BS EN 50463-1:2012

BSI Standards Publication

Railway applications — Energy measurement on board trains -

Part 1: General

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National foreword

This British Standard is the UK implementation of EN 50463-1:2012. Together with BS EN 50463-2:2012, BS EN 50463-3:2012, BS EN 50463-4:2012 and BS EN 50463-5:2012 it supersedes BS EN 50463:2007, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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CENELEC

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Contents

Foreword

This document (EN 50463-1:2012) has been prepared by CLC/TC9X "Electrical and electronic applications for railways".

The following dates are proposed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-10-15
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2015-10-15

This document (EN 50463-1:2012), together with parts 2, 3, 4 and 5, supersedes EN 50463:2007.

This series of European Standards includes the following significant technical changes with respect to EN 50463:2007:

— the series is based on and supersedes EN 50463:2007;

— the scope is extended, new requirements are introduced and conformity assessment arrangements are added.

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

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive 2008/57/EC amended by Commission Directive 2011/18/EU, see informative Annex ZZ, which is an integral part of this document.

This document is Part 1 of the EN 50463 series which consists of the following parts, under the common title *Railway applications — Energy measurement on board trains*:

Part 1, General;

Part 2, Energy measuring;

Part 3, Data handling;

Part 4, Communication;

Part 5, Conformity assessment.

This series of European Standards follows the functional guidelines description in Annex A, “Principles of conformity assessment”, of EN ISO/IEC 17000 tailored to the Energy Measurement System (EMS).

The requirements for Energy Measurement Systems in the relevant Technical Specifications for Interoperability are supported by this series of European Standards.

Introduction

The Energy Measurement System provides measurement and data suitable for billing and may also be used for energy management, e.g. energy saving.

This series of European Standards uses the functional approach to describe the Energy Measurement System. These functions are implemented in one or more physical devices. The user of this Series of standards is free to choose the physical implementation arrangements.

Structure and main contents of the EN 50463 series

This series of European Standards is divided into five parts. The titles and brief descriptions of each part are given below:

EN 50463-1 – General

The scope of EN 50463-1 is the Energy Measurement System (EMS).

EN 50463-1 provides system level requirements for the complete EMS and common requirements for all devices implementing one or more functions of the EMS.

EN 50463-2 – Energy measuring

The scope of EN 50463-2 is the Energy Measurement Function (EMF).

The EMF provides measurement of the consumed and regenerated active energy of a traction unit. If the traction unit is designed for use on a.c. traction supply systems, the EMF also provides measurement of reactive energy. The EMF provides the measured quantities via an interface to the Data Handling System.

The EMF consists of the three functions: Voltage Measurement Function, Current Measurement Function and Energy Calculation Function. For each of these functions, accuracy classes are specified and associated reference conditions are defined. This part also defines all specific requirements for all functions of the EMF.

The Voltage Measurement Function measures the voltage of the CL system and the Current Measurement Function measures the current taken from and returned to the CL system. These functions provide signal inputs to the Energy Calculation Function.

The Energy Calculation Function inputs the signals from the Current and Voltage Measurement Functions and calculates a set of values representing the consumed and regenerated energies. These values are transferred to the Data Handling System and are used in the creation of Compiled Energy Billing Data.

The standard has been developed taking into account that in some applications, the EMF may be subjected to legal metrological control. All relevant metrological aspects are covered in this part of EN 50463.

EN 50463-2 also defines the conformity assessment of the EMF.

EN 50463-3 – Data handling

The scope of EN 50463-3 is the Data Handling System (DHS).

The on board DHS receives, produces and stores data, ready for transmission to any authorised receiver of data on board or on ground. The main goal of the DHS is to produce Compiled Energy Billing Data and transfer it to an on-ground Data Collection Service (DCS). The DHS can support other functionality on board or on-ground with data, as long as this does not conflict with the main goal.

EN 50463-3 also defines the conformity assessment of the DHS.

EN 50463-4 – Communication

The scope of EN 50463-4 is the communication services.

This part of EN 50463 gives requirements and guidance regarding the data communication between the functions implemented within EMS as well as between such functions and other on board units where data are exchanged using a communications protocol stack over a dedicated physical interface or a shared network.

