliary inverters and motor-alternator or motor-generator sets with associated electronic regulations

Where the control system voltage supply is derived from a battery, the nominal and rated control system voltages are defined in 5.1. Where no battery is fitted, the nominal control system voltage is the normal controlled level of that voltage

3.10
vehicle wiring
all wiring which can be connected to the control system voltage supply, wherever located, and all other wiring external to the electronic equipment under consideration

3.11
supply overvoltage
electrical disturbance to the control system voltage supply caused by equipment controlling that supply. A supply overvoltage will occur as an increase in the level of the control system voltage supply

3.12
surge
non-periodic and relatively short positive or negative (or both) variable (voltage or current) between two steady states

It may be produced by the normal operation of equipment within the vehicle, caused generally by the discharge of energy when inductive circuits are switched

It may be present either on the control system voltage supply, or on wiring connected directly to switched inductive circuits, or coupled electrostatically or electromagnetically from such wiring into other wiring

The effective value of the source impedance of a transient will depend upon the manner of its generation and coupling

3.13
burst
repetitive pulses occurring during a fixed time interval

They may occur during normal operation of the vehicle, typically resulting from unstable arc conditions

3.14
failure
termination of the ability of an item to perform a required function

A temporary malfunction will not be considered a failure provided that:

a) The equipment recovers normal operation automatically following malfunction
b) The malfunction is not apparent to the vehicle operating staff; for example, fault indicators do not light up.

NOTE Attention is drawn to the possibility of a consequential failure of a second item of equipment resulting from a temporary malfunction of another item of equipment connected to it.

3.15
damage
any change in visual appearance or alteration of mechanical integrity

3.16
useful life
under given conditions, the time interval beginning at a given instant of time and ending when the failure rate becomes unacceptable, or when the item is considered not repairable as a result of a fault or for other relevant factors

NOTE For a repairable item the individual useful life may be ended by a failure which is not considered as repairable for any reason.

4 Environmental service conditions of operation

4.1 Normal service conditions

4.1.1 Altitude

The altitude at which the equipment is normally to function does not exceed the values called for in EN 50125-1, Subclause 4.2. When it exceeds this figure, compliance with the requirements shall be defined by agreement between manufacturer and user.

4.1.2 Ambient temperature

Electronic equipment shall be designed and manufactured to meet the full performance specification requirement for the selected temperature categories as stated in Table 1.

The design shall take into account temperature rises within cubicles to ensure that the components do not exceed their specified temperature ratings.

In addition, the equipment shall meet the special short-term start up thermal conditions as stated in column 3. In this interval the full performance ratings may be relaxed, but the maximum air temperature surrounding the printed board assembly according to column 4 shall not be exceeded.

Table 1 - Ambient temperature

Class	Column 1	Column 2	Column 3	Column 4
	Ambient temperature outside vehicle (EN 50125-1, Table 2, Column 1) °C	Internal cubicle temperature °C	Internal cubicle overtemperature during 10 min °C	Air temperature surrounding the printed board assembly °C
T1	-25 +40	-25 +55	+15	-25 +70
T2	-40 +35	-40 +55	+15	-40 +70
T3	-25 +45	-25 +70	+15	-25 +85
TX	-40 +50	-40 +70	+15	-40 +85

NOTE The differences between EN 50155 Table 1 (column 2) and EN 50125-1 Table 2 (column 3) are mainly due to the following reasons:

EN 50125-1 refers to a general application, where cubicles are provided without any particular thermal design.

In electronic equipment, a thermal design is usually needed, to guarantee a convenient minimum and maximum ambient temperature for the electronic components. The components reliability is very sensitive to the ambient temperature. The values given for the maximum temperatures inside the cubicle has been restricted to a choice of two to allow manufacturers to have only two classes of cards.

For peripheral units (measuring transducers, etc.), or if the equipment is in a decentralized configuration, then if the above ambient temperature ranges are exceeded, the actual temperatures occurring at the location of the equipment concerned shall be used in the design.

Rapid external ambient temperature variations resulting from running through tunnels shall be taken into account. For this purpose the rate of change of external temperature shall be assumed to be 3 °C/sec, with a maximum variation of 40 °C .

4.1.3 Shock and vibration

The equipment shall be able to withstand, without deterioration or malfunction, vibrations and shocks that occur in service.

In order to provide some reasonable degree of confidence that it will survive the specified useful life under service conditions, it shall be capable of meeting the vibration, shock and bump test as described in 12.2.11.

For these purposes the equipment is specified as having the electronic units installed complete, and supported in their designed fixings, with anti-vibration mounts where fitted.

For the typical values of shocks and vibrations in real service, reference is made to EN 61373.

