IEC 61215-1-4

Edition 1.0 2016-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-4: Special requirements for testing of thin-film Cu(In,Ga)(S,Se)$_2$ based photovoltaic (PV) modules

Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation –
Partie 1-4: Exigences particulières d'essai des modules photovoltaïques (PV) au Cu(In,Ga)(S,Se)$_2$ à couches minces

IEC 61215-1-4:2016-12(en-fr)

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ELECTROTECHNICAL
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INTERNATIONALE

ICS 27.160 ISBN 978-2-8322-3786-1

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International Standard IEC 61215-1-4 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This edition cancels and replaces the second edition of IEC 61646, issued in 2008, and constitutes a technical revision.

It constitutes a technical revision for thin-film $Cu(In,Ga)(S,Se)_2$ based terrestrial photovoltaic modules.

This standard is to be read in conjunction with IEC 61215-1:2016 and IEC 61215-2:2016.

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

FDIS	Report on voting
82/1184/FDIS	82/1208/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 61215 series, published under the general title *Terrestrial photovoltaic (PV) modules – Design qualification and type approval,* 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- withdrawn,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.

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

Part 1-4: Special requirements for testing of thin-film $Cu(In,Ga)(S,Se)_2$ based photovoltaic (PV) modules

1 Scope and object

This part of IEC 61215 lays down IEC requirements for the design qualification and type approval of terrestrial photovoltaic modules suitable for long-term operation in general open-air climates, as defined in IEC 60721-2-1. This document is intended to apply to all thin-film $Cu(In,Ga)(S,Se)_2$ based terrestrial flat plate modules. As such it addresses special requirements for testing of this technology supplementing IEC 61215-1:2016 and IEC 61215-2:2016 requirements for testing.

This document 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.

The object 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.

This document defines PV technology dependent modifications to the testing procedures and requirements per IEC 61215-1:2016 and IEC 61215-2:2016.

2 Normative references

The normative references of IEC 61215-1:2016 and IEC 61215-2:2016 are applicable without modifications.

3 Terms and definitions

This clause of IEC 61215-1:2016 is applicable without modifications.

4 Test samples

This clause of IEC 61215-1:2016 is applicable without modifications.

5 Marking and documentation

This clause of IEC 61215-1:2016 is applicable without modifications.

6 Testing

This clause of IEC 61215-1:2016 is applicable with the following modifications:

Special care has to be taken for stabilizing the power output of the module using MQT 19 procedure with specific requirements stated in 11.19 below.

7 Pass criteria

This clause of IEC 61215-1:2016 is applicable with the following modifications.

The maximum allowable value of reproducibility is set to r = 2,0 %.

8 Major visual defects

This clause of IEC 61215-1:2016 is applicable without modifications.

9 Report

This clause of IEC 61215-1:2016 is applicable without modifications.

10 Modifications

This clause of IEC 61215-1:2016 is applicable without modifications.

11 Test flow and procedures

The test flow from IEC 61215-1:2016 is applicable.

11.1 Visual inspection (MQT 01)

This test of IEC 61215-2:2016 is applicable without modifications.

11.2 Maximum power determination (MQT 02)

This test of IEC 61215-2:2016 is applicable without modifications.

11.3 Insulation test (MQT 03)

This test of IEC 61215-2:2016 is applicable without modifications.

11.4 Measurement of temperature coefficients (MQT 04)

This test of IEC 61215-2:2016 is applicable without modifications.

11.5 Measurement of nominal module operating temperature (NMOT) (MQT 05)

This test of IEC 61215-2:2016 is applicable without modifications.

11.6 Performance at STC (MQT 06.1) and NMOT (MQT 06.2)

This test of IEC 61215-2:2016 is applicable without modifications.

11.7 Performance at low irradiance (MQT 07)

This test of IEC 61215-2:2016 is applicable without modifications.

11.8 Outdoor exposure test (MQT 08)

This test of IEC 61215-2:2016 is applicable without modifications.

11.9 Hot-spot endurance test (MQT 09)

This test of IEC 61215-2:2016 is applicable with the following modifications:

$Cu(In,Ga)(S,Se)_2$ thin-film modules may exhibit performance changes with extended time in storage without light exposure (the “dark soak” effect). In order to minimize the influence of this dark soak effect, limit the time delay between the outdoor exposure or stabilization and the hot spot procedure to within 2 to 3 days; the modules are to be stored in the dark at ≤ 25 °C.

11.9.1 Purpose

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.9.2 Hot-spot effect

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.9.3 Classification of cell interconnection

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.9.4 Apparatus

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.9.5 Procedure

MQT 09.2 of IEC 61215-2:2016 shall be performed for any MLI module design.

If module is constructed by interconnection of cell-like substructures, MQT 09.1 of IEC 61215-2:2016 may be applicable.

11.9.6 Final measurements

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.9.7 Requirements

This subclause of IEC 61215-2:2016, test MQT 09, is applicable without modifications.

