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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Railway applications – Energy measurement on board trains – Part 1: General

Applications ferroviaires – Mesure d'énergie à bord des trains – Partie 1: Généralités

IEC 62888-1:2018-01(en-fr)

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

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

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Applications ferroviaires – Mesure d'énergie à bord des trains – Partie 1: Généralités

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RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 1: General

FOREWORD

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This standard is based on EN 50463.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
9/2320/FDIS	9/2331/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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A list of all parts in the IEC 62888 series, published under the general title *Railway applications – Energy measurement on board trains*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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INTRODUCTION

Three levels are introduced for categorizing EMS as described in 4.1.

This is Part 1 of the IEC 62888 series which consists of the following parts, under the general title *Railway applications – Energy measurement on board trains*:

Part 1: General

Part 2: Energy measurement

Part 3: Data handling

Part 4: Communication

Part 5: Conformance test

Part 6: Requirements for purposes other than billing

This series of International Standards follows the functional guidelines description in Annex A, "Principles of conformity assessment", of ISO/IEC 17000:2004 tailored to the Energy Measurement System (EMS).

The Energy Measurement System (EMS) provides measurement and data suitable for applications such as energy management, energy saving, billing and others.

This series of International Standards uses the functional approach to describe the EMS. 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 IEC 62888 series

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

IEC 62888-1 – General

The scope of IEC 62888-1 is the Energy Measurement System (EMS).

IEC 62888-1 provides system level requirements for the complete EMS and common requirements for all devices implementing one or more functions of the EMS.

IEC 62888-2 – Energy measurement

The scope of IEC 62888-2 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 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 (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.

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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 Measured Data.

All relevant metrological aspects are covered in this part of IEC 62888.

IEC 62888-2 also defines the conformance test of the EMF.

IEC 62888-3 – Data handling

The scope of IEC 62888-3 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 Measured 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.

IEC 62888-3 also defines the conformance test of the DHS.

IEC 62888-4 – Communication

The scope of IEC 62888-4 is the communication services.

This part of IEC 62888 gives requirements and guidance regarding the data 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.

IEC 62888-4 also defines the conformance test of the communications services.

IEC 62888-5 – Conformance test

The scope of IEC 62888-5 is the conformance test procedures for the EMS.

IEC 62888-5 also covers re-verification procedures and conformance test in the event of the replacement of a device of the EMS.

IEC 62888-6 – Requirements for purposes other than billing

The scope of IEC 62888-6 is to specify the requirements for EMS to be used for benchmarking, daily energy consumption monitoring, technical research and development.

This part provides the requirements for monitoring consumed energy on board in daily services in an easy way and the measured data are applicable for general purposes in industry such as energy management, energy saving, etc. However, this part is not applicable for billing purposes.

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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.

