IEC 60571

Edition 3.0 2012-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Electronic equipment used on rolling stock

Applications ferroviaires – Équipements électroniques utilisés sur le matériel roulant

IEC 60571:2012

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,…).
It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,…).
Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 60571

Edition 3.0 2012-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Electronic equipment used on rolling stock

Applications ferroviaires – Équipements électroniques utilisés sur le matériel roulant

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX X

ICS 45.060

ISBN 978-2-83220-411-5

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

RAILWAY APPLICATIONS –
ELECTRONIC EQUIPMENT USED ON ROLLING STOCK

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60571 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This third edition cancels and replaces the second edition issued in 1998 and its amendment 1 (2006). It constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

a) In 4.1.2, Table 1 has been modified according to IEC 62498-1. Additional explanation about the aim of this table is mentioned as notes.
b) In 5.1.1.1, "32 V", "36 V", "64 V" and "87 V" have been added as the nominal voltage of equipment according to IEC 60077-1.
c) In 5.3 and 5.5.7.2.1 (Figure 1), the word "interference" has been replaced by "disturbance" that is more appropriate because "disturbance" is the cause of "interference".
d) In 12.2.7, "max" of the test waveform duration D has been replaced by "min" in the table in Figure 2. Specifying "min" can be expected to derive the duration time D longer than 1 s but quite near 1,0 s in almost all actual business case. On the other hand, specifying "max" may cause unnecessarily shorter D than 1,0 s.

e) In 5.1.1.2, “0,7 U_n” has been changed to “k U_n” and some examples for Nickel-cadmium battery and Lead-acid battery are given as NOTE.

f) Subclause 12.2.9, Radio frequency test, has been divided into 12.2.9.1, Radio frequency immunity test, and 12.2.9.2, Radio frequency-emission test.

The text of this standard is originally based on EN 50155. It was submitted to the National Committees for voting under the Fast Track Procedure.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/1711/FDIS	9/1735/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.

RAILWAY APPLICATIONS – ELECTRONIC EQUIPMENT USED ON ROLLING STOCK

1 Scope

This International 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 IEC 61287-1.

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 ensure defined levels of functional safety are determined in accordance with 4.6.3.1 and 4.6.3.2 of IEC 62278 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), IEC 62279 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 IEC 61287-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 hour cycle)*

IEC 60297 (all parts), *Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482,6 mm (19 in) series*

IEC 60300-3-5, *Dependability management – Part 3-5: Application guide – Reliability test conditions and statistical test principles*

IEC 60352-1, *Solderless connections – Part 1: Wrapped connections – General requirements, test methods and practical guidance*

IEC 60352-2, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*

IEC 60529, *Degrees of protection provided by enclosures (IP Codes)*

IEC 60605 (all parts), *Equipment reliability testing*

IEC 60617, *Graphical symbols for diagrams*

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

IEC 61082 (all parts), *Preparation of documents used in electrotechnology*

IEC 61124, *Reliability testing – Compliance tests for constant failure rate and constant failure intensity*

IEC 61188 (all parts), *Printed boards and printed board assemblies – Design and use*

IEC 61188-5, *Printed boards and printed board assemblies – Design and use – Part 5: Attachment (land/joint) considerations*

IEC 61249-2-7, *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 61249-2-22, *Materials for printed boards and other interconnecting structures – Part 2-22: Reinforced base materials clad and unclad – Modified non-halogenated epoxide woven E-glass laminated sheets of defined flammability (vertical burning test), copper-clad*

IEC 61373, *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 62236-3-2:2008, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62278:2002, *Railway applications – Specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)*

IEC 62326 (all parts), *Printed boards*

IEC 62498-1:2010, *Railway Applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

ISO 9001, *Quality management systems – Requirements*

ISO 90003, *Software engineering – Guidelines for the application of ISO 9001:2000 to computer software*

3 Terms and definitions

For the purposes of this document, the following terms and 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

Note 1 to entry: 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

Note 1 to entry: 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

Note 1 to entry: 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 2 to entry: 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 1 to entry: 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 IEC 62498-1:2010, 4.2. When it exceeds this figure, compliance with the requirements shall be defined by agreement between user and manufacturer.

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.

Table 1 – Ambient temperature

Class	Column 1	Column 2	Column 3	Column 4
	Ambient temperature outside vehicle °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
T4	–10 +40	–10 +70	+15	–10 +85
T5	+5 +45	+5 +70	+15	+5 +85
T6	–20 +45	–20 +75	(NOTE 2)	–20 +(NOTE 2)
TX	–40 +50	–40 +70	+15	–40 +85

NOTE 1 The differences between this Table 1 (column 2) and IEC 62498-1:2010 Table 2 (column 3) are mainly due to the following reasons:

IEC 62498-1 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 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.

NOTE 2 This value may become as high as a level that some agreement between user and manufacturer may be necessary considering the effect of high temperature to the life and reliability of parts and to the cost of the thermal design.

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/s, 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 12.2.12.

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 IEC 61373.

4.1.4 Relative humidity

Refer to Table 2 of IEC 62498-1:2010 with regarding the relative humidity ranges for the temperature classes T1 to TX as basis of design of the equipment.

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

4.2.1 General

Special arrangements shall be agreed between the appropriate parties involved when service conditions can be proved to be different from those mentioned in 4.1 (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 user and manufacturer.

4.2.2 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

5.1.1.1 General

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