



**SLOVENSKI STANDARD**  
**SIST EN 50463-2:2018**

**01-januar-2018**

**Nadomešča:**  
**SIST EN 50463-2:2013**

---

**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

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

**Ta slovenski standard je istoveten z: EN 50463-2:2017**

[SIST EN 50463-2:2018](#)

[http://www.sist.si/log/standards/EN-50463-2-2017-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018](#)

---

**ICS:**

45.060.10      Vlečna vozila      Tractive stock

**SIST EN 50463-2:2018**      **en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 50463-2:2018](https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018)

<https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018>

EUROPEAN STANDARD

**EN 50463-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2017

ICS 45.060.10

Supersedes EN 50463-2:2012

English Version

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

Applications ferroviaires - Mesure d'énergie à bord des  
trains - Partie 2 : Mesure d'énergieBahnanwendungen - Energiemessung auf Bahnfahrzeugen  
- Teil 2: Energiemessung

This European Standard was approved by CENELEC on 2017-05-08. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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

<https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018>



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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

<b>Contents</b>	<b>Page</b>
European foreword.....	7
Introduction.....	8
<b>1 Scope.....</b>	<b>11</b>
<b>2 Normative references.....</b>	<b>12</b>
<b>3 Terms, definitions, abbreviations and symbols.....</b>	<b>13</b>
3.1 Terms and definitions .....	13
3.2 Abbreviations .....	16
3.3 Symbols .....	17
<b>4 Requirements .....</b>	<b>17</b>
4.1 General.....	17
4.2 Energy Measurement Function (EMF) .....	18
4.2.1 General .....	18
4.2.2 Electrical requirements.....	18
4.2.3 Accuracy requirements.....	19
4.2.4 Traction system change .....	21
4.2.5 Re-verification.....	21
4.3 Sensors.....	21
4.3.1 General .....	21
4.3.2 General requirements .....	22
4.3.3 Voltage sensors .....	23
4.3.4 Current sensors .....	28
4.4 Energy Calculation Function (ECF) .....	34
4.4.1 General .....	34
4.4.2 General requirements .....	34
4.4.3 Electrical requirements.....	36
4.4.4 Accuracy requirements.....	37
4.4.5 Effect of temperature on error limits .....	38
4.4.6 Limits of additional error due to influence quantities.....	41
4.4.7 Electromagnetic compatibility .....	43
4.4.8 Data transfer from ECF to DHS .....	44
<b>5 Conformity assessment.....</b>	<b>45</b>
5.1 General.....	45
5.1.1 Introduction.....	45
5.1.2 Applicability .....	45
5.1.3 Methodology .....	45
5.2 Testing framework.....	46
5.2.1 General .....	46

5.2.2	Reporting.....	46
5.3	Design review.....	47
5.3.1	General .....	47
5.3.2	Device design review .....	47
5.3.3	EMF design review .....	48
5.4	Type testing.....	48
5.4.1	General .....	48
5.4.2	Common type testing.....	48
5.4.3	Sensor type test.....	52
5.4.4	ECF type test.....	59
5.5	Routine test .....	70
5.5.1	General .....	70
5.5.2	Visual Inspection .....	70
5.5.3	Insulation test .....	70
5.5.4	Accuracy tests .....	71
Annex A (normative)	Test with magnetic induction of external origin .....	73
A.1	General.....	73
A.2	Test method 1.....	73
A.3	Test method 2.....	73
Annex B (normative)	EMF Configurations.....	75
B.1	Background.....	75
B.2	General.....	75
B.3	EMF with several CMF's in parallel.....	75
B.4	EMF with several VMF's connected to one ECF .....	76
B.5	EMF with several pairs of VMF and CMF.....	76
B.6	Several EMF's in parallel.....	77
B.7	One VMF or CMF connected to several ECFs.....	77
B.8	EMF without VMF .....	78
Annex C (informative)	Expressing EMF accuracy .....	79
C.1	Summary.....	79
C.2	Error limits or uncertainty.....	79
C.3	Presentation of error limits.....	79
C.4	Uncertainty calculations .....	80
C.4.1	AC active power.....	80
C.4.2	Primary values .....	81
C.4.3	Uncertainty in the measurement of active power (Watts).....	81
C.4.4	Relative uncertainty .....	82
C.4.5	Uncertainty in the measurement of reactive power (var) .....	83
C.4.6	Relative uncertainty .....	84
Annex D (informative)	Recommendations for re-verification and defining of its regime.....	85
D.1	Re-verification .....	85
D.1.1	Introduction and background.....	85

