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**Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance –
Part 1: Grid connected systems – Documentation, commissioning tests and inspection**

[IEC 62446-1:2016](#)

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Systèmes photovoltaïques (PV) – Exigences pour les essais, la documentation et la maintenance –

Partie 1: Systèmes connectés au réseau électrique – Documentation, essais de mise en service et examen



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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC (PV) SYSTEMS – REQUIREMENTS FOR TESTING,
DOCUMENTATION AND MAINTENANCE –****Part 1: Grid connected systems – Documentation,
commissioning tests and inspection**

FOREWORD

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International Standard IEC 62446-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This first edition cancels and replaces IEC 62446 published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to IEC 62446:2009:

- the scope has been expanded to include a wider range of system test and inspection regimes to encompass larger and more complex PV systems.

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

FDIS	Report on voting
82/1036/FDIS	82/1056A/RVD

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

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

A list of all parts in the IEC 62446 series, published under the general title *Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance*, can be found on the IEC website.

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

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INTRODUCTION

Grid connected PV systems are expected to have a lifetime of decades, with maintenance or modifications likely at some point over this period. Building or electrical works in the vicinity of the PV array are very likely, for example roof works adjacent to the array or modifications (structural or electrical) to a home that has a PV system. The ownership of a system may also change over time, particularly for systems mounted on buildings. Only by the provision of adequate documentation at the outset can the long term performance and safety of the PV system and works, on or adjacent to the PV system, be ensured.

This part of IEC 62446 is split into two sections:

- **System documentation requirements** – This section details the information that shall be provided within the documentation provided to the customer following installation of a grid connected PV system.
- **Verification** – This section provides the information expected to be provided following initial (or periodic) verification of an installed system. It includes requirements for inspection and testing.

This part of IEC 62446 references IEC TS 62548:2013, which is in the process of being converted into an International Standard. It is envisaged that work on the second edition of IEC 62446-1 will start when IEC 62548 is completed.

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PHOTOVOLTAIC (PV) SYSTEMS – REQUIREMENTS FOR TESTING, DOCUMENTATION AND MAINTENANCE –

Part 1: Grid connected systems – Documentation, commissioning tests and inspection

1 Scope

This part of IEC 62446 defines the information and documentation required to be handed over to a customer following the installation of a grid connected PV system. It also describes the commissioning tests, inspection criteria and documentation expected to verify the safe installation and correct operation of the system. It can also be used for periodic retesting.

This part of IEC 62446 is written for grid connected PV systems that do not utilize energy storage (e.g. batteries) or hybrid systems.

This part of IEC 62446 is for use by system designers and installers of grid connected solar PV systems as a template to provide effective documentation to a customer. By detailing the expected commissioning tests and inspection criteria, it is also intended to assist in the verification/inspection of a grid connected PV system after installation and for subsequent re-inspection, maintenance or modifications.

This part of IEC 62446 defines the different test regimes expected for different solar PV system types to ensure that the test regime applied is appropriate to the scale, type and complexity of the system in question. [IEC 62446-1:2016](https://standards.iteh.ai/catalog/standards/sist/3f2bbcf-b79d-40c8-b45f-189131cb414/iec-62446-1-2016)

NOTE This part of IEC 62446 does not address CPV (concentrating PV) systems, however many of the parts may apply.

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.

IEC 60364-6, *Low-voltage electrical installations – Part 6: Verification*

IEC TS 62548:2013, *Photovoltaic (PV) arrays – Design requirements*

IEC 61730 (all parts), *Photovoltaic (PV) module safety qualification*

IEC 61557 (all parts), *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures*

IEC 61010 (all parts), *Safety requirements for electrical equipment for measurement, control, and laboratory use*

3 Terms and definitions

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

3.1**AC module**

PV module with an integrated inverter in which the electrical terminals are AC only

3.2**cable type**

description of a cable to enable its rating and suitability for a particular use or environment to be determined

Note 1 to entry: In many countries this is done via a code number (eg "H07RNF").

