IEC 62052-41

Edition 1.0 2022-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment – General requirements, tests and test conditions –
Part 41: Energy registration methods and requirements for multi-energy and multi-rate meters

Équipement de comptage de l'électricité – Exigences générales, essais et conditions d'essai –
Partie 41: Méthodes d'enregistrement de l'énergie et exigences relatives aux compteurs à tarifs multiples et aux compteurs à énergies multiples

IEC 62052-41:2022-10(en-fr)

IEC Secretariat
3, rue de Varembé
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 corrigendum or an amendment might have been published.

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

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 une fois par mois par email.

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.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 62052-41

Edition 1.0 2022-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment – General requirements, tests and test conditions –
Part 41: Energy registration methods and requirements for multi-energy and multi-rate meters

Équipement de comptage de l'électricité – Exigences générales, essais et conditions d'essai –
Partie 41: Méthodes d'enregistrement de l'énergie et exigences relatives aux compteurs à tarifs multiples et aux compteurs à énergies multiples

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.220.20

ISBN 978-2-8322-5813-2

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ELECTRICITY METERING EQUIPMENT – GENERAL REQUIREMENTS, TESTS AND TEST CONDITIONS –

Part 41: Energy registration methods and requirements for multi-energy and multi-rate meters

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, access to 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.

IEC 62052-41 has been prepared by IEC technical committee 13: Electrical energy measurement and control. It is an International Standard.

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

Draft	Report on voting
13/1869/FDIS	13/1873/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all parts in the IEC 62052 series, published under the general title *Electricity metering equipment – General requirements, tests and test conditions*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 2 years from the date of publication.

INTRODUCTION

IEC 62052 series and IEC 62053 series define the physical, safety and metrological aspects of electricity meters. This document defines the requirements for multi-energy and multi-rate meters.

This part of IEC 62052 is to be used with relevant parts of the IEC 62052, IEC 62053, IEC 62055-31, IEC 62058 and IEC 62059 series:

IEC 62052-11:2020, *Electricity metering equipment – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62052-31:2015, *Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 31: Product safety requirements and tests*

IEC 62053-11: 2003/AMD1:2016, *Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2)*

IEC 62053-21:2020, *Electricity metering equipment – Particular requirements – Part 21: Static meters for AC active energy (classes 0,5, 1 and 2)*

IEC 62053-22:2020, *Electricity metering equipment – Particular requirements – Part 22: Static meters for AC active energy (classes 0,1 S, 0,2 S and 0,5 S)*

IEC 62053-23:2020, *Electricity metering equipment – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)*

IEC 62053-24:2020, *Electricity metering equipment – Particular requirements – Part 24: Static meters for fundamental component reactive energy (classes 0,5 S, 1 S, 1, 2 and 3)*

IEC 62053-41:2021, *Electricity metering equipment – Particular requirements – Part 41: Static meters for DC energy (classes 0,5 and 1)*

IEC 62055-31:2022, *Electricity metering – Payment systems – Part 31: Particular requirements – Static payment meters for active energy (classes 0,5, 1 and 2)*

IEC 62058-11:2008, *Electricity metering equipment (AC) – Acceptance inspection – Part 11: General acceptance inspection methods*

IEC 62058-21:2008, *Electricity metering equipment (AC) – Acceptance inspection – Part 21: Particular requirements for electromechanical meters for active energy (classes 0,5, 1 and 2)*

IEC 62058-31:2008, *Electricity metering equipment (AC) – Acceptance inspection – Part 31: Particular requirements for static meters for active energy (classes 0,2 S, 0,5 S, 1 and 2)*

IEC TR 62059-11:2002, *Electricity metering equipment – Dependability – Part 11: General concepts*

IEC TR 62059-21:2002, *Electricity metering equipment – Dependability – Part 21: Collection of meter dependability data from the field*

IEC 62059-32-1:2011, *Electricity metering equipment – Dependability – Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature*

This part of IEC 62052 is a standard for type testing electricity meters. This document is intended to be used in conjunction with the relevant parts of IEC 62052, IEC 62053 and IEC 62055-31. When any requirement in this document concerns an item already covered in the relevant parts of IEC 62052, IEC 62053 and IEC 62055-31, the requirements of this document take precedence.

The test levels are regarded as minimum values that provide for the proper functioning of the meter under normal working conditions. For special application, other test levels might be necessary and should be agreed on between the manufacturer and the purchaser.

