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Železniške naprave - Merjenje energije na vlaku - 2. del: Merjenje energije

Railway applications - Energy measurement on board trains - Part 2: Energy measuring

Bahnanwendungen - Energiemessung auf Bahnfahrzeugen - Teil 2: Energiemessung

Applications ferroviaires - Mesure d'énergie à bord des trains - Partie 2 : Mesure d'énergie

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Railway applications - Energy measurement on board trains - Part 2: Energy measuring

Applications ferroviaires - Mesure d'énergie à bord des trains - Partie 2 : Mesure d'énergie

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

This document (EN 50463-2:2012) 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- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2015-10-15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 50463-2:2012), together with parts 1, 3, 4 and 5, supersedes EN 50463:2007.

EN 50463-1:2012 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 2 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.

EN 50463-2 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 Contact Line system and the Current Measurement Function measures the current taken from and returned to the Contact Line 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.

Part 4 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.

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

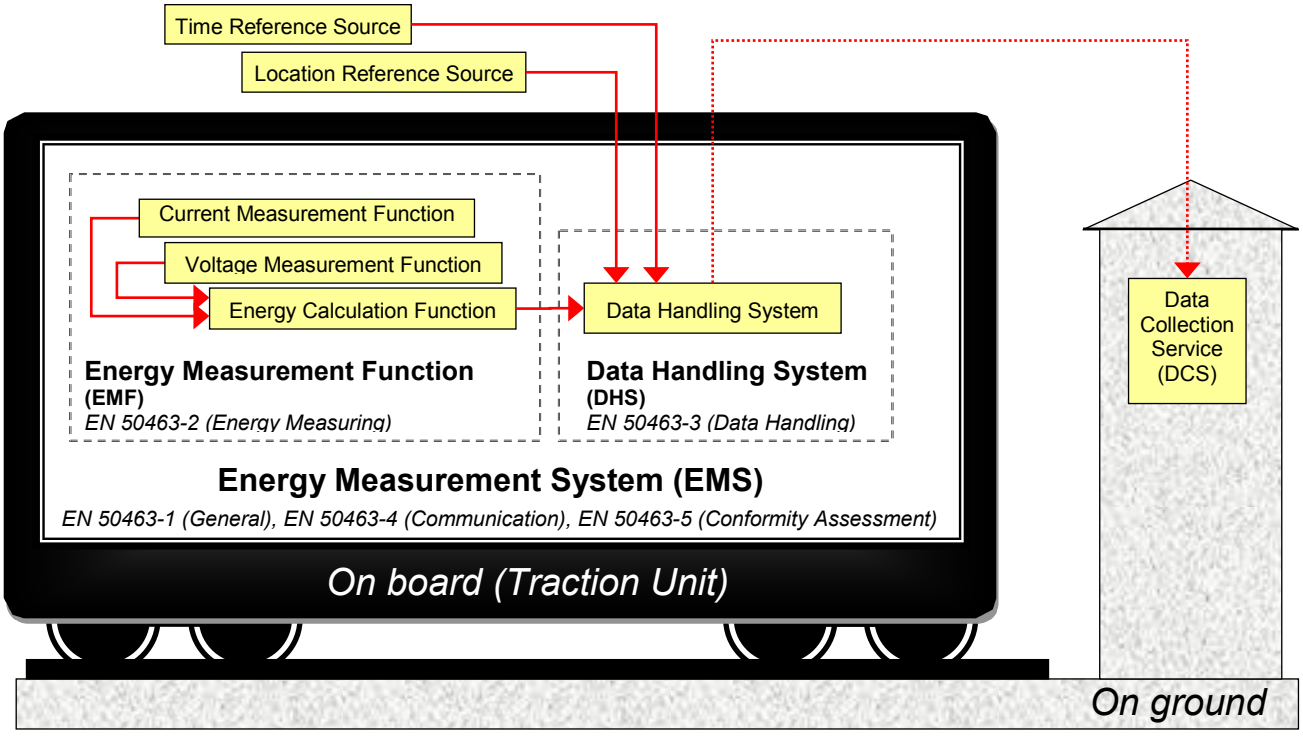

Figure 1 – EMS functional structure and dataflow diagram

1 Scope

This European Standard covers the requirements applicable to the Energy Measurement Function (EMF) of an Energy Measurement System (EMS) for use on board traction units for measurement of energy supplied directly from/to the Contact Line system.