3.3**data sheet**

basic product description and specification

Note 1 to entry: Typically one or two pages. Not a full product manual.

3.4**inspection**

examination of an electrical installation using all the senses in order to ascertain correct selection and proper erection of electrical equipment

3.5**inverter**

electric energy converter that changes direct electric current to single-phase or polyphase alternating current

3.6**micro inverter**

small inverter designed to be connected directly to one or two PV modules.

Note 1 to entry: A micro inverter will normally connect directly to the factory fitted module leads and be fixed to the module frame or mounted immediately adjacent to the module.

3.7**module integrated electronics**

any electronic device fitted to a PV module intended to provide control, monitoring or power conversion functions

Note 1 to entry: Module integrated electronics may be factory fitted or assembled on site.

3.8**PV array**

assembly of electrically interconnected PV modules, PV strings or PV sub-arrays.

3.9**PV cell**

most elementary device that exhibits the photovoltaic effect, i.e the direct non-thermal conversion of radiant energy into electrical energy

3.10**PV module**

smallest complete environmentally protected assembly of interconnected PV cells

3.11**PV string**

circuit of one or more series-connected PV modules

3.12**PV string combiner box**

junction box where PV strings are connected which may also contain overcurrent protection devices, electronics and/or switch-disconnectors

3.13 **$I_{MOD_MAX_OCPR}$**

PV module maximum overcurrent protection rating determined by IEC 61730-2

Note 1 to entry: This is often specified by module manufacturers as the maximum series fuse rating.

3.14**reporting**

recording of the results of inspection and testing

3.15**testing**

implementation of measures in an electrical installation by means of which its effectiveness is proved

Note 1 to entry: It includes ascertaining values by means of appropriate measuring instruments, said values not being detectable by inspection.

3.16**verification**

all measures by means of which compliance of the electrical installation to the relevant standards is checked

Note 1 to entry: It comprises inspection, testing and reporting.

4 System documentation requirements**4.1 General**

The purpose of Clause 4 is to list the minimum documentation that should be provided following the installation of a grid connected PV system. This information will ensure key system data is readily available to a customer, inspector or maintenance engineer. The documentation includes basic system data and the information expected to be provided in the operation and maintenance manual.

4.2 System data**4.2.1 Basic system information**

As a minimum, the following basic system information shall be provided. This “nameplate” information would typically be presented on the cover page of the system documentation pack.

- a) Project identification reference (where applicable).
- b) Rated (nameplate) system power (kW DC or kVA AC).
- c) PV modules and inverters – manufacturer, model and quantity.
- d) Installation date.
- e) Commissioning date.
- f) Customer name.
- g) Site address.

4.2.2 System designer information

As a minimum, the following information shall be provided for all bodies responsible for the design of the system. Where more than one company has responsibility for the design of the system, the following information should be provided for all companies together with a description of their role in the project.

- a) System designer, company.
- b) System designer, contact person.
- c) System designer, postal address, telephone number and e-mail address.

4.2.3 System installer information

As a minimum, the following information shall be provided for all bodies responsible for the installation of the system. Where more than one company has responsibility for the installation of the system, the following information should be provided for all companies together with a description of their role in the project.

- a) System installer, company.
- b) System installer, contact person.
- c) System installer, postal address, telephone number and e-mail address.

4.3 Wiring diagram

4.3.1 General

As a minimum, a single line wiring diagram shall be provided. This diagram shall be annotated to include the information detailed in 4.3.2 to 4.3.6.

In general, it is expected that this information will be presented as annotations to the single line wiring diagram. In some circumstances, typically for larger systems where space on the diagram may be limited, this information may be presented in table form.

4.3.2 Array – General specifications

The wiring diagram or system specification shall include the following array design information.

- a) Module type(s).
- b) Total number of modules.
- c) Number of strings.
- d) Number of modules per string.
- e) Identify which strings connect to which inverter.

Where an array is split into sub-arrays, the wiring diagram shall show the array – sub-array design and include all of the above information for each sub-array.

4.3.3 PV string information

The wiring diagram or system specification shall include the following PV string information.