It includes the on board to ground communication service and covers the requirements necessary to support data transfer between DHS and DCS.

EN 50463-4 also defines the conformity assessment of the communications services.

EN 50463-5 – Conformity assessment

The scope of EN 50463-5 is the conformity assessment procedures for the EMS.

EN 50463-5 also covers re-verification procedures and conformity assessment in the event of the replacement of a device of the EMS.

EMS functional structure and dataflow

Figure 1 illustrates the functional structure of the EMS, the main sub-functions and the structure of the dataflow and is informative only. Only the main interfaces required by this standard are displayed by arrows.

Since the communication function is distributed throughout the EMS, it has been omitted for clarity. Not all interfaces are shown.

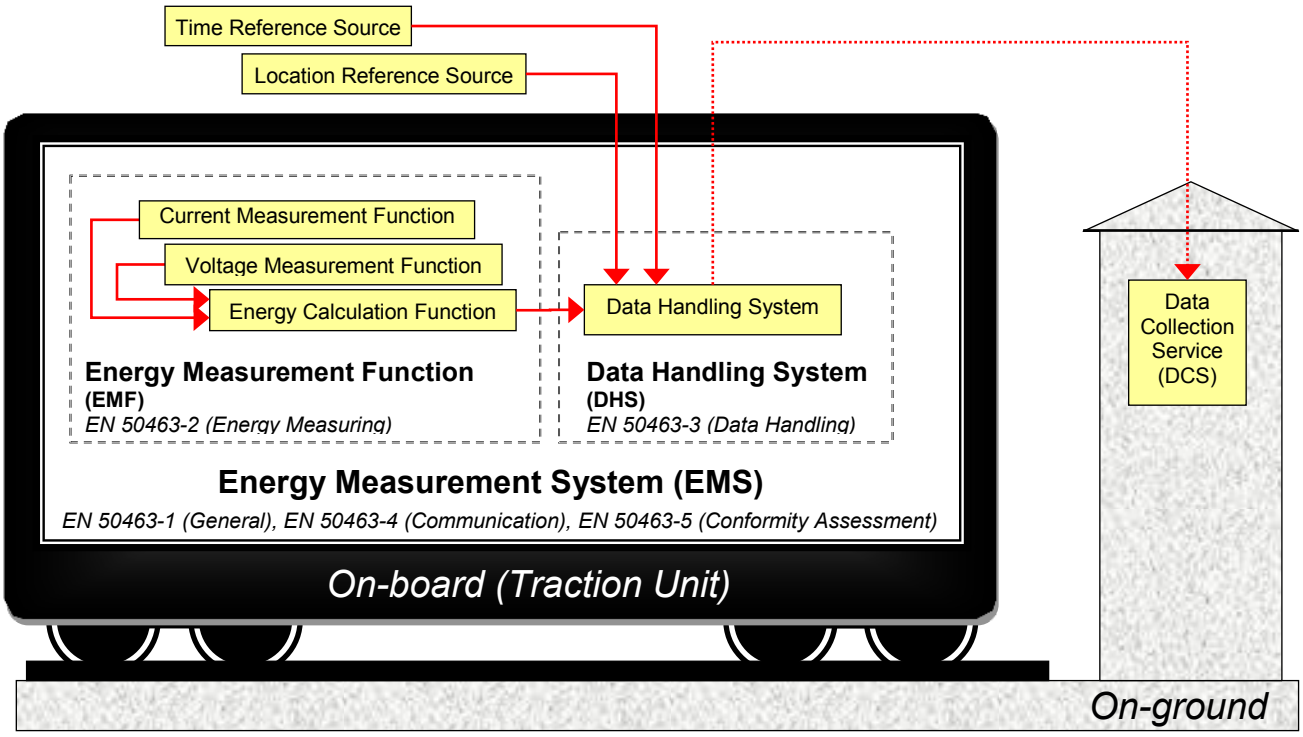

Figure 1 — EMS functional structure and dataflow diagram

1 Scope

This European Standard describes the primary purpose of the EMS, which is to meter energy consumption for billing. The EMS may also be used for other functions such as energy management.

