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

**Applications ferroviaires – Mesure d'énergie à bord des trains –
Partie 6: Exigences à des fins autres que la facturation**

IT-ESTANDARD PREVIEW
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IEC 62888-6:2019
<https://standards.iteh.ai/catalog/standards/sist/7d752a2-957c-494c-9b17-cf8add2d48b4/iec-62888-6-2019>



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INTERNATIONAL STANDARD

NORME INTERNATIONALE



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
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INTERNATIONALE

ICS 45.060.01

ISBN 978-2-8322-6092-0

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RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 6: Requirements for purposes other than billing

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International Standard IEC 62888-6 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This standard supplements and/or amends the requirements specified in IEC 62888-1 to IEC 62888-5 which are based on EN 50463.

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

FDIS	Report on voting
9/2431/FDIS	9/2450/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.

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 Clause 1.

This is Part 6 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

[IEC 62888-6:2019](http://standards.iteh.ai/catalog/standards/cist/949752a2-937c-4941-9b17-cf8add2d48b4/iec-62888-6-2019)

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.

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 another 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.

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.

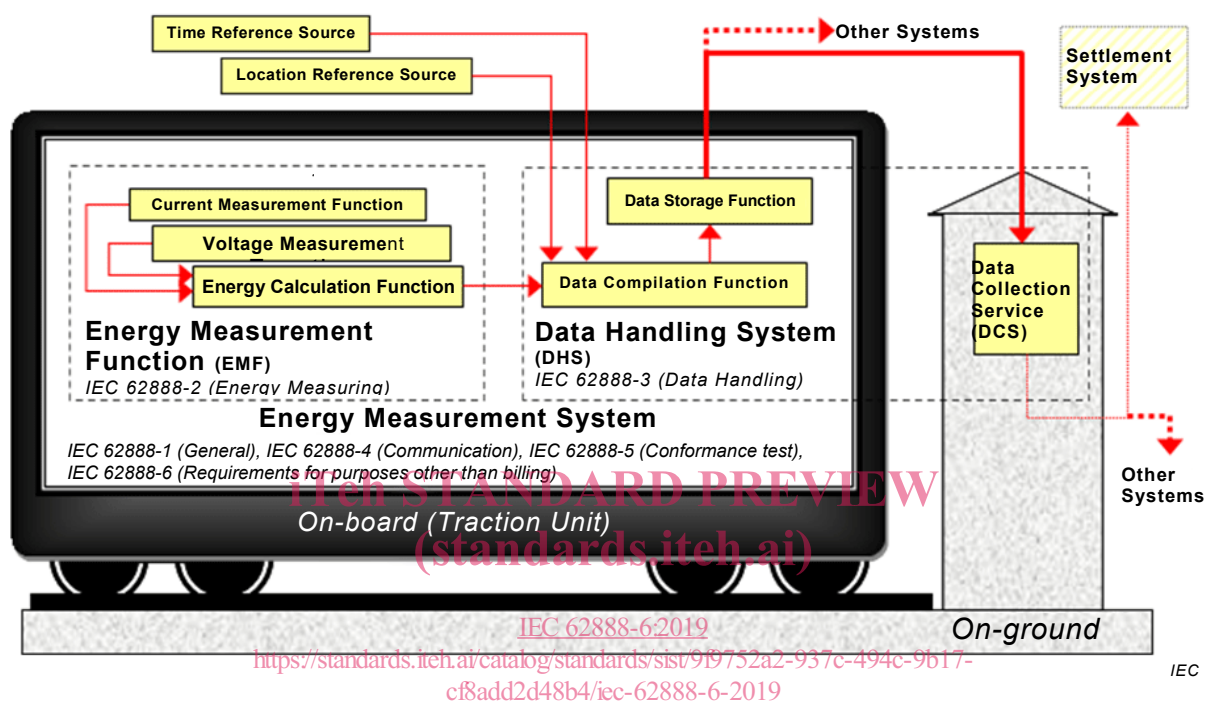


Figure 1 – EMS functional structure and dataflow diagram

RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 6: Requirements for purposes other than billing

1 Scope

This part of IEC 62888 specifies the specific requirements for EMS to be used for benchmarking, daily energy consumption monitoring, technical research and development.

This document 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 document is not applicable for billing purposes.

The practical purposes in industrial fields are, e.g.:

- a) monitoring daily energy consumption of vehicles;
- b) obtaining data on influential factors, such as operational commands and surrounding conditions, in order to analyse relations between operations and energy;
- c) energy management of power flow between vehicles and fixed installations;
- d) implementing investigation tests of research and development for vehicle systems;
- e) energy cost forecasting for analysing overall efficiency and consumption.

The requirements specified in this document supplement and/or amend the requirements specified in IEC 62888-1 to IEC 62888-5.

The energy measurement system (EMS) is categorized in 3 Levels as described in IEC 62888-1:2018, Table 1. This document applies to Level 2 and Level 3.

In this document unless levels are specially mentioned, both Level 2 and Level 3 apply. If a requirement applies only to one level between Level 2 and Level 3, this condition is clearly specified.