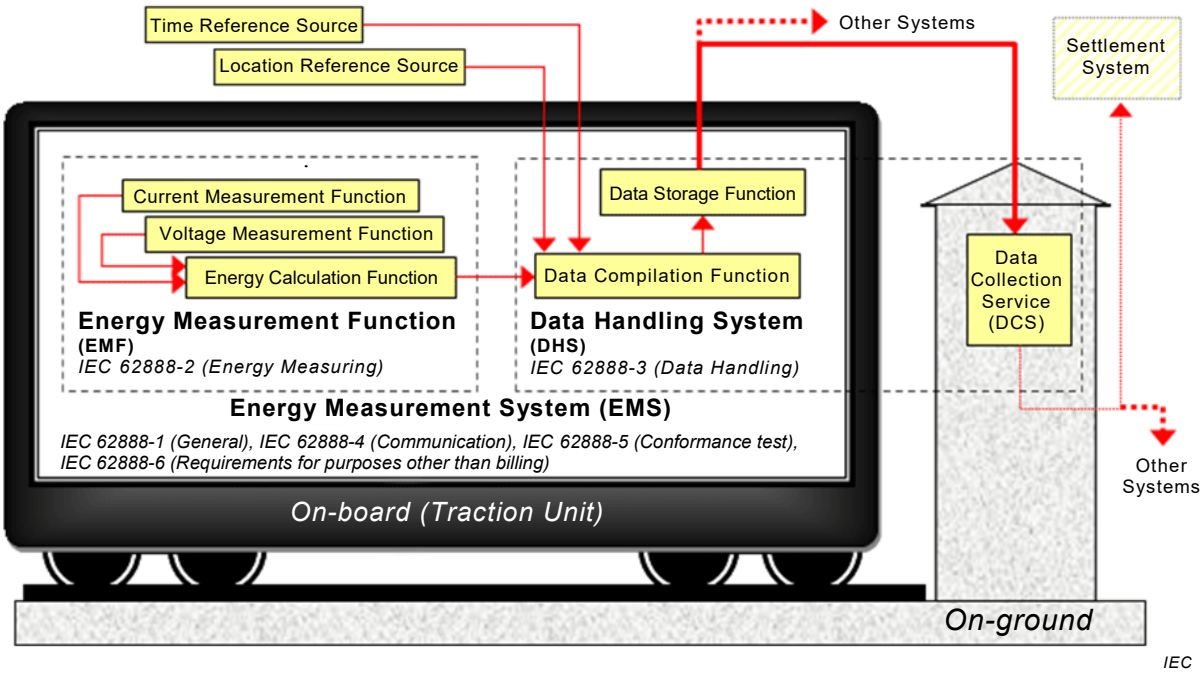

Figure 1 – EMS functional structure and dataflow diagram

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RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 1: General

1 Scope

This part of IEC 62888 describes the primary purpose of the Energy Measurement System (EMS), which measures energy consumption on board for applications such as energy management, energy saving, billing and others.

This part of IEC 62888:

- gives requirements for the complete EMS and also requirements for all devices implementing one or more functions of the EMS;
- applies to newly manufactured EMSs for use on board traction units, powered by AC and/or DC supply voltages as listed in IEC 60850;
- does not apply to portable EMSs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60571:2012, *Railway applications – Electronic equipment used on rolling stock*

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

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61991, *Railway applications – Rolling stock – Protective provisions against electrical hazards*

IEC 62497-1:2010, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*
IEC 62497-1:2010/AMD1:2013

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

IEC 62847, *Railway applications – Rolling stock – Electrical connectors – Requirements and test methods*

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IEC 62888-2, *Railway applications – Energy measurement on board trains – Part 2: Energy measurement*

IEC 62888-4, *Railway applications – Energy measurement on board trains – Part 4: Communication*

IEC 62888-6, *Railway applications – Energy measurement on board trains – Part 6: Requirements for purposes other than billing*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

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

3 Terms, definitions and abbreviated terms

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
authenticity
state in which information is valid and known to have originated from the stated source

[SOURCE: IEC 60050-821: 2017, 821-11-05]

3.1.2
compiled energy measured data
CEMD
dataset compiled by the DHS suitable for energy management

3.1.3
CEMD-related data
all data produced by any function of the EMS required for the production of CEMD

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

3.1.4
Consumption Point-Identification
CPID
code uniquely identifying each EMS installed 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: IEC 60050-811: 2017, 811-33-01, modified:"vehicles" changed to "traction unit"]

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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 CEMD 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: IEC 60050-195:1998, 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
mode of action or activity by which a product fulfils its purpose

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.

3.1.15
function
mode of action or activity by which a product fulfils its purpose

[SOURCE: IEC 60050-821: 2017, 821-12-25]

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3.1.16
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.

3.1.17
purchaser
entity that is a recipient of the EMS or parts of the EMS provided by a supplier

3.1.18
supplier
entity that supplies EMS or parts of the EMS

Note 1 to entry: The manufacturer may also play the role of supplier.

3.1.19
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: IEC 62888 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.

3.1.20
Voltage Measurement Function
VMF
function of an EMF measuring the voltage of the CL

3.1.21
Vehicle Identification Number
VIN
code uniquely identifying each vehicle

Note 1 to entry: For European countries it is represented by the European vehicle number (unique 12 digit identification number) as defined in the decision 2011/314/EU.

3.2 Abbreviated terms

CEMD	Compiled Energy Measured Data
CL	Contact Line
CMF	Current Measurement Function
CPID	Consumption Point Identification
DCS	Data Collection Service
DHS	Data Handling System
ECF	Energy Calculation Function
EMF	Energy Measurement Function
EMS	Energy Measurement System
RAMS	Reliability, Availability, Maintainability and Safety
VIN	Vehicle Identification Number
VMF	Voltage Measurement Function

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4 Requirements

4.1 General

Clause 4 of this document describes the requirements of an energy measurement system (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.