This part of EN 50463:

- gives requirements for the complete Energy Measurement System and also requirements for all devices implementing one or more functions of the Energy Measurement System;
- applies to newly manufactured Energy Measurement Systems for use on board railway traction units, powered by a.c. and/or d.c. supply voltages as listed in the EN 50163;
- does not apply to portable Energy Measurement Systems.

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.

EN 50124-1:2001+A2:2005, *Railway applications — Insulation coordination — Part 1: Basic requirements — Clearances and creepage distances for all electrical and electronic equipment*

EN 50125-1:1999, *Railway applications — Environmental conditions for equipment — Part 1: Equipment on board rolling stock*

EN 50153, *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 50155:2007, *Railway applications — Electronic equipment used on rolling stock*

EN 50463-2 , *Railway applications — Energy measurement on board trains — Part 2: Energy measuring*

EN 50463-3 , *Railway applications — Energy measurement on board trains — Part 3: Data handling*

EN 50463-4 , *Railway applications — Energy measurement on board trains — Part 4: Communication*

EN 50463-5 , *Railway applications — Energy measurement on board trains — Part 5: Conformity assessment*

EN 60085, *Electrical insulation — Thermal evaluation and designation (IEC 60085)*

EN 60529:1991+A1:2000, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989+A1:1999)*

EN 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements* (IEC 61010-1)

EN ISO 13732-1, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (*ISO 13732-1*)*

CEN/TS 45545-2, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behaviour of materials and components*

CLC/TS 45545-5*, Railway applications — Fire protection on railway vehicles — Part 5: Fire safety requirements for electrical equipment including that of trolley buses, track guided buses and magnetic levitation vehicles*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

NOTE When possible, the following definitions have been taken from the relevant chapters of the International Electrotechnical Vocabulary (IEV), IEC 60050. In such cases, the appropriate IEV reference is given. Certain new definitions or modifications of IEV definitions have been added in this standard in order to facilitate understanding. Expression of the performance of electrical and electronic measuring equipment has been taken from EN 60359.

3.1.1
authenticity
security measures ensuring that the interface only transfers data or signals when the source and destination are correctly matched

3.1.2
CEBD-related data
all data produced by any function of the EMS required for the production of CEBD

Note 1 to entry: This includes voltage data, current data, energy data, time data and location data.

3.1.3
Compiled Energy Billing Data
CEBD
dataset compiled by the DHS suitable for energy billing

3.1.4
Consumption Point ID
CPID
13 digit number (numeric value without dividers or decimals) based on a European Vehicle Number from the traction unit plus one additional digit to uniquely identifying each EMS installed on the traction unit

Note 1 to entry: Where a traction unit has more than one EMS, the 13th digit is used to uniquely identify each EMS on the traction unit.

3.1.5
Contact Line
CL
conductor system for supplying electric energy to a traction unit through current-collecting equipment

[SOURCE: IEV 811-33-01, modified]

3.1.6
Current Measurement Function
CMF
function of an EMF measuring the current taken from and returned to the CL by the traction unit

3.1.7
Data Collection Service
DCS
on ground service collecting the CEBD from an EMS

3.1.8
Data Handling System
DHS
function combining the energy data produced by an EMF with other data, storing and transmitting the data to a DCS and other systems

3.1.9
enclosure
housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEV 195-02-35]

3.1.10
Energy Calculation Function
ECF
function calculating energy data using input signals from the VMF and CMF

3.1.11
energy data
set of measured energy values transferred from EMF to DHS

3.1.12
Energy Measurement Function
EMF
function comprising the voltage measurement function, the current measurement function and the energy calculation function

3.1.13
Energy Measurement System
EMS
on board system comprising the EMF, DHS and associated communications services

3.1.14
equipment type
specific design of device containing one or more functions, produced by one supplier and having similar properties including where applicable metrological properties, the same uniform construction of parts determining these properties and the same functional components

Note 1 to entry: Equipment is designated by the manufacturer by one or more groups of letters or numbers, or a combination of letters and numbers. Each equipment type has one designation only.

Note 2 to entry: The equipment type is represented by the equipment sample as provided for type test.

Note 3 to entry: Functions can be VMF, CMF, ECF, EMF, DHS or EMS or any combination of these functions.

