IEC 61215-1-4

Edition 2.0 2021-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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 61215-1-4:2021-02(en-fr)

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

This second edition cancels and replaces the first edition of IEC 61215-1-4, issued in 2016, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) A cyclic (dynamic) mechanical load test (MQT 20) added.
b) A test for detection of potential-induced degradation (MQT 21) added.
c) A bending test (MQT 22) for flexible modules added.

Informative Annex A of 61215-1:2021 explains the background and reasoning behind some of the more substantial changes that were made in the IEC 61215 series in progressing from edition 1 to edition 2.

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

FDIS	Report on voting
82/1827/FDIS	82/1852/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.

This standard is to be read in conjunction with IEC 61215-1:2021 and IEC 61215-2:2021.

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- withdrawn,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.

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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

This document lays down requirements for the design qualification of terrestrial photovoltaic modules suitable for long-term operation in open-air climates. The useful service life of modules so qualified will depend on their design, their environment and the conditions under which they are operated. Test results are not construed as a quantitative prediction of module lifetime.

In climates where 98th percentile operating temperatures exceed 70 °C, users are recommended to consider testing to higher temperature test conditions as described in IEC TS 63126. Users desiring qualification of PV products with lesser lifetime expectations are recommended to consider testing designed for PV in consumer electronics, as described in IEC 63163 (under development). Users wishing to gain confidence that the characteristics tested in IEC 61215 appear consistently in a manufactured product may wish to utilize IEC 62941 regarding quality systems in PV manufacturing.

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 61215-1:2021 and IEC 61215-2:2021 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 irradiance, current, voltage and power levels expected at the design concentration.

The object of this test sequence is to determine the electrical 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 outdoors. Accelerated test conditions are empirically based on those necessary to reproduce selected observed field failures and are applied equally across module types. Acceleration factors may vary with product design and thus not all degradation mechanisms may manifest. Further general information on accelerated test methods including definitions of terms may be found in IEC 62506.

Some long-term degradation mechanisms can only reasonably be detected via component testing, due to long times required to produce the failure and necessity of stress conditions that are expensive to produce over large areas. Component tests that have reached a sufficient level of maturity to set pass/fail criteria with high confidence are incorporated into the IEC 61215 series via addition to Table 1 in IEC 61215-1. In contrast, the tests procedures described in this series, in IEC 61215-2, are performed on modules.

This document defines PV technology dependent modifications to the testing procedures and requirements per IEC 61215-1:2021 and IEC 61215-2:2021.

2 Normative references

The normative references of IEC 61215-1:2021 and IEC 61215-2:2021 are applicable without modifications.

3 Terms and definitions

This clause of IEC 61215-1:2021 is applicable without modifications.

4 Test samples

This clause of IEC 61215-1:2021 is applicable without modifications.

5 Marking and documentation

This clause of IEC 61215-1:2021 is applicable without modifications.

6 Testing

This clause of IEC 61215-1:2021 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 61215-1:2021 is applicable with the following modifications.

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

The maximum allowable value of measurement uncertainty is set to m_1 = 4,0 % for modules containing single-junction cells, and m_1 = 5,0 % for modules containing multi-junction cells.

8 Major visual defects

This clause of IEC 61215-1:2021 is applicable without modifications.

9 Report

This clause of IEC 61215-1:2021 is applicable without modifications.

10 Modifications

This clause of IEC 61215-1:2021 is applicable without modifications.

11 Test flow and procedures

The test flow from IEC 61215-1:2021 is applicable.

11.1 Visual inspection (MQT 01)

This test of IEC 61215-2:2021 is applicable without modifications.

11.2 Maximum power determination (MQT 02)

This test of IEC 61215-2:2021 is applicable without modifications.

11.3 Insulation test (MQT 03)

This test of IEC 61215-2:2021 is applicable without modifications.

11.4 Measurement of temperature coefficients (MQT 04)

This test of IEC 61215-2:2021 is applicable without modifications.

11.5 Placeholder section, formerly NMOT

This subclause of IEC 61215-2:2021 does not require technology-specific modifications.

11.6 Performance at STC (MQT 06.1)

This test of IEC 61215-2:2021 is applicable without modifications.

11.7 Performance at low irradiance (MQT 07)

This test of IEC 61215-2:2021 is applicable without modifications.

11.8 Outdoor exposure test (MQT 08)

This test of IEC 61215-2:2021 is applicable without modifications.

11.9 Hot-spot endurance test (MQT 09)

This test of IEC 61215-2:2021 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. During the first hour after the hot-spot procedure is complete, no additional heating or light beyond room ambient shall be applied. If the time delay is to exceed 1 h, the modules are to be stored in the dark at ≤ 25 °C.

11.9.1 Purpose

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.9.2 Hot-spot effect

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.9.3 Classification of cell interconnection

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.9.4 Apparatus

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.9.5 Procedure

MQT 09.2 of IEC 61215-2:2021 shall be performed for any monolithically integrated (MLI) module design.