## EN 50463-2:2017 (E)

D.1.2 Approaches to re-verification.....	85
D.2 Recommendations for defining the re-verification regime .....	86
D.2.1 General approach .....	86
D.2.2 Testing regime .....	87
Annex E (informative) Durability test .....	88
E.1 General.....	88
E.2 Initial measurements .....	88
E.3 Conditioning.....	88
E.4 Intermediate measurements .....	89
E.5 Final temperature ramp.....	90
E.6 Final measurements and acceptance criteria .....	90
E.7 Information to be given in the test report .....	90
Annex ZZ (informative) Relationship between this European Standard and the Essential Requirements of Directive 2008/57/EC.....	92
Bibliography.....	93
Figures	
Figure 1 — EMS functional structure and dataflow diagram.....	10
Figure 2 — EMF functional block diagram.....	11
Figure 3 — Example of energy index value.....	14
Figure 4 — Example of maximum percentage error for a VMF of class 0,5 R and a VMF of class 1,0 R with input signal in the range $U_{min1} \leq U \leq U_{max2}$ .....	26
Figure 5 — Example of maximum percentage error for a CMF class 1,0 R AC with input signals in the range $10 \% I_n \leq I \leq 120 \% I_n$ , $5 \% I_n \leq I < 10 \% I_n$ and $1 \% I_n \leq I < 5 \% I_n$ .....	32
Figure 6 — Primary current and voltage ranges .....	38
Figure 7 — Example of maximum percentage error for an ECF of class 0,5 R and an ECF of class 1,0 R with input signals in Area 1 and Area 2.....	40
Figure 8 — Test point matrix for ECF accuracy tests (type test) .....	61
Figure 9 — Test point matrix for tests of ambient temperature variation and influence quantities.....	62
Figure 10 — Test circuit diagram for determining the influence on accuracy of odd harmonics or sub-harmonics in the current circuit .....	65
Figure 11 — Phase-fired waveform (shown for 50 Hz) .....	65
Figure 12 — Analysis of harmonic content of phase-fired waveform (shown for 50 Hz) .....	66
Figure 13 — Burst fire waveform (shown for 50 Hz).....	66
Figure 14 — Analysis of harmonics (shown for 50 Hz) .....	67
Figure 15 — Test point matrix for ECF Accuracy Tests (type test).....	72

Figure A.1 — Test configuration for test method 1 .....	73
Figure A.2 — Test configuration for test method 2 .....	74
Figure B.1 — EMF with several CMF's in parallel .....	75
Figure B.2 — EMF with several VMF's connected to one ECF .....	76
Figure B.3 — EMF with several pairs of VMF and CMF .....	77
Figure B.4 — EMF with several ECF's .....	77
Figure B.5 — One VMF connected to two ECF's .....	78
Figure B.6 — EMF without VMF .....	78
<b>Tables</b>	
Table 1 — Nominal traction system voltages .....	19
Table 2 — Reference conditions .....	20
Table 3 — EMF percentage error limits .....	21
Table 4 — Percentage error limits — VMF .....	25
Table 5 — Maximum percentage error for a VMF including ambient temperature variation .....	26
Table 6 — Temperature coefficient for VMF .....	27
Table 7 — Influence quantities for voltage sensors .....	28
Table 8 — Percentage error limits — AC CMF .....	30
Table 9 — Percentage error limits — DC CMF .....	30
Table 10 — Maximum percentage error for a CMF including ambient temperature variation .....	31
Table 11 — Temperature coefficient for CMF .....	32
Table 12 — Percentage error limits with harmonics — AC current sensor .....	33
Table 13 — Influence quantities for current sensors .....	33
Table 14 — Variations due to short-time overcurrents .....	37
Table 15 — Variations due to self-heating .....	37
Table 16 — ECF percentage error limits for active energy .....	38
Table 17 — Maximum percentage error for an ECF including ambient temperature variation .....	39
Table 18 — Temperature coefficient for the ECF .....	40
Table 19 — Influence quantities for the ECF .....	42

EN 50463-2:2017 (E)

Table 20 — Test current for harmonics.....54

Table ZZ.1 — Correspondence between this European Standard, the TSI “Locomotives and Passenger Rolling Stock” (REGULATION (EU) No 1302/2014 of 18 November 2014) and Directive 2008/57/EC amended by Directive 2011/18/EU.....92

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 50463-2:2018](https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018)

<https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018>



## European foreword

This document (EN 50463-2:2017) has been prepared by CLC/TC 9X “Electrical and electronic applications for railways”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2018-04-06
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2020-10-06

This document supersedes EN 50463-2:2012.