[SOURCE: IEV 314-07-07, modified]

3.1.15
European Vehicle Number
EVN
unique 12 digit identification number defined according to European Legislation

Note 1 to entry: See decision 2011/314/EU.

3.1.16
function
specific purpose or objective to be accomplished that is specified or described without reference to the physical means of achieving it

Note 1 to entry: A function (considered as a black-box) transfers input parameters (material, energy, information) into related output parameters (material, energy, information).

3.1.17
interface
link between two functions of the EMS or between the EMS and other functions

Note 1 to entry: A link can be physical or virtual.

3.1.18
purchaser
entity that is a recipient of the EMS or parts of the EMS provided by a supplier

3.1.19
supplier
entity that supplies EMS or parts of the EMS; may also be the manufacturer

3.1.20
traction unit
vehicle or group of vehicles in fixed formation, for which the energy taken from and/or returned to the CL is to be measured by an EMS

Note 1 to entry: EN 50463 uses the term 'traction unit' to describe the part of a train to which energy metering is applied. The term 'traction unit' is considered to be a more suitable term than 'vehicle' because the latter term is generally used to describe the smallest part of a train i.e. an individual vehicle.

3.1.21
Voltage Measurement Function
VMF
function of an EMF measuring the voltage of the CL

3.2 Abbreviations

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

All the abbreviations are listed in alphabetical order.

CEBD Compiled Energy Billing Data

CL Contact Line

CMF Current Measurement Function

CPID Consumption Point ID

DCS Data Collection Service

DHS Data Handling System

ECF Energy Calculation Function

EMF Energy Measurement Function

EMS Energy Measurement System

RAMS Reliability, Availability, Maintenance and Safety

VMF Voltage Measurement Function

4 Requirements

4.1 General

Clause 4 of this document describes the requirements of an EMS.

4.2 gives system level requirements for the complete EMS.

4.3 gives common requirements for all devices implementing one or more functions of the EMS.

4.2 System level requirements

If an EMS has any functions which are additional to those specified in EN 50463, then these functions shall not:

- affect the accuracy,
- degrade the operation of the EMS, and
- influence the production and storage of CEBD and CEBD-related data.

Any changes to configuration shall be logged in the EMS, and the device marking and stored information shall also be updated.

4.2.1 Accuracy

The energy measurement accuracy is defined by the functions of the EMF and shall be determined in accordance with EN 50463-2.

4.2.2 EMS operation and power supply

The EMS shall be fully operational whenever energy flows from or to the CL.

Any part of the EMS powered by an auxiliary power supply, shall be compatible with the requirements of EN 50155:2007 regarding power supply characteristics.

The rated power supply voltage and maximum power consumption of the EMS shall be stated.

4.2.2.1 Power-up

The EMS shall achieve operational status and be ready to measure energy within 60 s of application of power to the EMS.

NOTE 1 The application of power to the EMS is an installation design consideration.

NOTE 2 The 60 s maximum time limit has been selected because the power-up procedure for traction units typically requires several minutes to elapse between switching on the vehicles ancillary supplies and any significant amount of energy being drawn from the CL.

4.2.2.2 Power-down

In the event of intentional loss of power to the EMS, no CEBD and other data shall be lost.

Unintentional loss of power shall not affect data stored in the EMS.

NOTE The EMS could include a procedure for transmitting all unsent CEBD to DCS as part of a planned power-down procedure of the EMS. This can help to support timely data processing on-ground.

4.2.3 EMS measuring input

4.2.3.1 Installation point of the VMF and CMF

The position of the VMF(s) and CMF(s) in the power circuit shall ensure that all active and reactive energy taken from and returned to the CL is measured.

NOTE Devices consuming small quantities of energy (e.g. high impedance voltage monitoring/detection devices, insulators etc.) are not considered significant and their consumption need not be measured by the EMS.

4.2.3.2 Characteristics of traction supply system

The ratings of the EMS voltage and current measuring inputs shall be selected in accordance with EN 50463-2 taking into account the intended traction energy supply system and traction unit rated current.

4.2.4 Data handling

4.2.4.1 Traction supply system change

An EMS (one or multiple) shall cover all traction supply system types that the traction unit can operate on.

