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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements

Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation – Partie 1: Exigences d'essai

IEC 61215-1:2016-03(en-fr)

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TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN QUALIFICATION AND TYPE APPROVAL –

Part 1: Test requirements

FOREWORD

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International Standard IEC 61215-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This first edition of IEC 61215-1 cancels and replaces the second edition of IEC 61215, published in 2005; it constitutes a technical revision.

This edition of IEC 61215-1 includes the following significant technical changes with respect to the second edition of IEC 61215:2005 and the second edition of IEC 61646:2008:

a) New standard series structure consistent with other IEC standards: Part 1 lists general requirements, Part 1-x specifics for each PV technology and Part 2 defines testing. All tests defined in Part 2 are MQTs (module quality tests).
b) Sampling procedure rewritten (Clause 4).
c) Marking requirements better defined for name plate and general documentation.

d) Pass/fail criteria have been divided into two “gates”. Gate No. 1 verifies the initial maximum power at STC with respect to name plate rating and Gate No. 2 defines the power loss during accelerated aging testing.

e) Revised hot-spot endurance test (MQT 09).

f) Update of the other tests to be consistent with changes in IEC 61646.

g) Removal of the method for measuring temperature coefficients and reference to IEC 60891.

h) Definition of NMOT as the nominal module operating temperature measured with the module under maximum power conditions.

i) Rewriting of the standard using NMOT instead of NOCT and reference to future IEC 61853-2 for the test procedure.

j) Rewriting of the robustness of termination test (MQT 14) to include evaluation of both cables and junction boxes.

k) Stabilization of PV modules implemented. This replaces either light soaking procedure from IEC 61646 or preconditioning from IEC 61215.

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

FDIS	Report on voting
82/1046/FDIS	82/1074/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.

A list of all parts in the IEC 61215 series, published under the general title *Terrestrial photovoltaic (PV) modules – Design qualification and type approval,* can be found on the IEC website.

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

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

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

INTRODUCTION

Whereas Part 1 of this standard series describes requirements (both in general and specific with respect to device technology), the sub-parts of Part 1 define technology variations and Part 2 defines a set of test procedures necessary for design qualification and type approval. The test procedures described in Part 2 are valid for all device technologies.

TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN QUALIFICATION AND TYPE APPROVAL –

Part 1: Test requirements

1 Scope and object

This part of IEC 61215 lays down IEC requirements for the design qualification and type approval of terrestrial photovoltaic (PV) modules suitable for long-term operation in general open-air climates, as defined in IEC 60721-2-1. This standard is intended to apply to all terrestrial flat plate module materials such as crystalline silicon module types as well as thin-film modules.

This standard does not apply to modules used with concentrated sunlight although it may be utilized for low concentrator modules (1 to 3 suns). For low concentration modules, all tests are performed using the current, voltage and power levels expected at the design concentration.

This standard does not address the particularities of PV modules with integrated electronics, it may however be used as a basis for testing such PV modules.

The objective of this test sequence is to determine the electrical and thermal characteristics of the module and to show, as far as possible within reasonable constraints of cost and time, that the module is capable of withstanding prolonged exposure in climates described in the scope. The actual lifetime expectancy of modules so qualified will depend on their design, their environment and the conditions under which they are operated.

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 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

IEC 60269-6, *Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems*

IEC 60891, *Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics*

IEC 60904-1, *Photovoltaic devices – Part 1: Measurement of photovoltaic current-voltage characteristics*

IEC 60904-3, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 60904-10, *Photovoltaic devices – Part 10: Methods of linearity measurement*

IEC 61215-2, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures*

IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC 61853-1, *Photovoltaic (PV) module performance testing and energy rating – Part 1: Irradiance and temperature performance measurements and power rating*

IEC 61853-2, *Photovoltaic (PV) module performance testing and energy rating – Part 2: Spectral response, incidence angle, and module operating temperature measurements*[1]

IEC TS 62915, *Photovoltaic (PV) modules – Retesting for type approval, design and safety qualification*[1]

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions in IEC 60050 and IEC 61836 apply, as well as the following.

3.1
bins of power classes
power (typically maximum power) sorting criteria from the PV module manufacturer

3.2
tolerances <on label>
value range of electrical parameters on the label of the PV module as given by the manufacturer

3.3
MQT
Module Quality Test

3.4
type approval
conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-581:2008, 581-21-08 – Type test]

3.5
reproducibility <of measurements>
closeness of agreement between the results of measurements of the same value of a quantity, when the individual measurements are made under different conditions of measurement:

– principle of measurement,
– method of measurement,
– observer,

[1] To be published.