ELECTRICITY METERING EQUIPMENT – GENERAL REQUIREMENTS, TESTS AND TEST CONDITIONS –

Part 41: Energy registration methods and requirements for multi-energy and multi-rate meters

1 Scope

This part of IEC 62052 applies only to newly manufactured multi-energy and/or multi-rate static meters and it applies to their type tests only.

NOTE 1 For other general requirements, such as electrical, mechanical, safety, marking, dependability, etc., see the relevant parts of IEC 62052 or IEC 62059. For accuracy requirements and other requirements specific to class indices, see the relevant parts of IEC 62053.

This document applies to electricity metering equipment designed to:

- measure and control electrical energy on networks with voltage up to 1 000 V AC, or 1 500 V DC;

NOTE 2 For AC electricity meters, the voltage mentioned above is the line-to-neutral voltage derived from nominal voltages. See IEC 62052-31:2015, Table 7.

NOTE 3 For meters designed for operation with LPITs, only the metering unit is considered a low voltage device. If the LPITs are rated for voltages exceeding 1 000 V AC, or 1 500 V DC, the combination of the metering unit and LPITs is not a low voltage device.

- have all functional elements, including add-on modules, enclosed in, or forming a single meter case with exception of indicating displays;
- operate with integrated displays;
- operate with detached indicating displays, or without an indicating display;
- be installed in a specified matching socket or rack;
- optionally, provide additional functions other than those for measurement of electrical energy.

Meters designed for operation with Low Power Instrument Transformers (LPITs as defined in the IEC 61869 series) may be tested for compliance with this document and the relevant IEC 62053 series documents only if such meters and their LPITs are tested together as directly connected meters.

NOTE 4 Modern electricity meters typically contain additional functions such as measurement of voltage magnitude, current magnitude, power, frequency, power factor, etc.; measurement of power quality parameters; load control functions; delivery, time, test, accounting, recording functions; data communication interfaces and associated data security functions. The relevant standards for these functions may apply in addition to the requirements of this document. However, the requirements for such functions are outside the scope of this document.

NOTE 5 Product requirements for power monitoring devices and measurement functions such as voltage magnitude, current magnitude, power, frequency, etc., are covered in IEC 61557-12:2018. However, devices compliant with IEC 61557-12:2018 are not intended to be used as billing meters, unless they are also compliant with IEC 62052-11 and relevant IEC 62053-xx accuracy class standards.

NOTE 6 Product requirements for power quality monitoring instruments are covered in IEC 62586-1:2017. Requirements for power quality measurement techniques (functions) are covered in IEC 61000-4-30:2015. Requirements for testing of the power quality measurement functions are covered in IEC 62586-2:2017.

This document does not apply to:

- meters for which the line-to-neutral voltage derived from nominal voltages exceeds 1 000 V AC, or 1 500 V DC;
- meters intended for connection with low power instrument transformers (LPITs as defined in the IEC 61869 series of standards) when tested without such transformers;
- metering systems comprising multiple devices (except for LPITs) physically remote from one another;
- portable meters;

NOTE 7 Portable meters are meters that are not permanently connected.

- meters used in rolling stock, vehicles, ships and airplanes;
- laboratory and meter test equipment;
- reference standard meters;

NOTE 8 Nominal values, accuracy classes, requirements and test methods for reference standard meters are specified in IEC 62057-1 (First edition under preparation. Stage at the time of publication: IEC FDIS 62057-1:2022).

- data interfaces to the register of the meter;
- matching sockets or racks used for installation of electricity metering equipment.

This document does not cover measures for the detection and prevention of fraudulent attempts to compromise a meter's performance (tampering).

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 62052-11:2020, *Electricity metering equipment – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62053-21:2020, *Electricity metering equipment – Particular requirements – Part 21: Static meters for AC active energy (classes 0,5, 1 and 2)*

IEC 62053-22:2020, *Electricity metering equipment – Particular requirements – Part 22: Static meters for AC active energy (classes 0,1 S, 0,2 S and 0,5 S)*

IEC 62053-23:2020, *Electricity metering equipment – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)*

IEC 62053-24:2020, *Electricity metering equipment – Particular requirements – Part 24: Static meters for fundamental component reactive energy (classes 0,5 S, 1 S, 1, 2 and 3)*

IEC 62053-41:2021, *Electricity metering equipment – Particular requirements – Part 41: Static meters for DC energy (classes 0,5 and 1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62052-11:2020, as well as 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/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Definitions related to energy meters

3.1.1
energy meter
instrument intended to measure electrical energy by integrating power with respect to time

[SOURCE: IEC 60050-300:2001, 313-01-35]

3.1.2
bidirectional meter
energy meter measuring energy flow in both directions

Note 1 to entry: For instance, energy received at the measuring point (for example import) and energy supplied at the same measuring point (for example export).

