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Date: 04 March 2025

Origin: International

Latest date for receipt of comments: 26 March 2025

Project No. 2025/00526

Responsible committee: GEL/82 Photovoltaic Energy Systems

Interested committees:

Title: BS EN 61215-2 Amd.1 Ed.2.0 Draft Amendment 1 - Terrestrial photovoltaic (PV) modules - Design qualification and type approval. Part 2: Test procedures.

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- i) has any issues related to 3rd party IPR, patent or copyright
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- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



82/2372/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 61215-2/AMD1 ED2

DATE OF CIRCULATION:

2025-02-28

CLOSING DATE FOR COMMENTS:

2025-04-25

SUPERSEDES DOCUMENTS:

82/2085/RR

IEC TC 82 : SOLAR PHOTOVOLTAIC ENERGY SYSTEMS

SECRETARIAT:

United States of America

SECRETARY:

Mr George Kelly

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

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TITLE:

Amendment 1 - Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures

NOTE FROM TC/SC OFFICERS:

This project was discussed and supported by WG2 during their meeting in 2024-10.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TERRESTRIAL PHOTOVOLTAIC (PV) MODULES –
DESIGN QUALIFICATION AND TYPE APPROVAL –****Part 2: Test procedures****FOREWORD**

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International Standard IEC 61215-2 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition of IEC 61215-2 cancels and replaces the first edition of IEC 61215-2 issued in 2016; it constitutes a technical revision.

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

- a) The bifacial stress irradiance (BSI), which was used to determine stress conditions for bifacial modules, has been replaced by the applied bifacial stress irradiance (aBSI).
- b) A revised procedure for cell shadowing during hot-spot testing (MQT 09).
- c) Revision of the applied current requirements for thermal cycling (MQT 11) and humidity freeze (MQT 12) tests.
- d) Addition of weights to junction box during damp heat (MQT 13) testing.

e) Cemented joins shall be tested with an increased maximum voltage during wet leakage testing (MQT 15)

f) Updated requirements for the non-uniformity of load distribution in static mechanical load test (MQT 16).

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

FDIS	Report on voting
82/1829/FDIS	82/1853/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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

221

INTRODUCTION

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

226

227

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

Part 2: Test procedures

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 63126¹. 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 TS 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 terrestrial flat plate module materials such as crystalline silicon module types as well as thin-film modules.

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 objective 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 61215-1:202X. In contrast, the tests procedures described in this series, in IEC 61215-2, are performed on modules.

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.

¹ Information on 98th percentile operating temperature as a function of system location and mounting configuration is included in IEC TS 63126.

- 271 IEC 60068-1, *Environmental testing – Part 1: General and guidance*
- 272 IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations*
 273 *and integral mounting devices*
- 274 IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady*
 275 *state*
- 276 IEC 60891, *Photovoltaic devices – Procedures for temperature and irradiance corrections to*
 277 *measured I-V characteristics*
- 278 IEC 60904-1, *Photovoltaic devices – Part 1: Measurements of photovoltaic current-voltage*
 279 *characteristics*
- 280 IEC 60904-1-1, *Photovoltaic devices – Part 1-1: Measurement of current-voltage characteristics*
 281 *of multi-junction photovoltaic (PV) devices*
- 282 IEC TS 60904-1-2, *Photovoltaic devices – Part 1-2: Measurement of current-voltage*
 283 *characteristics of bifacial photovoltaic (PV) devices*
- 284 IEC 60904-2, *Photovoltaic devices – Part 2: Requirements for photovoltaic reference devices*
- 285 IEC 60904-3, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic*
 286 *(PV) solar devices with reference spectral irradiance data*
- 287 IEC 60904-7, *Photovoltaic devices – Part 7: Computation of the spectral mismatch correction*
 288 *for measurements of photovoltaic devices*
- 289 IEC 60904-8, *Photovoltaic devices – Part 8: Measurement of spectral responsivity of a*
 290 *photovoltaic (PV) device*
- 291 IEC 60904-9:2020, *Photovoltaic devices – Part 9: Classification of solar simulator*
 292 *characteristics*
- 293 IEC 60904-10, *Photovoltaic devices – Part 10: Methods of linearity measurement*
- 294 IEC TR 60904-14: *Photovoltaic devices – Part 14: Guidelines for production line measurements*
 295 *of single-junction PV module maximum power output and reporting at standard test conditions*
- 296 IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*
- 297 IEC 61215-1:202X, *Terrestrial photovoltaic (PV) modules – Design qualification and type*
 298 *approval – Part 1: Test requirements*
- 299 IEC 61215-1-1, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*
 300 *– Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules*
- 301 IEC 61730-1:2016, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for*
 302 *construction*
- 303 IEC 61730-2, *Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing*
- 304 IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*
- 305 IEC TS 62782, *Photovoltaic (PV) modules – Cyclic (dynamic) mechanical load testing*