EN 50463-2:2017 includes the following significant technical changes with respect to EN 50463-2:2012:

- updated requirements for events, quality codes, flags and logs (Clause 4);
- updated for consistency between Table 16 and Figure 6 regarding “Area 2” (Clause 4).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC 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 the relationship with EU Directive(s) 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*.

This series of European Standards follows the functional guidelines description in EN ISO/IEC 17000:2004, Annex A “Principles of conformity assessment”, 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.

**EN 50463-2:2017 (E)****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 and on-ground Data Collecting 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.

**a) 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:

**1) 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.

**2) 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 AC traction 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 (CEBD).

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.

**3) EN 50463-3 — Data handling:**

The scope of EN 50463-3 is the Data Handling System (DHS) and the associated requirements of Data Collecting System (DCS).

The on board DHS receives, produces and stores data, ready for transmission to any authorized receiver of data on board or on ground. The main goal of the DHS is to produce Compiled Energy Billing Data and transfer it on an interoperable basis to an on-ground Data Collecting System (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.

The DCS on-ground receives Compiled Energy Billing Data and transfer it to settlement system.

EN 50463-3 also defines the conformity assessment of the DHS and for the transfer of CEBD to an on-ground Data Collecting System (DCS).

#### 4) 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 reference to the on board to ground communication service and covers the requirements necessary to support data transfer between DHS and DCS including the transfer of CEBD on an interoperable basis.

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

#### 5) 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.

#### b) 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 widely omitted for clarity, except for the train to ground communication. Not all interfaces are shown.

EN 50463-2:2017 (E)

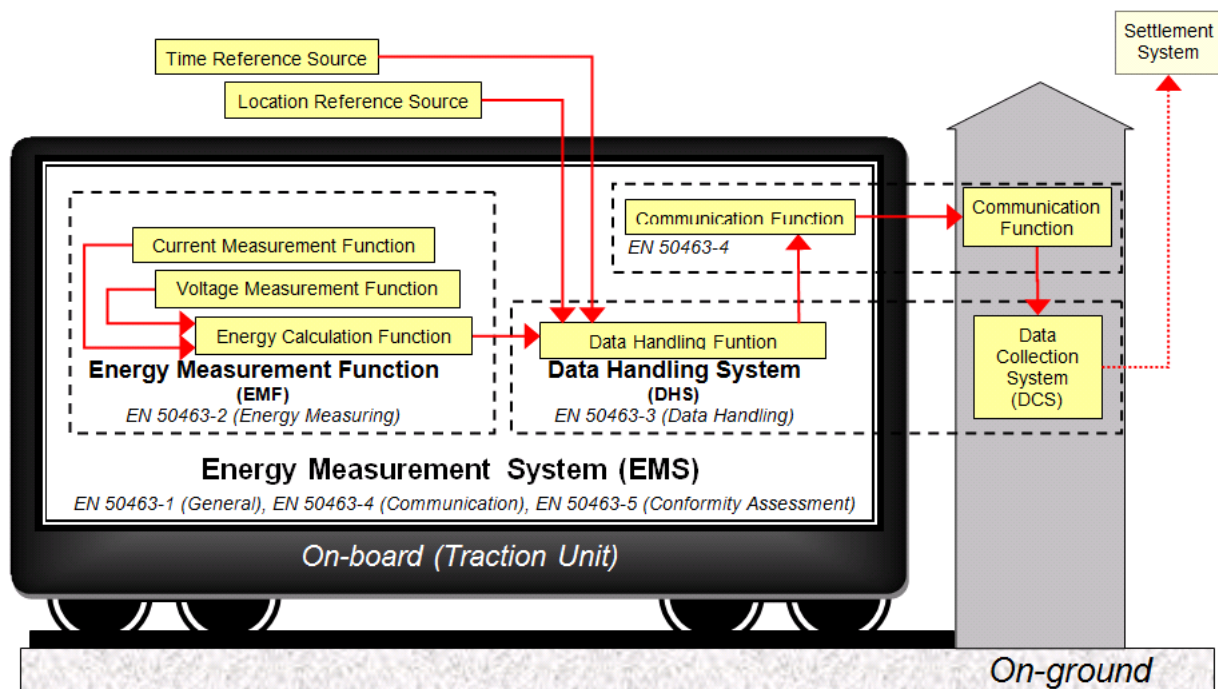


Figure 1 — EMS functional structure and dataflow diagram

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 50463-2:2018

<https://standards.iteh.ai/catalog/standards/sist/5fac2bc1-25d8-4cc0-a0d2-cf76a90c1e97/sist-en-50463-2-2018>