4.1.4 Relative humidity

The equipment shall be designed for the following humidity stresses (limit values) over the relevant range of the external ambient temperature as defined in 4.1.2:

- yearly average ≤ 75 % relative humidity,
- 30 consecutive days in the year: 95 % relative humidity.

In addition, any moisture condensation shall not lead to any malfunction or failure.

For peripheral units (measuring transducers etc.), or if the equipment is in a decentralized configuration, then if the above humidity stresses are exceeded, the actual humidity occurring at the location of the equipment concerned shall be used in the design.

4.2 Special service conditions

Special arrangements shall be agreed between the appropriate parties involved when service conditions can be proved to be different from those mentioned in 2.1 (e.g. electronic equipment mounted on the bogie or integrated within a power converter etc.). Checks for the effectiveness of such arrangements can, if required, form the subject of optional type tests which can be carried out on the vehicle itself in accordance with methods to be agreed between the user and the manufacturer.

4.2.1 Atmospheric pollutants

The equipment may be expected to be exposed throughout its life to various pollutants (e.g. oil mist, salt spray, conductive dust, sulphur dioxide.). The types of pollutants and their concentration should be defined in the tender documents.

5 Electrical service conditions

5.1 Power supply

5.1.1 Supply from accumulator battery

The nominal voltage of equipment (U_n) so supplied shall be selected from amongst the following values:

24 V, 48 V, 72 V, 96 V, 110 V

NOTE 1 These nominal voltage values are given only as standardising values for the design of equipment. They should not be considered as the off load battery voltages since these are determined by the types of battery, the number of cells and the operating conditions.

NOTE 2 Different voltage variations may be used, following EN 60077. In this case compliance with the requirements should be defined by agreement between manufacturer and user.

5.1.1.1 Variations of voltage supply

Electronic equipment supplied by accumulator batteries without a voltage stabilizing device shall operate satisfactorily for all the values of the supply voltage within the range defined below (measured at the input terminals of the equipment).

The supplier of the electronic equipment shall specify its power consumption in order to enable calculations for the battery cabling.

Minimum voltage:	0,7 U_n
Nominal voltage:	U_n
Rated voltage:	1,15 U_n
Maximum voltage:	1,25 U_n

Voltage fluctuations (e.g. during start-up of auxiliary equipment or voltage oscillations of battery chargers) lying between 0,6 U_n and 1,4 U_n and not exceeding 0,1 s shall not cause deviation of function.

Voltage fluctuations lying between 1,25 U_n and 1,4 U_n and not exceeding 1 s shall not cause damage: equipment may not be fully functioning during these fluctuations.

In the case of thermal engines, see also 5.1.1.3.

5.1.1.2 Interruptions of voltage supply

Interruptions of up to 10 ms may occur on input voltage as defined below:

- Class S1: no interruptions
- Class S2: 10 ms interruptions

This shall not cause any equipment failure.

The time values specified are for nominal voltage and the choice of classes shall be defined by the system designer.

5.1.1.3 Variations of voltage supplies for rolling stock powered by thermal engines

At start-up of thermal engines the voltage supply system shall be designed to guarantee the supply to the essential electronic equipment during the whole starting sequence.

5.1.1.4 D.C. ripple factor

All batteries on charge have a pulsating voltage, the d.c. ripple factor of which, unless otherwise stated, shall not be greater than 15 % calculated from the equation:

$$\text{d.c. ripple factor} = \frac{U_{max} - U_{min}}{U_{max} + U_{min}} \times 100$$

where U_{max} and U_{min} are the maximum and minimum values, respectively, of the pulsating voltage.

The minimum and maximum voltages as defined in 5.1.1.1 however shall not be exceeded.

5.1.2 Supply by a static converter or a rotating set

In the case of equipment supplied with power from a stabilized source, (e.g. a static converter or a rotating motor-generator set provided with a regulator), electronic equipment shall operate satisfactorily for values of the supply voltage lying between 0,9 and 1,1 U_n, where U_n is the nominal voltage and can be either d.c. or a.c.

In addition, for operating equipment, voltage fluctuations lying between 0,7 U_n and 1,25 U_n not exceeding 1 s and also between 0,6 U_n and 1,4 U_n not exceeding 0,1 s are allowed.

5.1.3 Supply change over

In the case of equipment supplied with power alternatively from an accumulator battery and a stabilized source (d.c.), the equipment shall operate satisfactorily under the conditions stated in 5.1.1, 5.1.1.1, 5.1.1.4 and 5.1.2.

- Class C1: at 0,6 U_n during 100 ms (without interruptions).
- Class C2 during a supply break of 30 ms.