IEC 62790, *Junction boxes for photovoltaic modules – Safety requirements and tests*

IEC TS 62804-1:2015, *Photovoltaic (PV) modules – Test methods for the detection of potential-induced degradation – Part 1: Crystalline silicon*

IEC TS 63163: –² *Terrestrial photovoltaic (PV) modules for consumer products – Design qualification and type approval*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 61836 and IEC 61215-1:202X apply, as well as the following.

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

accuracy <of a measuring instrument>

quality which characterizes the ability of a measuring instrument to provide an indicated value close to a true value of the measurand [consistent with the International Vocabulary of Metrology (VIM), 5.18]

Note 1 to entry: This term is used in the "true value" approach.

Note 2 to entry: Accuracy is all the better when the indicated value is closer to the corresponding true value.

[SOURCE: IEC 60050-311:2001, 311-06-08]

3.2

control device

irradiance sensor (such as a reference cell or module) that is used to detect drifts and other problems of the solar simulator

3.3

electrically stable power output level

state of the PV module where it will operate under long-term natural sunlight

3.4

repeatability <of results of measurements>

closeness of agreement between the results of successive measurements of the same measurand, carried out under the same conditions of measurement, i.e.:

- by the same measurement procedure,
- by the same observer,
- with the same measuring instruments,
- used under the same conditions,
- in the same laboratory,

at relatively short intervals of time [$\approx$ VIM, 3.6].

² Under preparation. Stage at the time of publication: ADTS.

343 Note 1 to entry: The concept of "measurement procedure" is defined in VIM, 2.5.

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

345 **3.5**

346 **Gate No. 1**

347 a pass / fail comparison between the performance of a module and its nameplate specifications,
348 as described in IEC 61215-1:202X

349 **3.6**

350 **Gate No. 2**

351 a pass / fail comparison between the performance of a module before versus after stress, as
352 described in IEC 61215-1:202X

353 **4 Test procedures**

354 The subclauses below provide detailed instructions for performing each module quality test
355 (MQT). Reporting and test sequence requirements for qualification are described in
356 IEC 61215-1.

357 **4.1 Visual inspection (MQT 01)**

358 **4.1.1 Purpose**

359 To detect any visual defects in the module.

360 **4.1.2 Procedure**

361 Carefully inspect each module under an illumination of not less than 1 000 lux for conditions
362 and observations as defined in IEC 61215-1:202X.

363 Make note of and/or photograph any defects that may be major visual defects as defined in
364 IEC 61215-1. Also make note of and/or photograph the nature and position of any cracks,
365 bubbles or delaminations, etc., which may worsen and adversely affect the module performance
366 in subsequent tests. Record any other relevant information regarding origin of failure and
367 associated test or lab conditions.

368 **4.1.3 Requirements**

369 No evidence of major visual defects permitted, as defined in IEC 61215-1:202X.

370 **4.2 Maximum power determination (MQT 02)**

371 **4.2.1 Purpose**

372 To determine the maximum power of the module after stabilization as well as before and after
373 the various environmental stress tests.

374 **4.2.2 Apparatus**

375 a) Apparatus for measuring I - V characteristics in accordance with IEC 60904-1.