If an EMS is used for more than one traction supply system, it shall continue to function correctly when changing between systems, and log each change of traction supply system. Changes between 600 V and 750 V d.c. traction supply systems do not need to be logged.

NOTE 1 This may be achieved directly by the EMS or by input signals from the traction unit.

NOTE 2 If voltage detection is used to detect traction supply system change, overvoltages above U_{max2}, in accordance with EN 50163:2004, and voltage drops below U_{min2} could cause a detection of a system change.

The EMS shall measure energy consumption within 1 s of the change to the new traction supply system.

4.2.4.2 Consumption point ID

Each EMS shall be assigned a unique consumption point ID.

NOTE The EMS can carry a fictitious CPID until such time as the EMS is commissioned into commercial use. The process of assigning the correct CPID to a specific EMS needed when bringing it into commercial use, is out of the scope of this standard.

The consumption point ID shall be stored in non-volatile memory of the EMS. Security procedures shall be implemented to prevent unauthorised changes to the consumption point ID.

4.2.5 RAMS

4.2.5.1 Reliability

Reliability requirements shall be in accordance with EN 50155:2007, 6.1.1. Reliability figures and calculation methods are a matter of agreement between the supplier and purchaser.

4.2.5.2 Availability

Calculation methods and availability figures shall be agreed between the supplier and purchaser.

4.2.5.3 Maintainability

Maintainability requirements shall be in accordance with EN 50155:2007, 6.3, 6.4 and 6.5.

Further requirements, if any, shall be agreed between the supplier and purchaser.

4.2.5.4 Safety

The EMS shall be designed, manufactured and installed on board the traction unit in such a way that it is safe in normal use and under normal conditions, in particular to ensure

- personal safety against electric shock in accordance with EN 50153,
- personal safety against effects of excessive temperature in accordance with EN ISO 13732-1, and
- protection against spread of fire (guideline can be found in CEN/TS 45545-2 and CLC/TS 45545-5).

NOTE When considering personal safety (electric shock risk), CL failure is a credible failure condition. This may pose a risk if a live part of the CL comes into direct contact with an exposed part of the EMS, or an exposed device connected directly to the EMS (e.g. roof mounted devices containing VMF, CMF or antenna).

4.3 Device level requirements

4.3.1 Marking and availability of essential data

4.3.1.1 Marking

Each device of the EMS shall be permanently and clearly marked, internally or externally, with the following information. If the marking is internal it shall be visible from the outside of the device.

Marking shall include:

a) the manufacturer’s name or trade mark;

b) the designation of equipment type;

c) the serial number and date of manufacture;

NOTE It is permitted to integrate the date of manufacturing into the serial number.

The device marking may contain other additional information.

4.3.1.2 Availability of essential information

The following information shall be available in a format (e.g. hardcopy or electronic) agreed between supplier and purchaser:

a) data identifying all devices in the EMS and the EMS configuration;

b) all information necessary to specify the characteristics and control the behaviour of each device of the EMS;

c) any special installation requirements necessary to ensure safe and correct operation (e.g. any requirements related to personal safety, installation environmental constraints to ensure correct operation, etc.).

4.3.2 Interfaces

Any interfaces associated with the EMS shall comply with the following requirements:

- the use of any interface shall not degrade the performance of the EMS;
- the normal operation of the EMS shall be secured against unintentional influence or unintentional changes caused by use of any interface;
- the choice of communication (physical layer, protocol, application profile, etc.) shall be in accordance with EN 50463-4 and shall be agreed between supplier and purchaser.

Interfaces may be used for more than one purpose.

4.3.2.1 Mandatory interfaces

4.3.2.1.1 Maintenance and service interfaces

The EMS shall have the capability to be interrogated locally by qualified persons on board the traction unit using appropriate equipment (e.g. laptop computer, display) for audit, recovery of data, maintenance etc.

This interface may be provided on one or more devices of the EMS.

Access to data via this interface shall be protected in order to prevent access and modifications by non-authorised personnel. Examples of suitable protection include the use of passwords, cryptography, etc.

4.3.2.1.2 Operational interfaces

Each function shall have input and output interfaces.

These interfaces link the individual functions to form the EMS.