11.10 UV preconditioning test (MQT 10)

This test of IEC 61215-2:2016 is applicable without modifications.

11.11 Thermal cycling test (MQT 11)

This test of IEC 61215-2:2016 is applicable with the following modifications:

The technology specific current which needs to be applied according to MQT 11 of IEC 61215-2:2016 shall be equal to 0,1 × STC peak power current.

11.12 Humidity-freeze test (MQT 12)

This test of IEC 61215-2:2016 is applicable without modifications.

11.13 Damp heat test (MQT 13)

This test of IEC 61215-2:2016 is applicable with the following modifications:

MQT 13 of IEC 61215-2:2016 can be conducted according to the following methods:

Method A) Perform MQT 13 as defined in IEC 61215-2:2016.

Method B) Perform MQT 13 as defined in IEC 61215-2:2016 with applied forward bias:

11.13.1 Procedure

a) Attach a suitable temperature sensor (see apparatus requirements of MQT 11) to the front or back surface of the module(s) near the middle. If more than one module of the same type is tested simultaneously, it will suffice to monitor the temperature of one representative sample.

b) Connect the temperature-monitoring equipment to the temperature sensor(s). Connect each module individually to the appropriate voltage supply by connecting the positive terminal of the module to the positive terminal of the power supply and the second terminal accordingly. During the damp-heat set the applied voltage to V_{mpp} ± 5 % at STC taken from the data-sheet and limit the current of the power supply to less than 25 % of I_{sc} at STC.

c) Throughout the test monitor the module's applied voltage and current. Report I/V-trend. If current limit is reached, applied voltage can drop below V_{mpp} ± 5 % at STC.

d) Set chamber temperature to achieve a module temperature of 85 °C ± 2 °C.

e) During cooling phase to ambient temperature (25 °C or less), the specified applied voltage shall be maintained and shall be switched off when the module temperature reaches 25 °C ± 5 °C.

11.14 Robustness of terminations test (MQT 14)

This test of IEC 61215-2:2016 is applicable without modifications.

11.15 Wet leakage current test (MQT 15)

This test of IEC 61215-2:2016 is applicable without modifications.

11.16 Static mechanical load test (MQT 16)

This test of IEC 61215-2:2016 is applicable without modifications.

11.17 Hail test (MQT 17)

This test of IEC 61215-2:2016 is applicable without modifications.

11.18 Bypass diode testing (MQT 18)

This test of IEC 61215-2:2016 is applicable without modifications.

11.19 Stabilization (MQT 19)

This test of IEC 61215-2:2016 is applicable with the following modifications:

11.19.1 Criterion definition for stabilization

For the definition of stabilization as per MQT 19 of IEC 61215-2:2016, x = 0,02 shall be used.

Any kind of storage shall be done at temperature below 25 °C to avoid thermal activated processes affecting MQT 06.1 of IEC 61215-2:2016 measurement.

11.19.2 Light induced stabilization procedure

This test of IEC 61215-2:2016 is applicable without modifications.

11.19.3 Other stabilization procedures

This test of IEC 61215-2:2016 is applicable without modifications.

11.19.4 Initial stabilization (MQT 19.1)

Initial stabilization is performed on all modules.

To fulfil MQT 19 requirements using light exposure, a minimum of two intervals each of at least 10 kWh/m^2 are required. After this preconditioning all of the test modules shall be measured for STC power (MQT 06.1 of IEC 61215-2:2016).

If stabilization is performed outdoors in general no module temperature limits apply. The outdoor stabilization shall be proven at least with one module using the indoor method following the validation procedure from MQT 19 of IEC 61215-2:2016.

The minimum and maximum module temperatures observed during outdoor light exposure stabilization verification while the irradiance level is above 500 W/m^2 shall be the minimum and maximum allowable module temperatures for all modules. If the module temperature falls outside of these limits the new module temperature range has to be re-verified.

Output power determination shall be performed after a minimum cooling time of 30 min and maximum 60 min.

A validated alternative procedure can be used in accordance to MQT 19 of IEC 61215-2:2016.

11.19.5 Final stabilization (MQT 19.2)

Final stabilization is performed on all modules after the test sequences to prove fulfilment of gate No. 2 requirement of IEC 61215-1:2016.

To fulfil MQT 19 requirements a minimum of two intervals of at least 10 kWh/m^2 each are required.

If stabilization is performed outdoors in general no module temperature limits apply. The outdoor stabilization shall be proven at least with one module using the indoor method following MQT 19 of IEC 61215-2:2016.

The minimum and maximum module temperatures observed during outdoor light exposure stabilization verification while the irradiance level is above 500 W/m^2 shall be the minimum and maximum allowable module temperatures for all modules. If the module temperature falls outside of these limits the new module temperature range has to be re-verified.

Output power determination shall be performed after a minimum cooling time of 30 min and maximum 60 min.

A validated alternative procedure can be used in accordance to MQT 19 of IEC 61215-2:2016.