376 b) A PV reference device in accordance with IEC 60904-2.

c) At least one of the following two options to reduce the spectral mismatch component of uncertainty shall be utilized:

- Perform a spectral mismatch correction. The spectral responsivity of the module shall be measured according to IEC 60904-8. The spectral response data may originate from the same lab that is performing IEC 61215-2:202X, or from a different lab. The sample used to obtain the spectral response data may be the test module or may be a reference cell made with the same bill of materials as the test module. The spectral distribution of the solar simulator shall then be utilized to correct for spectral mismatch according to IEC 60904-7.
- Use a matched reference cell or module. The reference device shall be of the same cell technology as the test module, to match spectral responsivity. There is no requirement on the cell or module size.

d) A radiant source: natural sunlight or a solar simulator of class CAA or better in accordance with IEC 60904-9. For very large modules, as defined in IEC 61215-1:202X, a class CBA simulator may be used.

NOTE 1 Class CBA is defined according to IEC 60904-9: The AM1.5 spectral match is categorized as C, non-uniformity of irradiance for the module size categorized as B, and temporal stability of irradiance categorized as A.

To achieve a high accuracy of power measurement, the spectral irradiance distribution of the solar simulator should cover the whole wavelength range that is spanned by the spectral responsivity of the PV device under test. See IEC TR 60904-14 and IEC 60904-9:2020.

e) A suitable mount for supporting the test specimen and the reference device in a plane normal to the radiant beam.

NOTE 2 MQT 02 measurement procedures are intended for minimal uncertainty, for example as performed by an accredited testing laboratory. Lesser requirements, such as use of CAB class simulators, may be appropriate for other applications, such as quality control in the factory. Applications that only require repeatability, such as comparing module performance before and after an extended stress, may wish to relax spectral mismatch correction requirements.

4.2.3 Procedure

Determine the current-voltage characteristic of the module in accordance with IEC 60904-1 at a specific set of irradiance and temperature conditions (a recommended range is a cell temperature between 20 °C and 50 °C and an irradiance between 700 W/m² and 1 100 W/m²) using the apparatus described in 4.2.2. In special circumstances when modules are designed for operation under a different range of conditions, the current-voltage characteristics can be measured using temperature and irradiance levels similar to the expected operating conditions. For linear modules (as defined in IEC 60904-10) temperature and irradiance corrections can be made in accordance with IEC 60891 in order to compare sets of measurements made on the same module before and after environmental tests. For nonlinear modules (as defined in IEC 60904-10) the measurement shall be performed within ±5 % of the specified irradiance and within ±2 °C of the specified temperature. However, every effort should be made to ensure that peak power measurements are made under similar operating conditions, that is minimize the magnitude of the correction by making all peak power measurements on a particular module at approximately the same temperature and irradiance.

For flexible modules, the maximum power determination shall be measured with the flexible module in the flat position.

4.3 Insulation test (MQT 03)

4.3.1 Purpose

To determine whether or not the module is sufficiently well insulated between live parts and accessible parts.

4.3.2 Apparatus

- a) DC voltage source, with current limitation, capable of applying the voltage as specified in the third column of Table 1 for the various module classes.
- b) An instrument to measure the insulation resistance.

4.3.3 Test conditions

The test shall be made on modules at ambient temperature of the surrounding atmosphere (see IEC 60068-1) and in a relative humidity not exceeding 75 %.

The voltage stress levels applied to the module are determined by the module's maximum system voltage (V_{sys}), the module class, and whether or not cemented joints are present. The definitions of module classes are taken from IEC 61140, and are discussed as related to PV modules in IEC 61730-1:2016, Clause 4. The definition of cemented joints is given in IEC 61730-1:2016, 3.4.2, and is further discussed in IEC 61730-1:2016, Clauses B.5 and B.9. The voltage stress levels applied in this test are the same as those applied for IEC 61730-2 MST 16.