4.3.2.1.3 Test interfaces

Each function of the EMS shall be provided with input and output test interfaces. The input interface shall allow injection of input signals and the output interface shall allow measurement and monitoring. Interfaces for testing shall be clearly identified and designated as ‘input’ and / or ‘output’ test interfaces.

Any signals injected for testing shall not cause any changes to existing CEBD.

If signals injected for testing generates or influences new CEBD, this data should not be presented as valid CEBD.

NOTE 1 If the operational interface of a function is accessible and can be used as a test interface then an additional test interface is not required.

4.3.2.2 Access security

This clause covers requirements for access to any function of the EMS from an external source.

Any request for access to data, software or system parameters that may affect the production and storage of CEBD and CEBD-related data shall go through an authorisation procedure before access is granted.

NOTE 1 Requests for access can be either from a remote location or on-site using portable equipment or human machine interface device.

Access to other data, software or system parameters can have different access rights as long as this has no influence for the production and storage of CEBD and CEBD-related data.

All requests for access and all changes shall be automatically logged within the EMS.

NOTE 2 Logging of a read-only access is not mandatory.

Access rights shall be agreed between the supplier and purchaser.

NOTE 3 It is advisable to be able to have more than one level of access rights, e.g. user and administrator. Some types of access may not need authorisation procedure.

4.3.3 Data processing and transfer

The EMS can also process and transfer other data or datasets associated with other aspects of the EMS (e.g. energy management). The processing of this data shall be a secondary priority for the EMS and shall not affect the CEBD. Flow and processing of data associated with CEBD shall take priority.

4.3.4 Software

Software shall be designed, tested and documented according to EN 50155:2007.

4.3.4.1 Identification of functions implemented in software

Any functions implemented in software shall be unambiguously identified and their operation suitably documented by the supplier.

4.3.4.2 Identification and protection of software

Software version shall be easily identifiable. The software version used for the production and storage of the CEBD in each device of a given equipment type shall be identical to the version used for conformity assessment. The software shall be protected against any accidental or intentional changes. Any changes or attempts to make a change shall be recorded.

NOTE If the software can only be changed after breaking (a) seal(s) or breaking the case, this is considered as an adequate level of protection.

Any corruption of the software used for the production and storage of CEBD and CEBD-related data shall be easily detectable.

4.3.4.3 Protection of CEBD and CEBD-related data

CEBD and CEBD-related data shall be protected against any accidental change, intentional change and corruption. Occurrence of any such event shall be recorded or self evident (e.g. broken seal). The security system of the EMS, providing protection of software, system parameters and assuring this requirement, including any hardware and software solutions, shall be suitably documented.

4.3.4.4 Protection against influence by other parts of software

Where any function incorporated within the EMS includes software that is not used for the production and storage of the CEBD, the operation of that software shall not impair the correct production and storage of the CEBD.

4.3.4.5 Protection against influence by connecting another device

The production and storage of CEBD and CEBD-related data shall not be influenced in any unintended way by the connection of any part of the EMS to another local or remote device that communicates with the EMS.

4.3.5 Dataflow security

The implementation of dataflow security arrangements shall be agreed between supplier and purchaser. The dataflow security arrangements shall comply with the following requirements.

4.3.5.1 Analogue dedicated connection

Authenticity and integrity of the data shall be assured by mechanical protection of the terminals or connectors forming the physical connection.

NOTE If the mechanical protection can only be removed after breaking of (a) seal(s) or breaking the enclosure, this is considered an adequate level of protection.

4.3.5.2 Digital dedicated connection

Loss of integrity shall be readily detected.

Authenticity shall be provided by mechanical protection of the terminal blocks or connectors forming the physical connection.

NOTE If the mechanical protection can only be changed after breaking (a) seal(s) or breaking the case, this is considered as an adequate level of protection.

4.3.5.3 Digital shared connection

Loss of integrity shall be readily detected.

The authenticity of sender and receiver shall be assured.

NOTE In some cases, authenticity could be assured by physical means like the mechanical protection of the terminal blocks or connectors of the physical connection. If in such cases the mechanical protection can only be removed after breaking of (a) seal(s) or breaking the enclosure, this is considered as an adequate level of protection.

If encryption is required, it shall be agreed between supplier and purchaser.