3.1.3
multi-energy meter
energy meter which, in a single case, measures two or more types of electrical energy

Note 1 to entry: The electrical energy may include active energy, reactive energy or apparent energy.

3.1.4
multi-function meter
energy meter which, in a single case, incorporates other functions in addition to the energy measurement functions

Note 1 to entry: Multi-function meters may include: maximum demand indicator, time switches, ripple control or radio receivers, pulse output devices, power monitoring functions, power quality functions, input-output control functions, communication function, etc.

3.1.5
multi-rate meter
energy meter provided with multiple registers, each becoming operative as defined by a tariff schedule

Note 1 to entry: A tariff schedule could be held in the meter, operated on a time basis or a consumption basis, or operated by external control signals.

[SOURCE: IEC 60050-300:2001, 313-06-09, modified to be better adapted to metering and note added.]

3.2 Definitions related to energy registers

3.2.1
cumulative energy register
quantity of energy registered (active energy, reactive energy or apparent energy) over a period of time or all the time

3.2.2
delta energy register
quantity of energy registered (active energy, reactive energy or apparent energy) over a period of time or all the time starting with the last activation of the register

3.2.3
total energy register
quantity of energy registered (active energy, reactive energy or apparent energy) over all the time

Note 1 to entry: Total energy registers are normally cumulative registers.

3.2.4
rate energy register
quantity of energy registered (active energy, reactive energy or apparent energy) during certain time periods of a day

Note 1 to entry: Rate registers are normally cumulative registers.

3.3 Definitions related to demand

3.3.1
demand
average value of power over an integration period

Note 1 to entry: Demand is calculated by dividing the energy registered during the integration period by the length of the integration period.

3.3.2
demand integration period
interval of time of an hour [half-hour] [quarter-hour], etc., over which the registered electrical energy is integrated in order to determine the average hourly [half-hourly] [quarter-hourly], etc., demand

EXAMPLE: 15 min, 30 min.

Note 1 to entry: Each demand integration period shall be of the same duration and one of which shall finish at 00:00 hours.

Note 2 to entry: Other methods for demand calculation are possible but are not covered in this document.

3.3.3
maximum demand
highest registered demand during a specific period, e.g. a billing period

3.4 Definitions related to interval data

3.4.1
profile
organized collection of historical values in one or more channels at regular specified intervals

3.4.2
channel
input or a register for raw data in a physical or logical electricity meter, used to measure energy from different sources, to be identified and handled separately

3.4.3
objects
organized collection of all status information (time stamp + profile status) and registers in a profile, organized in channels and entries

3.4.4
load profile
profile that stores a series of objects on one or more channels at regular, specified intervals

Note 1 to entry: Objects in the channel can be status information (status registers: date / time of data capturing, profile status) and cumulative, delta, total, and rate energy registers and/or demand registers.

Note 2 to entry: A set of objects are stored at every end of the specified interval in an entry of the profile.

3.4.5
billing period
time between consecutive billing dates, nominally in months (e.g. one, three or six months), but periods of days may also be required (e.g. 28, 31, 60, 89, 90, 91)

4 Standard electrical values

The requirements of IEC 62052-11:2020 and the relevant parts of IEC 62053 apply.

5 Construction requirements

5.1 General

The requirements of IEC 62052-11:2020 apply.

5.2 Maximum demand reset mechanism

These requirements are applicable to an electricity meter that supports maximum demand measurement.

The meter shall maintain a register that contains the maximum demand over a billing period.

A feature shall exist to manually, or through a communication interface or automatically reset the maximum demand registers at the end of the billing period.

When the maximum demand reset is performed, a reset event shall be logged.

The manual reset mechanism shall be sealable with a mechanical seal.

6 Meter marking and documentation

The requirements of IEC 62052-11:2020 apply.

7 Accuracy requirements

The requirements of the relevant parts of IEC 62053 apply. Additional accuracy requirements are stated in Clause 8.

8 Multi-energy and multi-rate meters

8.1 General

The requirements as listed below may be applicable to an electricity meter that supports all functionalities or a combination thereof.