The EMS is categorized in one of the following 3 levels of performance, see Table 1.

Table 1 – Levels of performance

Levels	Description	Notes
Level 1	Level for measuring energy consumption on board for applications like energy management, energy saving, billing and others.	This is the only level applicable for billing.
Level 2	Level for measuring energy consumption on board for applications like energy management, energy saving, benchmarking among suppliers or train operators and others. This level is not applicable for billing.	Level 2 is applied when accuracy requirements need to be raised to ones equivalent to level 1 by agreement among the Parties for international comparison or benchmarking purposes.
Level 3	Level for daily energy measurement, for instance: technical research and development. This Level is not applicable for billing.	-based on users requests. -Both measuring performance and service conditions can be less severe than level 1. Power and energy are calculated based on voltage and current data acquired from existing sensors installed in converter systems, etc.

Requirements applicable to level 2 and level 3 are specified in IEC 62888-6.

4.2 System level requirements

4.2.1 General

If an EMS has any functions which are additional to those specified in IEC 62888, then these functions shall not:

- affect the accuracy,
- degrade the operation of the EMS, and
- influence the production and storage of compiled energy measured data (CEMD) and CEMD-related data.

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

4.2.2 Accuracy

The energy measurement accuracy is defined by the functions of the EMF and shall be determined in accordance with IEC 62888-2.

Requirements applicable to level 2 and level 3 are specified in IEC 62888-6.

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4.2.3 EMS operation and power supply

4.2.3.1 General

The EMS shall be fully operational whenever energy flows from or to the contact line (CL).

Any part of the EMS powered by an auxiliary power supply, shall be compatible with the requirements of IEC 60571:2012 regarding power supply characteristics.

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

4.2.3.2 Power-up

Following the application of the power supply, the EMS shall achieve operational status and be ready to measure energy within time of Table 2.

Table 2 – Power-up time classes

Power-up classes	Power up time s
PWR-A	60
PWR-B	120
PWR-X	Agreed between the involved parties

Unless otherwise specified, the requirements of class PWR-A apply.

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.

4.2.3.3 Power-down

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

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

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

4.2.4 EMS measuring input

4.2.4.1 Installation point of the VMF and CMF

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

Requirements applicable to level 2 and level 3 are specified in IEC 62888-6.

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

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4.2.4.2 Characteristics of traction supply system

The ratings of the EMS voltage and current measuring inputs shall be selected in accordance with IEC 62888-2 taking into account the intended traction energy supply system and traction unit rated current.

Requirements applicable to level 2 and level 3 are specified in IEC 62888-6.

4.2.5 Data handling

4.2.5.1 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 DC traction supply systems do not need to be logged.

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

If voltage detection is used to detect traction supply system change, overvoltages above U_{max2}, in accordance with IEC 60850, and voltage drops below U_{min2} could cause a detection of a system change.

In changing the traction supply system, the EMS shall measure energy consumption within the time listed in Table 3.

Table 3 – Traction supply system change classes

Traction supply system change classes	Maximum time s
TSC-A	1
TSC-B	2
TSC-X	Agreed between the involved parties

Unless otherwise specified, the requirements of category TSC-A apply.

4.2.5.2 Consumption Point Identification (CPID)

A consumption point is identified using a Country Code (CC), a Vehicle Keeper Marking (VKM), a Vehicle Identification Number (VIN) and the EMF-ID (n).

- Country Code (CC): coding of the countries in which the vehicles are registered, consisting of 2 characters as defined by ISO 3166-1 alpha-2;
- Vehicle Keeper Marking (VKM): an alphabetic code, consisting of 2 to 5 characters
- Vehicle Identification Number (VIN): the number defined by Intergovernmental organisation for international carriage by rail (OTIF) is the unique identifier of the vehicle/consist on which one or more EMS are installed and is composed of 12 numerical digits;
- n is the number identifying the EMF installed in the consist.

NOTE 1 For European countries, 13 digit number (numeric value without dividers or decimals) is used based on a VIN from the traction unit plus one additional digit.

NOTE 2 Where a traction unit has more than one EMS, the additional digits are used to uniquely identify each EMS within the traction unit.

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