In the following clauses and subclauses square brackets, e.g. [IEC 62888-3:2018, 4.6.1] in the title indicate relevant clauses and subclauses of other parts.

When lower subclauses of other parts are not listed, provisions of higher subclauses apply to the lower subclauses.

Table 1 – Levels of performance [IEC 62888-1:2018, Table 1]

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 by 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 by 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.	<ul style="list-style-type: none"> – Based on users requests. – Both measuring performance and service conditions can be less severe than Level 1. <p>Power and energy are calculated based on voltage and current data acquired from existing sensors installed in converter systems, etc.</p>

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 60044-8, *Instrument transformers – Part 8: Electronic current transformers*

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IEC 60850:2014, *Railway applications – Supply voltages of traction systems*

IEC 61287-1, *Railway applications – Power converters installed on board rolling stock – Part 1: Characteristics and test methods*

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

IEC 62313:2009, *Railway applications – Power supply and rolling stock – Technical criteria for the coordination between power supply (substation) and rolling stock*

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

IEC 62625-1, *Electronic railway equipment – On board driving data recording system – Part 1: System specification*

IEC 62888-1:2018, *Railway applications – Energy measurement on board trains – Part 1: General*

IEC 62888-2:2018, *Railway applications – Energy measurement on board trains – Part 2: Energy measurement*

IEC 62888-3:2018, *Railway applications – Energy measurement on board trains – Part 3: Data handling*

IEC 62888-4:2018, *Railway applications – Energy measurement on board trains – Part 4: Communication*

IEC 62888-5:2018, *Railway applications – Energy measurement on board trains – Part 5: Conformance test*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62888 (all parts) and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
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3.1.1

involved party

entity that is involved in designing, manufacturing, supplying and/or using the EMS or parts/components of the EMS

Note 1 to entry: Involved party can be a purchaser, supplier, manufacturer or user. Members of involved parties do not necessarily consist of all of them. Members of the involved parties depend on the provisions of subclauses in this document and are appropriately interpreted.

3.2 Abbreviated terms

CEMD	Compiled Energy Measured Data
CL	Contact Line
CMF	Current Measurement Function
DCS	Data Collection Service
DHS	Data Handling System
DSI	Data Handling System to service Interface
ECF	Energy Calculation Function
EMDI	EMF to DHS Interface
EMF	Energy Measurement Function
EMS	Energy Measurement System
ESI	Energy Measuring Function to service Interface
MCF	Mobile Communication Function
PF	Power Factor
PICS	Protocol Implementation Conformity Statement
PIXIT	Protocol Implementation Extra Information for Testing
RAMS	Reliability, Availability, Maintainability and Safety
TCN	Train Communication Network
TRP	Time Reference Period
UTC	Coordinated Universal Time
VEI	VMF/CMF to ECF interface
VMF	Voltage Measurement Function

3.3 Symbols

f_n	rated frequency
$I_{CMF,cth}$	rated continuous thermal current
$I_{CMF,dyn}$	rated dynamic current
$I_{CMF,th}$	rated short-time thermal current
$I_{n,CMF}$	rated primary current of the CMF
$I_{n,ECF}$	rated primary current of the ECF
$I_{n,EMF}$	rated primary current of the EMF
$t_{s,r}$	response time
U_{max2}	highest non permanent voltage according to IEC 60850
U_{max3}	highest long term overvoltage according to IEC 60850
U_{min1}	lowest permanent voltage according to IEC 60850
U_{min2}	lowest non permanent voltage according to IEC 60850
$U_{n,VMF}$	rated primary voltage of the VMF
ε_{CMF}	maximum percentage (ratio) error allowed in accordance with the selected accuracy class for the CMF
ε_{ECF}	maximum percentage error allowed in accordance with the selected accuracy class for the ECF
ε_{VMF}	maximum percentage (ratio) error allowed in accordance with the selected accuracy class for the VMF

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4 Requirements

[IEC 62888-6:2019](#)

4.1 General <https://standards.iteh.ai/catalog/standards/sist/9f9752a2-937c-494c-9b17-cf8add2d48b4/iec-62888-6-2019>

4.1.1 Overview

The requirements specified in this document apply only in applications not related to billing. These requirements supplement and/or amend the requirements specified in IEC 62888-1 to IEC 62888-5. Individual permissions and requirements applicable to Level 2 and Level 3 are specified in this document. Clauses not mentioned in this document are covered by IEC 62888-1 to IEC 62888-5.

The differences between Level 1, Level 2 and Level 3 are summarized in Annex C.

4.1.2 Applications and usage

At present the traction equipment and the auxiliary equipment onboard are mainly controlled by microcomputers installed in the control units. These equipments are equipped with voltage and current sensors. They can calculate energy using these data.

Using these existing infrastructures can make a convenient energy measurement system on board.

The data obtained by these systems may be used in applications other than billing purposes.

For these various purposes EMS functions may be different from Level 1.

Level 2 is applied to the following applications: