

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Railway applications – Energy measurement on board trains –
Part 4: Communication**

**Applications ferroviaires – Mesure d'énergie à bord des trains –
Partie 4: Communications**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2018 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Railway applications – Energy measurement on board trains –
Part 4: Communication**

**Applications ferroviaires – Mesure d'énergie à bord des trains –
Partie 4: Communications**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 45.060.01

ISBN 978-2-8322-5097-6

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and abbreviated terms	11
3.1 Terms and definitions.....	11
3.2 Abbreviated terms.....	16
4 General	17
4.1 Overview.....	17
4.2 On board communication subsystem.....	17
4.2.1 General	17
4.2.2 Communication protocols stack	20
4.2.3 Communication security.....	21
4.2.4 VMF/CMF to ECF Interface (VEI).....	22
4.2.5 EMF to DHS interface (EMDI).....	22
4.2.6 Maintenance/testing interfaces (DSI and ESI).....	22
4.2.7 DHS to location function	23
4.2.8 DHS to UTC source	23
4.2.9 DHS to Consist Network digital interface (CNI)	24
4.3 On board to ground communication subsystem.....	24
4.4 Access security.....	25
5 Conformance test	25
5.1 General.....	25
5.1.1 Overview	25
5.1.2 Applicability	26
5.1.3 Methodology.....	26
5.2 PICS and PIXIT	26
5.2.1 General	26
5.2.2 PICS.....	26
5.2.3 PIXIT.....	26
5.3 Design review.....	27
5.4 Type test procedure.....	27
5.4.1 General.....	27
5.4.2 Testing the communication	27
5.4.3 Testing the on board interfaces	27
5.4.4 Testing the on board to ground interface	29
Annex A (normative) On board to ground communication preferred solution.....	31
A.1 Communication services	31
A.1.1 General	31
A.1.2 Communication general architecture.....	31
A.1.3 General requirements	32
A.1.4 Communication services specification.....	34
A.1.5 Application services specification	34
A.2 EMS data transfer.....	35
A.2.1 CEMD transmission record format	35
A.2.2 CRC calculation and verification	38

A.2.3	CEMD file structure	39
A.2.4	Transferred data file XML schema	40
A.3	Access security	40
Annex B (informative)	VEI–VMF/CMF to ECF interface implementation example.....	41
B.1	General.....	41
B.2	Payload format.....	41
B.3	Encryption	42
Annex C (informative)	PICS structure and instruction.....	43
C.1	Structure.....	43
C.2	Instructions for completing the PICS pro-forma	43
C.2.1	PICS table structure	43
C.2.2	Abbreviations used in PICS	43
C.2.3	Ref. column	44
C.2.4	Subclause column	44
C.2.5	Capability column	44
C.2.6	Requirement column.....	44
C.2.7	Implementation column.....	44
C.2.8	Parameter values column	45
C.3	PICS pro-forma examples	45
C.3.1	Identification of PICS.....	45
C.3.2	Identification of the implementation under assessment.....	45
C.3.3	Identification of the IUA supplier	46
C.3.4	Identification of the standards.....	46
C.3.5	Global statement of conformity	47
C.3.6	Level of conformity	47
Annex D (informative)	Access security	48
Bibliography.....		49
Figure 1	– EMS functional structure and dataflow diagram	9
Figure 2	– Example of energy index value.....	13
Figure 3	– Communication interface between function/sub-function	18
Figure 4	– EMS block diagram and interfaces	19
Figure 5	– Preferred solution stack for on board to ground communication stack	25
Figure 6	– Test bench for on board interface.....	28
Figure 7	– On board to ground test bench 1	29
Figure 8	– On board to ground test bench 2	29
Figure A.1	– Communication components	31
Figure B.1	– Payload format	41
Table 1	– Example list of protocol stacks	20
Table A.1	– Preferred solution communication services	34
Table A.2	– Preferred solution application services	35
Table A.3	– Record format	37
Table C.1	– PICS table format	43
Table C.2	– PICS identification table.....	45
Table C.3	– IUA identification table	46

Table C.4 – IUA supplier identification table.....	46
Table C.5 – Applicable standards identification table	47
Table C.6 – Global statement table	47
Table C.7 – Level of conformity	47

Currently in preview, click buy full version

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 4: Communication

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, accept IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62888-4 has been prepared by technical committee 9: Electrical equipment and systems for railways.

This standard is based on EN 50463.

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

FDIS	Report on voting
9/2323/FDIS	9/2334/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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

This part is Part 4 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.

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 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.

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.

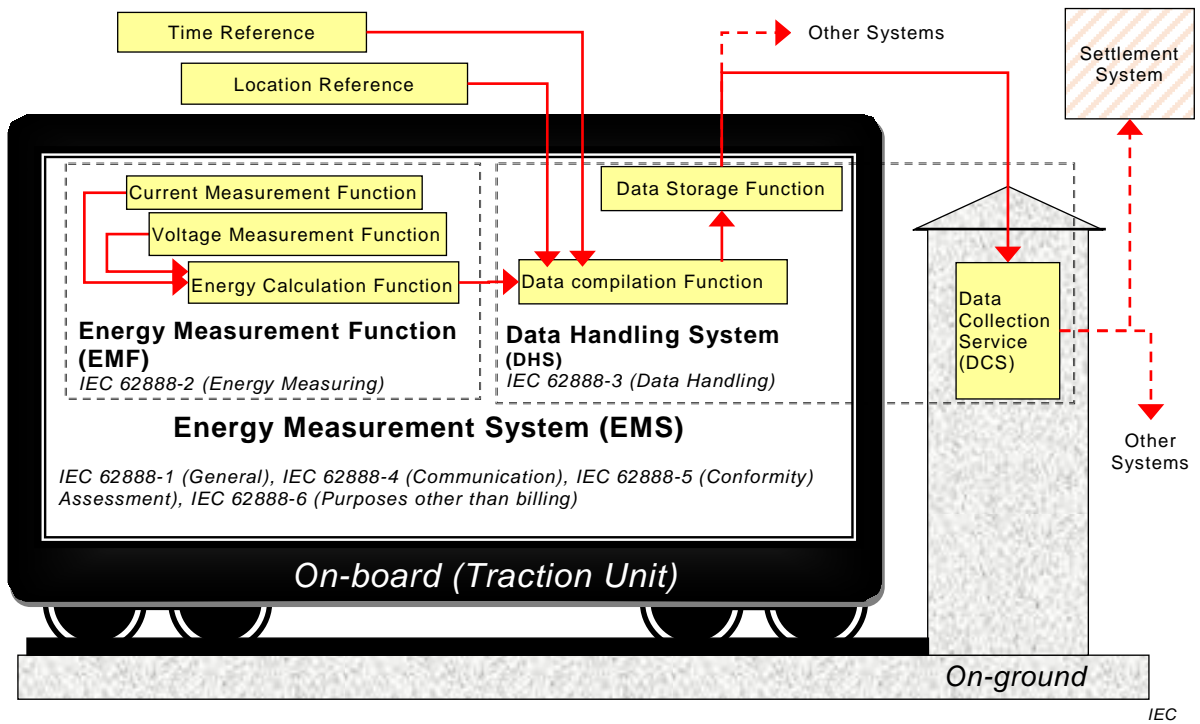


Figure 1 – EMS functional structure and dataflow diagram

RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 4: Communication

1 Scope

This part of IEC 62888 applies to the on board and on board to ground communication services, i.e. it covers the data communication using digital interfaces:

- a) between functions implemented within the EMS;
- b) between EMS function and other on board subsystems;
- c) between EMS and ground communication services.

The on board data communication services of the EMS cover the data exchange between functions of the EMS and the data exchange between EMS and other on board units, where data is exchanged using a communications protocol stack over a dedicated physical interface or a shared communication network.

The on board to ground communication services cover the wireless data communication between the DHS and the on ground server. Furthermore, this document includes conformance test requirements.

Specific requirements for EMS Level 2 and Level 3 are specified in IEC 62888-6.

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 60870-5 (all parts), *Telecontrol equipment and systems – Part 5: Transmission protocols*

IEC 61158-2, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61375 (all parts), *Electronic railway equipment – Train communication network (TCN)*

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