This European Standard also gives requirements for the Current Measurement Function (e.g. current sensor), the Voltage Measurement Function (e.g. voltage sensor) and the Energy Calculation Function (e.g. energy meter).

The Conformity Assessment arrangements for the Voltage Measurement Function, Current Measurement Function, the Energy Calculation Function and a complete Energy Measurement Function are also specified in this document.

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.

Figure 2 shows the flow between the functional blocks of the EMF. Only connections between the functional blocks required by this standard are displayed.

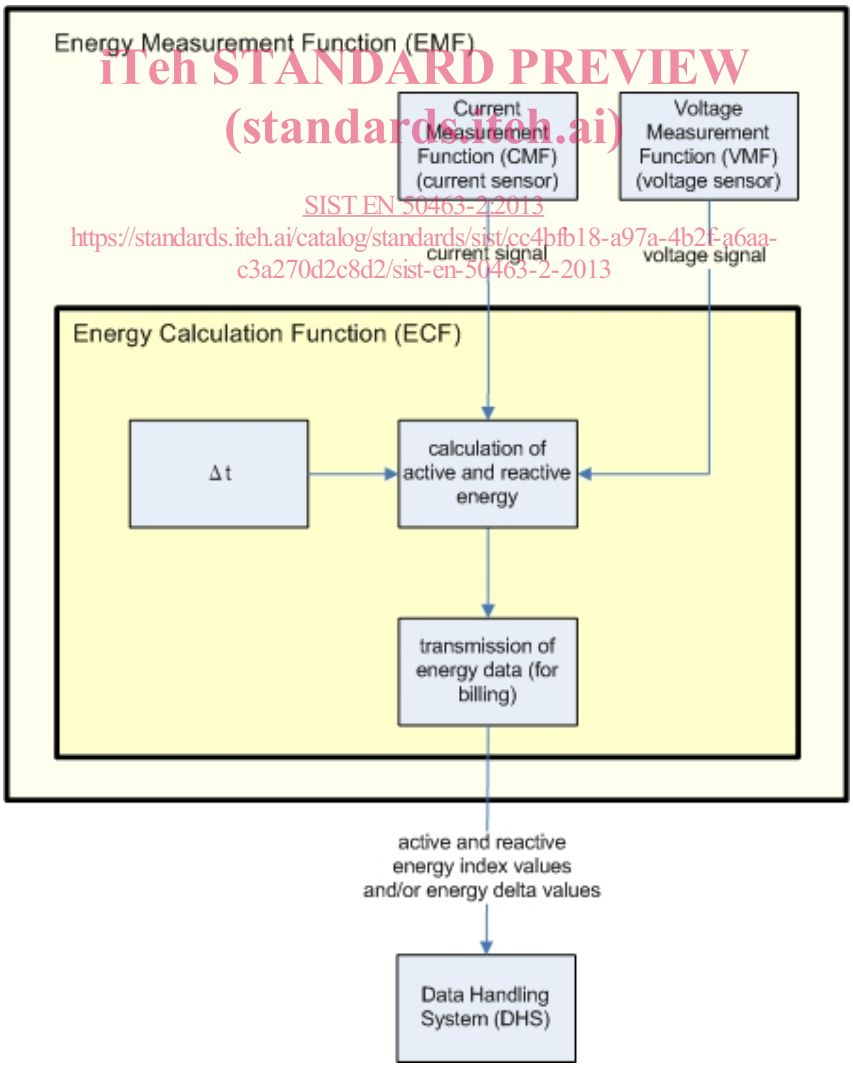

Figure 2 – EMF functional block diagram

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.

CEN/TS 45545-2:2009, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behaviour of materials and components*

CLC/TS 45545-5:2009, *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*

EN 50121-1:2006, *Railway applications — Electromagnetic compatibility — Part 1: General*

EN 50121-3-2:2006, *Railway applications — Electromagnetic compatibility — Part 3-2: Rolling stock — Apparatus*

EN 50123-1:2003, *Railway applications — Fixed installations — D.C. switchgear — Part 1: General*

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

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

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

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

EN 50388:2005, *Railway applications — Power supply and rolling stock — Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*

EN 50463-1:2012, *Railway applications — Energy measurement on board trains — Part 1: General*

EN 50463-3:2012, *Railway applications — Energy measurement on board trains — Part 3: Data handling*

EN 50463-4:2012, *Railway applications — Energy measurement on board trains — Part 4: Communication*

EN 50463-5:2012, *Railway applications — Energy measurement on board trains —Part 5: Conformity assessment*

EN 60044 (all parts), *Instrument transformers (IEC 60044, all parts)*

EN 60068-2-1:2007, *Environmental testing — Part 2-1: Tests — Test A: Cold (IEC 60068-2-1:2007)*

EN 60068-2-2:2008, *Environmental testing — Part 2-2: Tests — Test B: Dry heat (IEC 60068-2-2:2007)*

EN 60068-2-30:2005, *Environmental testing — Part 2-30: Tests — Test Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30:2005)*

EN 60077-4:2003, *Railway applications — Electric equipment for rolling stock — Part 4: Electrotechnical components — Rules for AC circuit-breakers (IEC 60077-4:2003)*

EN 60085:2008, *Electrical insulation — Thermal evaluation and designation (IEC 60085:2007)*

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

EN 61000-4-2:2009, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test (IEC 61000-4-2:2008)*

EN 61000-4-3:2006+A1:2008, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:2006+A1:2007)*

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 61000-4-5:2006, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test (IEC 61000-4-5:2005)*

EN 61000-4-6:2009, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:2008)*

EN 61373:2010, *Railway applications — Rolling stock equipment — Shock and vibration tests (IEC 61373:2010)*

IEC 60028:1925, *International standard of resistance for copper*

IEC 60121:1960, *Recommendation for commercial annealed aluminium electrical conductor wire*

3 Terms, definitions, abbreviations and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50463-1:2012 and the following apply.

NOTE When possible, the following definitions have been taken from the relevant chapters of the International Electrotechnical Vocabulary (IEV), IEC 60050-311, IEC 60050-312, IEC 60050-313, IEC 60050-314, IEC 60050-321 and IEC 60050-811. 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
accuracy class
designation that identifies a set of error limits for measured quantities under reference conditions and the additional percentage errors due to influence quantities

Note 1 to entry: An individual accuracy class is associated with each metrological function of the EMF

Note 2 to entry: The suffix “R” is used to differentiate classes according to this standard from other technical standards.

3.1.2
consumed active energy
active energy taken from the Contact Line by the traction unit on which the EMF is installed

3.1.3
consumed reactive energy
reactive energy taken from the Contact Line by the traction unit on which the EMF is installed

3.1.4
electronic sensor
device in which electronic circuits are used to process a measured signal

Note 1 to entry: Electronic circuits for processing the measurement signal include items such as analogue to digital converters, signal amplifiers etc.

3.1.5
energy delta value
energy consumed and/or regenerated during a time period

Note 1 to entry: See Figure 3 for example.

3.1.6
energy index value
total accumulated energy consumption and/or energy regeneration at the end of a time period

Note 1 to entry: See Figure 3 for example.

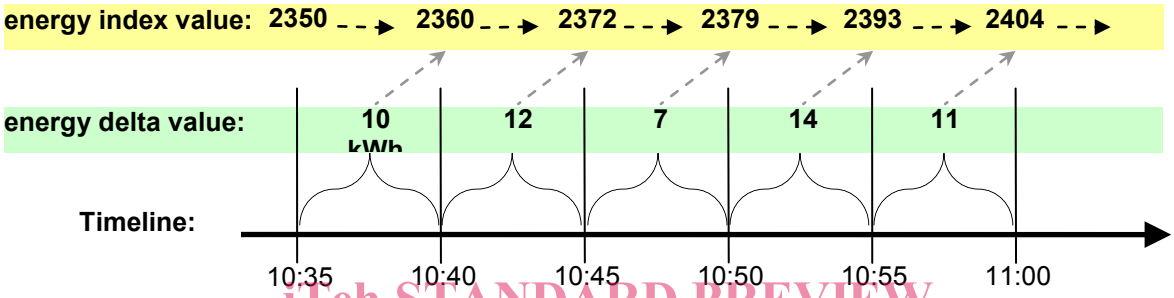

Figure 3 – Example of energy index value

3.1.7
flag
code indicating information relevant to the functioning of the EMS

Note 1 to entry: Examples include data quality, operational status, etc.

3.1.8
index value overrun
return to zero of the index value after reaching the maximum value allowed by the register

3.1.9
influence quantity
external condition which affects metrological performance

3.1.10
k-factor
multiplicand necessary to convert a secondary value into a primary value

Note 1 to entry: Each Voltage Measurement Function and/or Current Measurement Function can have a specific k-factor. If the k-factor is applied to Energy Data, this factor is the product of the k-factors of the Voltage Measurement Function and/or Current Measurement Function used.

3.1.11
percentage error
value given by the following formula:

$$Percentage\ \ error = \left| \frac{measured\ \ quantity - true\ \ quantity}{true\ \ quantity} \right| \times 100$$

Note 1 to entry: Since the true quantity cannot be determined, it is approximated by a quantity with a stated uncertainty that can be traced to standards agreed upon between supplier and purchaser or to national standards.

3.1.12
phase influence function
function of the real or apparent phase angle between a measured voltage and a measured current

Note 1 to entry: Phase influence function expressed as a Power Factor refers to measurements of real and apparent powers and energies, while sin φ refers to reactive powers and energies.

Note 2 to entry: For d.c. measurements the requirements for a phase influence function of 1 need to be used.

3.1.13
Power Factor
PF
ratio of the absolute value of the active power P to the apparent power S

[SOURCE: IEV 131-11-46, modified]

3.1.14
primary value
value referred to the measuring inputs of an EMF

3.1.15
rated continuous thermal current
$I_{CMF,cth}$
value of current which can be permitted to flow continuously into the primary input of a current sensor

3.1.16
rated dynamic current
$I_{CMF,dyn}$
peak value of the primary current which a current sensor will withstand without being damaged

3.1.17
rated primary current of the EMF
$I_{n,EMF}$
value of current which is used to define the relevant performance of the EMF

Note 1 to entry: The term current refers to r.m.s. value for a.c. unless otherwise specified.

3.1.18
rated primary voltage of the EMF
$U_{n,EMF}$
value of voltage which is used to define the relevant performance of the EMF

Note 1 to entry: The term voltage refers to r.m.s. value for a.c. unless otherwise specified.

3.1.19
rated short-time thermal current
$I_{CMF,th}$
value of the primary current which a current sensor will withstand for a specified time period without being damaged

3.1.20
rated traction unit current
maximum current that the traction unit is designed to draw from the Contact Line when operating under normal conditions and with a voltage in the range from U_{min1} to U_{max2} according to EN 50163

3.1.21
reference conditions
set of influence quantities, with reference values and tolerances, with respect to which the error limits are specified for an input quantity range

[SOURCE: IEV 311-06-02, modified]

3.1.22
regenerated active energy
active energy fed back into the Contact Line by the traction unit on which the EMF is installed

3.1.23
regenerated reactive energy
reactive energy fed back into the Contact Line by the traction unit on which the EMF is installed

3.1.24
register
electronic device which stores the information representing the measured energy and associated flags

Note 1 to entry: Registers can also be accessed and displayed locally via a service tool and if available via a local display.

[SOURCE: IEV 314-07-09, modified]

3.1.25
response time
$t_{s,r}$
duration between the instant of a step change in the measured quantity and the instant when the output signal reaches 90 % of the intended value

[SOURCE: IEV 394-39-09, modified]

3.1.26
secondary value
value of current, voltage, power or energy which needs to be multiplied by a k-factor to become a primary value

3.1.27
sensor
device performing the VMF or CMF

Note 1 to entry: Sensor is used as a general term and encompasses a wide variety of technology / devices for measurement purposes e.g. inductive transformers, hall-effect devices, capacitive and resistive dividers, resistive shunts etc.

Note 2 to entry: One sensor may perform multiple functions.

3.1.28
temperature coefficient
ratio between the temperature change and the resulting change in measurement error

3.1.29
time period
period of time for which energy data is produced

3.1.30
Time Reference Period
TRP
period of time for which CEBD is produced

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