4.3.4 Procedure

- a) Connect the shorted output terminals of the module to the positive terminal of a DC insulation tester with a current limitation.
- b) Connect the exposed metal parts of the module to the negative terminal of the tester. If the module has no frame or if the frame is a poor electrical conductor, wrap a conductive foil around the edges. Connect all foil covered parts to the negative terminal of the tester.
- c) Some module technologies may be sensitive to static polarization if the module is maintained at positive voltage to the frame. In this case, the connection of the tester shall be done in the opposite way. If applicable, information with respect to sensitivity to static polarization shall be provided by the manufacturer and documented in the test report.
- d) Read the "one-minute preconditioning" voltage, V_{Test1} from the third column of Table 1. Increase the voltage applied by the tester at a rate not exceeding 500 V/s to a maximum equal to V_{Test1} . Maintain the voltage at this level for 1 min.
- e) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.
- f) Remove the short-circuit.
- g) Read the "two-minute stress" voltage, V_{Test2} from the fourth column of Table 1. Increase the voltage applied by the test equipment at a rate not exceeding 500 V/s to V_{Test2} . Maintain the voltage at this level for 2 min. Then determine the insulation resistance.
- h) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.
- i) Remove the short-circuit and disconnect the test equipment from the module.

Table 1 – Voltage stress levels

Module class	Are cemented joints present?	1 min preconditioning V_{Test1}	2 min stress for measuring insulation resistance, V_{Test2}
		V	V
0	No	$1\,000 + 2 \times V_{sys}$	Greater of 500 or V_{sys}
II	No	$2\,000 + 4 \times V_{sys}$	Greater of 500 or V_{sys}
III	No	500	500
0	Yes	$1,35 \times (1\,000 + 2 \times V_{sys})$	Greater of 500 or V_{sys}
II	Yes	$1,35 \times (2\,000 + 4 \times V_{sys})$	Greater of 500 or V_{sys}
III	Yes	$1,35 \times (500)$	500

4.3.5 Test requirements

- a) No dielectric breakdown or surface tracking.
- b) For modules with an area of less than 0,1 m² the insulation resistance shall not be less than 400 MΩ.
- c) For modules with an area larger than 0,1 m² the measured insulation resistance times the area of the module shall not be less than 40 MΩ·m².

4.4 Measurement of temperature coefficients (MQT 04)

Determine the temperature coefficients of current (α), voltage (β) and peak power (δ) from module measurements as specified in IEC 60891. The coefficients so determined are valid at the irradiance at which the measurements were made. See IEC 60904-10 for evaluation of module temperature coefficients at different irradiance levels. For bifacial modules determine the temperature coefficients utilizing the same procedure, but insuring no backside irradiation. The backside shall be covered such that the contribution from the non-exposed side of the module is limited to or below the levels specified for "non-irradiated background" in IEC TS 60904-1-2. If open-circuit voltage or short-circuit current cannot be measured due to module-integrated electronics, the associated temperature coefficient shall be reported as "not measurable due to module-integrated electronics." Open-circuit voltage or short-circuit current shall not be determined by any method other than direct measurement, such as extrapolation.

NOTE For linear modules in accordance to IEC 60904-10, temperature coefficients are valid over an irradiance range of ± 30 % of this level.

4.5 Placeholder section, formerly NMOT

The nominal module operating temperature (NMOT) test, formerly MQT 05, is no longer a part of this document. This subclause is preserved so that, in the following subclauses of the document, the MQT numbers match the subclause numbers.

4.6 Performance at STC (MQT 06.1)

4.6.1 Purpose

To determine how the electrical performance of the module varies with load at STC (1 000 W/m², 25 °C cell temperature, with the IEC 60904-3 reference solar spectral irradiance distribution). MQT 06.1 is a case of maximum power determination (MQT 02) performed at STC. MQT 06.1 is used to verify the name plate information of the module, and for determining power loss from the stress tests. Uncertainty, m_1 , shall include a component from spectral mismatch, based either on measured spectral response or the worst-case possibility for a given technology type, and the method used to set the simulator intensity. For nameplate verification, the uncertainty m_1 is subject to the limits specified in the technology-specific parts. For determining the power loss from the stress tests, reproducibility of the test, r , is subject to the limits specified in the technology-specific parts.