- a) String cable specifications – size and type.
- b) String overcurrent protective device specifications (where fitted) – type and voltage/current ratings.
- c) Blocking diode type (if relevant).

4.3.4 Array electrical details

The wiring diagram or system specification shall include the following array electrical information (where fitted).

- a) Array main cable specifications – size and type.
- b) Array junction box / combiner box locations.
- c) DC switch disconnecter, location and rating (voltage / current).
- d) Array overcurrent protective devices – type, location and rating (voltage / current).
- e) Other array electronic protective circuitry (such as arc fault detection), if applicable – type, location and rating.

4.3.5 AC system

The wiring diagram or system specification shall include the following AC system information.

- a) AC isolator location, type and rating.
- b) AC overcurrent protective device location, type and rating.
- c) Residual current device location, type and rating (where fitted).

4.3.6 Earthing and overvoltage protection

The wiring diagram or system specification shall include the following earthing and overvoltage protection information.

- a) Details of all earth / bonding conductors – size and type. Including details of array frame equipotential bonding cable where fitted.
- b) Details of any connections to an existing Lightning Protection System (LPS).
- c) Details of any surge protection device installed (both on AC and DC lines) to include location, type and rating.

4.4 String layout

For systems with three or more strings, a layout drawing of the PV system showing how the array is split and connected into strings shall be provided.

NOTE This is particularly useful for finding faults in larger systems and on building mounted arrays where access to the rear of the modules is difficult.

4.5 Datasheets

As a minimum, datasheets shall be provided for the following system components.

- a) Module datasheet for all types of modules used in system – to the requirements of IEC 61730-1.
- b) Inverter datasheet for all types of inverters used in system.

The provision of datasheets for other significant system components should also be considered.

4.6 Mechanical design information

A data sheet for the array mounting system shall be provided. If the mounting structure was custom engineered, include the relevant documentation.

4.7 Emergency systems

Documentation of any emergency systems associated with the PV system (fire alarms, smoke alarms, etc). This information shall include both operation and design details.

4.8 Operation and maintenance information

Operation and maintenance information shall be provided and shall include, as a minimum, the following items:

- a) Procedures for verifying correct system operation.
- b) A checklist of what to do in case of a system failure.
- c) Emergency shutdown / isolation procedures.
- d) Maintenance and cleaning recommendations (mechanical, civil & electrical) – if any.
- e) Considerations for any future building works related to the PV array (e.g. roof works).
- f) Warranty documentation for PV modules and inverters – to include starting date of warranty and period of warranty.
- g) Documentation on any applicable workmanship or weather-tightness warranties.

4.9 Test results and commissioning data

Copies of all test and commissioning data shall be provided. As a minimum, these shall include the results from the verification tests detailed in Clause 5 of this standard.

5 Verification

5.1 General

Clause 5 provides the requirements for the initial and periodic verification of a grid connected PV electrical installation. It references IEC 60364-6 where appropriate and also details additional requirements or considerations.

Much of the verification of a grid connected PV system should be done with reference to IEC 60364-6, which provides the requirements for initial and periodic verification of any electrical installation.

Every installation of subsystems and components shall be verified with reference to IEC 60364-6 during erection, as far as reasonably practicable, and on completion, before being put into service by the user. Initial verification shall include comparison of the results with relevant criteria to confirm that the requirements of IEC 60364 have been met.

For an addition or alteration to an existing installation, it shall be verified that the addition or alteration complies with IEC 60364 and does not impair the safety of the existing installation.

Initial and periodic verifications shall be made by a skilled person, competent in verification.

NOTE 1 Typical verification test sheets are provided in Annexes A, B and C to this standard.

Initial verification takes place upon completion of a new installation or completion of additions or of alterations to existing installations. Periodic verification shall determine, as far as reasonably practicable, whether the installation and all its constituent equipment remain in a satisfactory condition for use.

For a PV system, the interval between verifications shall be no longer than that required by the AC electrical system that the PV system is connected to.

NOTE 2 In some countries the interval between verifications is stipulated by national regulations.