– measuring instruments,
– reference standards,
– laboratory,
– under conditions of use of the instruments, different from those customarily used,

after intervals of time relatively long compared with the duration of a single measurement. [≈ VIM 3.7]

Note 1 to entry: The concepts of "principle of measurement" and "method of measurement" are respectively defined in VIM 2.3 and 2.4.

Note 2 to entry: The term "reproducibility" also applies to the instance where only certain of the above conditions are taken into account, provided that these are stated.

[SOURCE: IEC 60050-311:2001, 311-06-07]

4 Test samples

The PV module samples shall have been manufactured from specified materials and components in accordance with the relevant drawings and process sheets and have been subjected to the manufacturer's normal inspection, quality control and production acceptance procedures. The PV modules shall be complete in every detail and shall be accompanied by the manufacturer's handling, mounting, and connection instructions. When the PV modules to be tested are prototypes of a new design and not from production, this fact shall be noted in the test report (see Clause 9).

The number of test samples required is derived from the applicable test sequences (see Clause 11).

Special test samples may be required for tests such as the bypass diode test MQT 18 (see IEC 61215-2).

For qualification of multiple bins of power classes within the boundaries given in future IEC TS 62915 at least 2 modules each, from the lower end, median and higher end power class shall be used for testing. If median power class does not exist the next higher class shall be used.

If qualification of a single power class shall be extended to further bins of power classes within the boundaries given in IEC TS 62915 at least 2 modules each, from the lower end, median and higher end power class shall be used for label verification (see Gate No. 1 in 7.2.1).

It is advisable to provide additional spare samples meeting the same output power requirements.

If applicable, the test samples shall be used to represent a group of products, or variations in the materials, or production processes used to produce the modules. The additional samples required for the test programme are then derived from IEC TS 62915.

5 Marking and documentation

5.1 Name plate

Each module shall include the following clear and indelible markings:

a) name, registered trade name or registered trade mark of manufacturer;
b) type or model number designation;

c) serial number (unless marked on other part of product);

d) date and place of manufacture; alternatively serial number allowing to trace the date and place of manufacture;

e) maximum system voltage;

f) class of protection against electrical shock;

g) voltage at open-circuit or V_{oc} including tolerances;

h) current at short-circuit or I_{sc} including tolerances;

i) module maximum power or P_{max} including tolerances.

All electrical data shall be shown as relative to standard test conditions (1 000 W/m^2, 25 °C, AM 1,5 according to IEC TS 61836).

International symbols shall be used where applicable.

Compliance of marking is checked by inspection and MQT 06.1.

5.2 Documentation

5.2.1 Minimum requirements

Modules shall be supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module. The documentation shall state the class of protection against electrical shock under which the module has been qualified and any specific limitations required for that class. The documentation shall assure that installers and operators receive appropriate and sufficient documentation for safe installation, use, and maintenance of the PV modules.

NOTE It is considered to be sufficient that one set of documentation is supplied with the module shipping unit.

5.2.2 Information to be given in the documentation

a) all information required under 5.1 e) to i);

b) reversed current rating in accordance to IEC 61730-2;

- overcurrent protection device type and rating are e.g. given in IEC 60269-6. Overcurrent protection devices with a 1 h, 1,35 I_n overload rating, where I_n is the rated value of the overcurrent protection device, are recommended.
- maximum series/parallel module configurations is recommended;

c) manufacturer's stated tolerance for V_{oc}, I_{sc} and maximum power output under standard test conditions;

d) temperature coefficient for voltage at open-circuit;

e) temperature coefficient for maximum power;

f) temperature coefficient for short-circuit current.

All electrical data mentioned above shall be shown as relative to standard test conditions (1 000 W/m^2, 25 °C, AM 1,5 according to IEC TS 61836). Moreover the following parameters shall be specified:

g) nominal module operating temperature (NMOT);

h) performance at NMOT (MQT 06.2);

i) performance at low irradiance (MQT 07).

International symbols shall be used where applicable.

Compliance is checked by inspection and MQT 04 through MQT 07.