4.3.6 Environmental conditions

For equipment designed for installation on board rolling stock, environmental conditions are defined in EN 50125-1:1999 and EN 50155:2007. These requirements shall be applied to any on board device forming the EMS unless other requirements are specified elsewhere in EN 50463. Equipment environmental classes shall take account of the intended location on the traction unit where any device forming the EMS is intended to be installed.

All equipment (devices) shall comply with the requirements of EN 50463 under the following conditions.

4.3.6.1 Altitude

Equipment shall be designed and manufactured in accordance with the requirements for the selected altitude classes as stated in EN 50125-1:1999, 4.2.

4.3.6.2 Temperature

Electronic equipment shall be designed and manufactured in accordance with the requirement for the selected temperature classes as stated in EN 50155:2007, 4.1.2.

The temperature class for other equipment of the EMS shall comply with temperature classes defined in EN 50125-1:1999, 4.3.

The design should take into account temperature rises within electrical cubicles, on or just under metallic part of the roof, to ensure that the components do not exceed their specified temperature ratings.

The EMS shall be unaffected by rapid external ambient temperature variations (e.g. resulting from travel through tunnels). The rate of change of external temperature shall be assumed to be 3 K/s, with a maximum variation of 40 K.

4.3.6.3 Humidity

Equipment shall be designed and manufactured in accordance with the humidity requirements as stated in EN 50125-1:1999, 4.4.

Special attention should be paid to avoid failure or malfunction due to moisture condensation, especially in case of hermetic enclosure.

4.3.6.4 Air Movement

Equipment shall be designed and manufactured in accordance with the air movement requirements as stated in EN 50125-1:1999, 4.5.

4.3.6.5 Rain

Equipment shall be designed and manufactured in accordance with the rain requirements as stated in EN 50125-1:1999, 4.6.

4.3.6.6 Snow and hail

Equipment shall be designed and manufactured in accordance with the snow and hail requirements as stated in EN 50125-1:1999, 4.7.

4.3.6.7 Ice

Equipment shall be designed and manufactured in accordance with the ice requirements as stated in EN 50125-1:1999, 4.8.

4.3.6.8 Solar radiation

Equipment shall be designed and manufactured in accordance with the solar radiation requirements as stated in EN 50125-1:1999, 4.9.

4.3.6.9 Lightning

Equipment shall be designed and manufactured in accordance with the lightning requirements as stated in EN 50125-1:1999, 4.10.

NOTE Overvoltages and related protections associated with the CL and train line are defined in EN 50124-2.

4.3.6.10 Pollution

Equipment shall be designed and manufactured in accordance with the pollution requirements as stated in EN 50125-1:1999, 4.11.

4.3.6.11 Vibration and shock

Equipment shall be designed and manufactured in accordance with the vibration and shock requirements for the selected classes as stated in EN 50125-1:1999, 4.12.

4.3.6.12 Electromagnetic environment

Equipment shall be designed and manufactured in accordance with the electromagnetic environment as stated in EN 50155:2007, 5.5.

NOTE Items susceptible to influence from the electromagnetic environment need careful consideration in locations on the vehicle which are in proximity to the CL, the current collector / contact line interface and communications equipment.

4.3.7 Mechanical requirements, construction and design

4.3.7.1 General requirements

Equipment for installation on board rolling stock shall comply with the applicable mechanical requirement as defined in EN 50125-1:1999 and EN 50155:2007. These requirements shall be applied to any on board device forming the EMS unless other requirements are specified elsewhere in any part of this standard.

4.3.7.2 Enclosure

Any components of the EMS requiring environmental protection shall be mounted in an enclosure complying with EN 60529:1991. The level of protection shall be suitable for the intended component installation location and shall meet the environmental requirements as defined in EN 60529:1991, 4.3.

The enclosure shall be constructed and arranged so that any non-permanent deformation shall not prevent the operation of the EMS.

If any separate component of the EMS has one or more seals, the internal parts of this component should only be accessible by breaking the seal or the seals.

4.3.7.3 Indicator

Electronic devices shall have an indicator in accordance with EN 50155:2007, 6.5.