## 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 can 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.

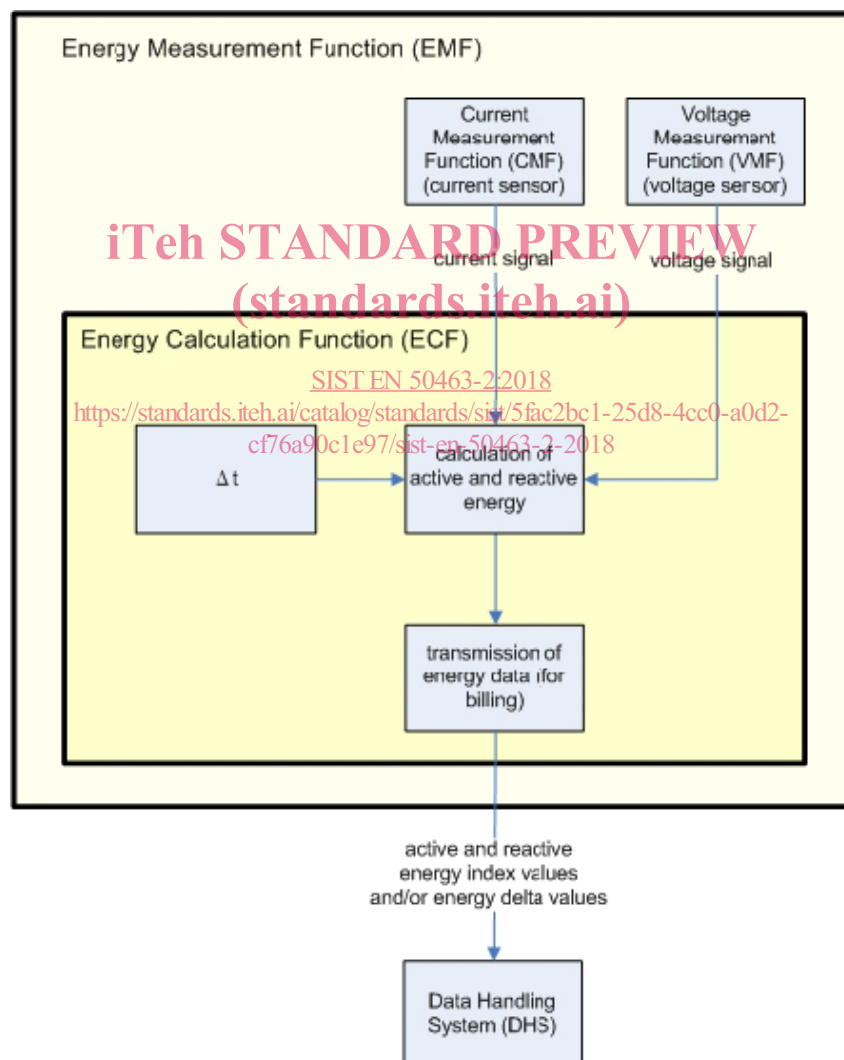


Figure 2 — EMF functional block diagram

**EN 50463-2:2017 (E)****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 45545-2:2013+A1:2015, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behaviour of materials and components*

EN 45545-5:2013+A1:2015, *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 50121-1:2017, *Railway applications — Electromagnetic compatibility — Part 1: General*

EN 50121-3-2:2015, *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 50125-1:2014, *Railway applications — Environmental conditions for equipment — Part 1: Rolling stock and on-board equipment*

EN 50155:2017, *Railway applications — Rolling stock — Electronic equipment*

EN 50163:2004, *Railway applications — Supply voltages of traction systems (IEC 60850:2000, not equivalent)*

EN 50388:2012, *Railway Applications — Power supply and rolling stock — Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*

EN 50463-1:2017, *Railway applications — Energy measurement on board trains — Part 1: General*

EN 50463-3:2017, *Railway applications — Energy measurement on board trains — Part 3: Data handling*

EN 50463-4:2017, *Railway applications — Energy measurement on board trains — Part 4: Communication*

EN 50463-5:2017, *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 60068-2-2:2007, *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 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, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61000 (all parts), *Electromagnetic compatibility (EMC) (IEC 61000, all parts)*

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

EN 61869-3:2011, *Instrument transformers — Part 3: Additional requirements for inductive voltage transformers (IEC 61869-3:2011)*

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 50463-1:2017 and the following apply.

Note 1 to entry: 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.