4.6.2 Apparatus

- a) The apparatus shall be as described in 4.2.2 (MQT 02).
- b) It shall also be equipped with a means for monitoring the temperature of the test specimen and the reference device to an accuracy of ± 1 °C and repeatability of $\pm 0,5$ °C.
- c) For measurement of bifacial modules the following capability is also necessary: The radiant source utilized as specified in 4.6.2a shall be operable with adjustable irradiance levels and/or rear-side irradiance such that BNPI (as defined in IEC 61215-1:202X) can be applied by at least one method allowed by IEC TS 60904-1-2.
- d) For measurement of multi-junction modules, the simulator and reference device shall meet the additional requirements imposed by IEC 60904-1-1.

4.6.3 Procedure for measuring at STC (MQT 06.1)

Maintain the module at $(25 \pm 2)^\circ\text{C}$ and trace its current-voltage characteristic at an irradiance of $(1\,000 \pm 100)\text{ W/m}^2$ (as measured by a suitable reference device), in accordance with IEC 60904-1, using the apparatus described in 4.6.2.

Module temperature shall be corrected to 25°C using temperature coefficients and IEC 60904 series and IEC 60891.

For bifacial modules, measurements shall proceed as specified in IEC TS 60904-1-2. MQT 06 shall be performed at STC and at elevated irradiance BNPI for Gate No 1. Each time MQT 06 is performed at STC, the STC bifaciality coefficients of short-circuit current ($\phi_{I_{sc}} = I_{scr} / I_{scf}$), of open circuit voltage ($\phi_{V_{oc}} = V_{ocr} / V_{ocf}$), and of power ($\phi_{P_{max}} = P_{maxr} / P_{maxf}$) shall be measured according to IEC TS 60904-1-2. Full definition of these quantities, the method to measure them, and the symbols used to describe them are specified in IEC TS 60904-1-2. When evaluating Gate No 2 (i.e. post-stress), MQT 06 shall only be performed at BNPI. Post-stress, bifaciality coefficients need not be remeasured, unless specifically noted in the MQT stress test procedure. The bifaciality coefficients measured pre-stress may be utilized to calculate the appropriate equivalent intensity in a single-sided illumination measurement. When performing MQT 06 at BNPI, any method described in IEC 60891 may be used to correct the applied irradiance to desired equivalent front-side irradiance, as long requirements on maximum uncertainty m_1 are met.

NOTE 1 Using methods from IEC 60891 to correct the applied irradiance to desired equivalent front-side irradiance can help the tester avoid using a different simulator calibration for every module with a slightly different bifaciality coefficient.

NOTE 2 Measurement of performance at aBSI is not required. Where stress levels are set according to aBSI, currents may be extrapolated from lower intensities, as described specifically in the MQTs utilizing aBSI for bifacial modules.

For flexible modules, the maximum power determination shall be measured with the flexible module in the flat (i.e. completely unfolded) position. For very large modules (as defined in IEC 61215-1:202X), testing by the testing entity may be performed at the manufacturer's facility, but shall still meet the requirements stated in 4.6.2.

For multi-junction modules, measurements shall proceed as specified in IEC TS 60904-1-1.

4.7 Performance at low irradiance (MQT 07)

4.7.1 Purpose

To determine how the electrical performance of the module varies with load at 25°C and an irradiance of 200 W/m^2 .

4.7.2 Apparatus

a) The apparatus shall be as described in 4.2.2 (MQT 02).

The apparatus shall also have the following capabilities:

- b) Equipment necessary to change the irradiance to 200 W/m^2 without affecting the relative spectral irradiance distribution and the spatial uniformity in accordance with IEC 60904-10.
- c) A means for monitoring the temperature of the test specimen and the reference device to an accuracy of $\pm 1^\circ\text{C}$ and repeatability of $\pm 0,5^\circ\text{C}$.
- d) For measurement of bifacial modules the following equipment is also necessary: Baffles that can be arranged around the modules edges, as well as a non-reflective cover allowing for temporarily blocking the irradiance to the opposite module side, to evaluate the front- and back-side performance of bifacial modules individually.