8.2 Overview

Multi-rate meters are able to measure and record data in different registers, each becoming operative at specified time intervals corresponding to different tariffs. The rates can be applied to a single quantity or multiple quantities (active, reactive, apparent energy or maximum demand).

These values are recorded in cumulative, delta, total, and rate energy registers and/or demand registers and can also be recorded in interval data (load profile data). Electricity registered is either derived through reading energy registers or by reading and totalising interval data via appropriate software systems.

Tests shall be done on the energy and demand variables supported by the multi-energy and multi-rate meter. For multi-energy meters energy testing shall include tests on import and export active energy and reactive energy on all four quadrants. Demand testing shall include tests on active and apparent demand in the import and export direction.

Additional energy and demand variable testing as agreed between the user and manufacturer may be stipulated.

The manufacturer shall provide to the testing laboratory any software tools which may be required to test the energy and demand variables supported by the meter.

For testing purposes it shall be possible for the testing laboratory to read not only the meter's registers via communication ports but also to activate or deactivate the applicable registers in order to test the variables agreed upon. It shall also be possible to specify time intervals corresponding to different tariffs.

8.3 Energy calculation methods – Calculation methods for active energy in multi-phase systems

NOTE 1 This subclause does not apply to DC meters covered by IEC 62053-41.

NOTE 2 Calculation methods for reactive energy are not covered in this version of the document.

Electricity meters designed and intended to be used on multiple phase systems may offer different computation methods for aggregating the measurement values of the different phases in order to support different measurement needs at unbalanced load conditions or when import and export energy flows are present simultaneously in different phases.

The following computation methods can be used for active power in electricity meters:

a) Vectorial computation method:

   The signed product of voltage, current and power factor of the different phases are summed in the aggregate value.

$$P = \sum_{i=1}^{n} P_i$$

   Depending on the sign of the aggregated value the measured active power P should be registered as import active power if it is positive ($P \geq 0$):

$$P_{\text{import}} = P$$

   or it shall be registered as export value if it is negative ($P < 0$):

$$P_{\text{export}} = P$$

b) Algebraic computation method:

The computation of the import aggregate value only includes the import phase values:

$$P_{\text{import}} = \sum_{i=1}^{n} P_i, \text{ for } P_i > 0$$

The computation of the export aggregate value only includes the export phase values:

$$P_{\text{export}} = \sum_{i=1}^{n} P_i, \text{ for } P_i < 0$$

c) Absolute computation method:

The absolute values of the product of voltage, current and power factor of the different phases are summed in the aggregate value:

$$P = \sum_{i=1}^{n} |P_i|$$

It is desired that a register different to P_{import} and P_{export} is used for the value aggregated by the absolute computation method. If this register is not available, P_{import} shall show the aggregated P while register P_{export} shall be set to zero.

$$P_{\text{import}} = P, \quad P_{\text{export}} = 0$$

NOTE 3 The absolute computation method is used to prevent tampering in changing the phase polarity on the meter's terminals (typically implemented in pre-paid meters).

Manufacturers may elaborate and select other computation methods to be used for aggregating energy values measured at different phases that shall be clearly described in the technical documentation of the device. The specific computation method shall be clearly indicated and shall be distinguished from the ones listed above.

The electricity meter may offer one or more simultaneous computation methods at the same time. If the meter offers simultaneous calculation methods the result of the different calculation methods shall be stored in different registers.

In addition to the aggregated power and energy values, values per phase can also be stored and displayed in the meter.

8.4 Registers

8.4.1 General

The meter continuously measures and records various metering parameters and stores their values in a suitable set of local registers for a predetermined period of time.

8.4.2 Energy registers

The errors between the cumulative total energy registers and the reference standard values for the same energy quantity shall conform to the values as listed in the relevant IEC 62053-21/22/23/24:2020 accuracy class standards under Table 3 – Acceptable percentage error limits (single-phase meters and poly-phase meters with balanced loads or single-phase loads) and IEC 62053-41:2021 for DC meters under Table 4 - Acceptable percentage error limits.

The differences between the cumulative total energy registers and the rate energy registers for the same energy quantity shall not exceed 1/10th of the values as listed in the relevant IEC 62053 xx21/22/23/24:2020 accuracy class standards for AC meters under Table 3 – Acceptable (percentage) error limits (single-phase meters and poly-phase meters with balanced loads or single-phase loads) and IEC 62053-41:2021 for DC meters under Table 4 - Acceptable percentage error limits. The requirement is applicable for currents equal to or larger than 0,5 I_{max}.