The electrical documentation shall include a detailed description of the electrical installation wiring method to be used. This description shall include:

j) the minimum cable diameters for modules intended for field wiring;

k) any limitations on wiring methods and wire management that apply to the wiring compartment or box;

l) the size, type, material and temperature rating of the conductors to be used;

m) type of terminals for field wiring;

n) specific PV connector model/types and manufacturer to which the module connectors shall be mated;

o) the bonding method(s) to be used (if applicable); all provided or specified hardware shall be identified in the documentation;

p) the type and ratings of bypass diode to be used (if applicable);

q) limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling);

r) a statement indicating the fire rating(s) and the applied standard as well as the limitations to that rating (e.g., installation slope, sub structure or other applicable installation information);

s) a statement indicating the design load per each mechanical means for securing the module as evaluated during the static mechanical load test according to MQT 16. At discretion of the manufacturer the test load and/or the safety factor γ_m may be noted, too.

To allow for increased output of a module resulting from certain conditions of use, the installation instructions shall include relevant parameters specified by manufacturer or the following statement or the equivalent:

"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{SC} and V_{OC} marked on this module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."

5.2.3 Assembly instructions

These shall be provided with a product shipped in subassemblies, and shall be detailed and adequate to the degree required to facilitate complete and safe assembly of the product.

6 Testing

It is requested that the test laboratory uses a control module to be able to detect drifts in their measurement results.

The modules shall be divided into groups and subjected to the qualification test sequences in Figure 1. Qualification test sequences are to be carried out in the order specified. The MQT designations in the boxes refer to the corresponding test definitions in Part 2 of this standard. Technology specific test details are listed in the respective parts of this standard.

Intermediate measurements of maximum power (MQT 02) and insulation test (MQT 03) are not necessary, but they may be used to track changes.

Any single tests executed independently of a test sequence, e.g., on special test samples for MQT 09 and MQT 18, shall be preceded by the initial tests of MQT 01, MQT 02, MQT 03, and MQT 15 as appropriate.

In carrying out the tests, the tester shall strictly observe the manufacturer's handling, mounting, and connection instructions. Sequence A may be omitted if the module type has

been tested according to IEC 61853-1. In this case the relevant test results from IEC 61853-1 shall be stated or referenced in the final report.

Test conditions are summarized in Table 1. The test levels in Table 1 are the minimum levels required for qualification. If the laboratory and the module manufacturer agree, the tests may be performed with increased severities. In this case this shall be noted in the test report.

7 Pass criteria

7.1 General

If two or more modules fail to meet the following test criteria, the design shall be deemed not to have met the qualification requirements. Should one module fail any test, two additional modules meeting the requirements of Clause 4 shall be subjected to the entire series of tests of the respective test sequence.

If one or both of these modules also fail, the design shall be deemed not to have met the qualification requirements. If, however, both modules pass the test sequence, the design shall be judged to have met the qualification requirements.

A module design shall be judged to have passed the qualification tests and therefore to be approved according to this standard, if each test sample meets all of the following criteria.

7.2 Power output and electric circuitry

7.2.1 Verification of rated label values → Gate No. 1

All modules shall be stabilized following method MQT 19.1 from IEC 61215-2 (for technology specific requirements see sub-parts of IEC 61215-1). After stabilization the modules shall be measured in accordance with MQT 6.1 (P_{max}(Lab)). After the stabilization procedure all modules shall be within the power rating of the name plate (P_{max}(NP)) including stated measurement uncertainty m_1. Therefore, the following criterion shall be met:

P_{max} Verification:

Each individual module shall meet the following criterion:

$$P_{max}(\text{Lab}) \cdot \left(1 + \frac{|m_1|\,[\%]}{100}\right) \geq P_{max}(\text{NP}) \cdot \left(1 - \frac{|t_1|\,[\%]}{100}\right)$$

where

P_{max} (Lab) is the measured maximum STC power of each module in the stabilized state;

P_{max} (NP) is the maximum rated nameplate power of each module without tolerances;

m_1 is the measurement uncertainty in % of laboratory for P_{max} (expanded combined uncertainty (k=2), ISO/IEC Guide 98-3);

t_1 is the manufacturer's rated lower production tolerance in % for P_{max}.

For $\overline{P}_{max}(\text{Lab})$, the following criterion shall apply:

$$\overline{P}_{max}(\text{Lab}) \cdot \left(1 + \frac{|m_1|\,[\%]}{100}\right) \geq P_{max}(\text{NP})$$

where