4.3.7.4 Terminal blocks and terminal covers

Terminal blocks shall be suitable for the applied voltage and current.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact so as to minimise the risk of loosening or undue heating. Screw connections transmitting contact force and screw fixings that might be loosened and tightened several times during the life of the device shall be durable and shall not suffer loss of performance (e.g. metallic nut).

Electrical connections shall be such that contact pressure is not transmitted through insulating material.

NOTE 1 Terminals can be grouped in one or a number of terminal blocks having adequate insulating properties and mechanical strength.

If electrical connectors are used, then consideration should be given to EN 50467.

All parts of each terminal shall be constructed so as to minimise the risk of corrosion resulting from contact with any other metal part.

Terminals with different potentials which are grouped close together shall be protected against accidental short-circuiting.

NOTE 2 Protection can be obtained by insulating barriers or by separation. Terminals of one current circuit are considered to be at the same potential.

If the terminal cover is made of metal, then the terminals, the conductor fixing screws, and the external and internal conductors shall be insulated from the terminal cover in accordance with EN 61010-1 and shall not be able to come into contact with the terminal cover while it is being fitted or removed.

4.3.8 Electrical requirements

4.3.8.1 Insulation

The rated primary voltage and current inputs of the EMS shall be insulated from all exposed and accessible outputs in normal operation.

The insulation may be placed anywhere between input and output. However, its voltage withstand performance shall be not less than achieved by the circuit on the input side of the point at which insulation is provided.

The insulation materials shall comply with the appropriate requirements of EN 60085.

4.3.8.2 EMS rated insulation level

Table D.1 of EN 50124-1:2001 gives the minimum values of the rated insulation voltage for different system and battery voltages. The minimum rated insulation voltage (U_{NM}) of the EMS measuring circuits shall be based on the nominal voltage of the traction supply system for which the EMS is designed. The minimum rated insulation voltage (U_{NM}) of the EMS auxiliary supply circuits shall be based on the nominal voltage of the auxiliary supply for which the EMS is designed. Any EMS input that is not directly subjected to the nominal voltage of the traction supply system or auxiliary supply shall be assigned a rated insulation voltage based on its nominal working voltage to ground.

The rated impulse voltage of the EMS measuring input (U_{Ni}) shall be based on the rated insulation voltage (U_{NM}) and selected from EN 50124-1:2001, Table A.2. Overvoltage category shall be chosen in accordance with EN 50124-1:2001.

The rated power-frequency withstand voltage of the EMS measuring input shall be equal to the test voltage (U_a) specified in EN 50124-1:2001, Table B.1, corresponding to the rated impulse voltage (U_{Ni}) of the EMS measuring input.

4.3.8.3 Requirements for EMS creepage, clearances and insulation

The minimum creepage distances for EMS insulation shall comply with the requirements of EN 50124-1:2001 and shall be chosen from Tables A.5, A.6, and A.7 as applicable in accordance with the EMS's rated insulation voltage (U_{NM}).

The degree of pollution in which the EMS's exposed insulation is intended to operate as defined in 4.3.5, shall be in accordance with EN 50124-1:2001 and the associated definitions in Table A.4.

The minimum clearance in air with which the EMS is to function when installed shall be in accordance with EN 50124-1:2001 and the dimensions given in Table A.3 in accordance with the rated impulse voltage (U_{Ni}). For roof mounted installations, dimensioning shall take account of EN 50124-1:2001, 6.2.

The voltage and current inputs of the EMS shall be insulated from all exposed and accessible outputs. The insulation may be placed anywhere between input and output. However, its voltage withstand performance shall be not less than achieved by the circuit on the input side of the point at which insulation is provided.

Annex ZZ
(informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Annex III of the EU Directive 2008/57/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive(s) concerned.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

Bibliography

EN 50124-2:2001, *Railway applications — Insulation coordination — Part 2: Overvoltages and related protection*

EN 50163:2004+A1:2007, *Railway applications — Supply voltages of traction systems*

EN 50467:2011, *Railway applications — Rolling stock — Electrical connectors, requirements and test methods*

EN 60359:2002, *Electrical and electronic measurement equipment — Expression of performance (IEC 60359:2001)*

IEC 60050 (all parts)*, International Electrotechnical Vocabulary*

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