If the module is constructed by interconnection of cell-like substructures, MQT 09.1 of IEC 61215-2:2021 may be applicable.

11.9.6 Final measurements

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.9.7 Requirements

This subclause of IEC 61215-2:2021, test MQT 09, is applicable without modifications.

11.10 UV preconditioning test (MQT 10)

This test of IEC 61215-2:2021 is applicable without modifications.

11.11 Thermal cycling test (MQT 11)

This test of IEC 61215-2:2021 is applicable with the following modifications:

MQT 11 of IEC 61215-2:2021 can be conducted according to the following methods:

Method A) Perform MQT 11 as defined in IEC 61215-2:2021, with the technology specific current equal to 0,1 × STC peak power current. If 0,1 × STC peak power current is less than 100 mA, then 100 mA may be applied instead.

Method B) Perform MQT 11 as defined in IEC 61215-2:2021 with the following modifications:

During the thermal cycling test, set the continuous current flow during the heat up cycle to the technology specified current noted below at temperature from 0 °C to 85 °C. Maintain current flow during high temperature dwell and cool down cycle until the module temperature is below 0 °C. As necessary, adjust the chamber temperature to maintain module temperature below 85 °C.

The technology specific current which needs to be applied according to MQT11 of IEC 61215-2 shall be a forward bias current of 0,1 × STC peak power current to 0,3 × STC peak power current. If 0,1 × STC peak power current is less than 100 mA, then 100 mA may be applied instead.

The current flow applied during Method B is shown superimposed on the temperature cycle in Figure 1.

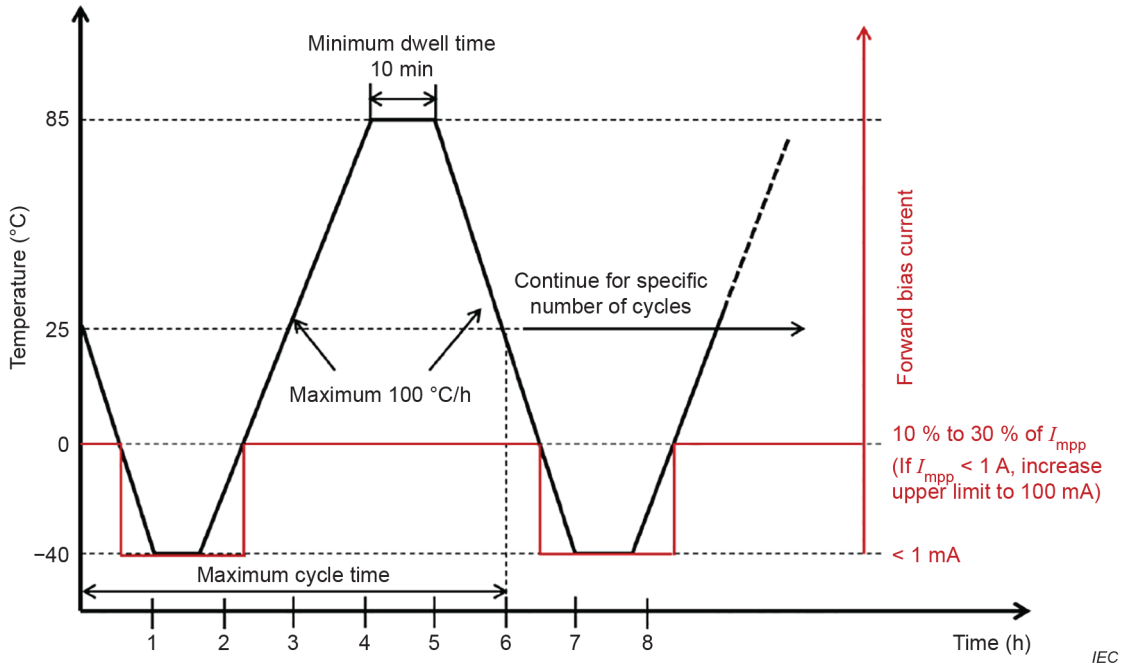

Figure 1 – Current flow using MQT 11 Method B

11.12 Humidity-freeze test (MQT 12)

This test of IEC 61215-2:2021 is applicable with the following modifications:

MQT 12 of IEC 61215-2:2021 can be conducted according to the following methods:

Method A) Perform MQT 12 as defined in IEC 61215-2:2021.

Method B) Perform MQT 12 as defined in IEC 61215-2:2021 with the following modifications:

During the humidity freeze test, set the continuous current flow during the heat up cycle to the technology specified current noted below at temperature from 0 °C to 85 °C. Maintain current flow during high temperature dwell and cool down cycle until module temperature has reached 0 °C. As necessary, adjust the chamber temperature to maintain module temperature below 85 °C.

The technology specific current which needs to be applied according to MQT12 of IEC 61215-2 in Method B shall be a forward bias current of 0,1 × STC peak power current to 0,3 × STC peak power current, with a minimum of 100 mA.

The current flow applied during Method B is shown superimposed on the humidity-freeze cycle in Figure 2.