



UL IEC 61215-1:2025

(IEC 61215-1:2021/Cor1:2021, IDT)

STANDARD FOR SAFETY

Terrestrial Photovoltaic (PV) Modules –
Design Qualification and Type Approval
– Part 1: Test Requirements



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UL Standard for Safety for Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval – Part 1: Test Requirements, UL IEC 61215-1

Second Edition, Dated July 28, 2021

Summary of Topics

This revision of ANSI/UL IEC 61215-1 dated October 17, 2025 includes the replacement of [Figure 2](#) to align with the IEC Publication of Corrigendum 1, issued 2021.

UL 61215-1 is an adoption of IEC 61215-1, Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval – Part 1: Test Requirements (Second Edition, issued February 2021). Please note that there are no National Differences.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 29, 2025.

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ANSI/UL IEC 61215-1-2025

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UL IEC 61215-1:2025

(IEC 61215-1:2021/Cor1:2021, IDT)

**Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type
Approval – Part 1: Test Requirements**

First Edition – February, 2017

Second Edition

July 28, 2021

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through October 17, 2025.

The most recent designation of ANSI/UL 61215-1 as an American National Standard (ANSI) occurred on October 17, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The IEC Foreword is also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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PREFACE

This UL Standard is based on IEC Publication IEC 61215-1: Second edition Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval – Part 1: Test Requirements, as revised by corrigendum 1. IEC publication IEC 61215-1 is copyrighted by the IEC.

This revised edition has been issued to correct [Figure 2](#) to align with the IEC Corrigendum 1 issued 2021.

This is the UL Standard for Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval – Part 1: Test Requirements. This UL Part 1 is to be used in conjunction with UL 61215-2.

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Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN QUALIFICATION AND TYPE APPROVAL – Part 1: Test requirements

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

This second edition of IEC 61215-1 cancels and replaces the first edition of IEC 61215-1, published in 2017; it constitutes a technical revision.

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

a) Addition of a test taken from IEC TS 62782.

b) Addition of a test taken from IEC TS 62804-1.

c) Addition of test methods required for flexible modules. This includes the addition of the bending test (MQT 22).

d) Addition of definitions, references and instructions on how to perform the IEC 61215 design qualification and type approval on bifacial PV modules.

e) Clarification of the requirements related to power output measurements.

f) Addition of weights to junction box during 200 thermal cycles.

g) Requirement that retesting be performed according to IEC TS 62915.

h) Removal of the nominal module operating test (NMOT), and associated test of performance at NMOT, from the IEC 61215 series.

Informative Annex A 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
82/1828A/FDIS	82/1848/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 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 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.

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.

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.

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TERRESTRIAL PHOTOVOLTAIC (PV) MODULES – DESIGN

QUALIFICATION AND TYPE APPROVAL – Part 1: Test requirements

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 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. It does not apply to systems that are not longterm applications, such as flexible modules installed in awnings or tenting.

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.

This document 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 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 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.

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 TS 60904-1-2:2019, *Photovoltaic devices – Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices*

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 linear dependence and linearity measurements*

IEC TS 60904-13, *Photovoltaic devices – Part 13: Electroluminescence of photovoltaic modules*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

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

IEC 61730-1, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction*

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

IEC 62852, *Connectors for DC-application in photovoltaic systems – Safety requirements and tests*

IEC TS 62915, *Photovoltaic (PV) modules – Type approval, design and safety qualification – Retesting*

IEC 62941, *Terrestrial photovoltaic (PV) modules – Quality system for PV module manufacturing*

IEC TS 63163: –¹ *Terrestrial photovoltaic (PV) modules for consumer products – Design qualification and type approval*

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

¹ Under preparation. Stage at the time of publication: ADTS.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions in IEC TS 61836 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

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 60050-311:2001, 311-06-08 – 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,
- 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 [consistent with the International Vocabulary of Metrology (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.

Note 3 to entry: It is recommended that laboratories determine their reproducibility according to the formulas and principles in ISO 5725-2.

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

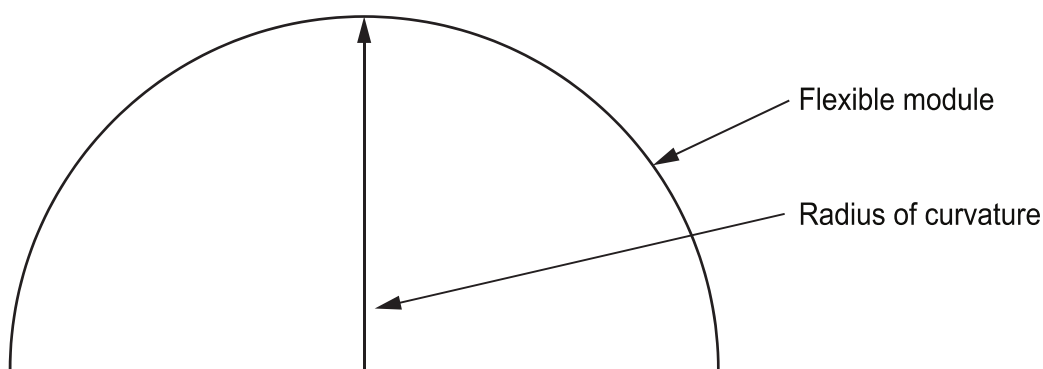
3.6

flexible module

PV module that exhibits a radius of curvature of 500 mm or less in at least one direction according to the manufacturer's specification and is capable of bending to conform to a flat or curved surface

Note 1 to entry: A curved module with a rigid shape is not considered a flexible module.

Note 2 to entry: Radius of curvature is defined as shown in [Figure 1](#). During testing, the applied radius of curvature is no smaller than that specified by the manufacturer.



IEC

su3962

Figure 1

Geometry that shows radius of curvature of a flexible module

3.7

representative sample

sample that includes all the components of the module, except some repeated parts

Note 1 to entry: The representative samples shall use all key materials and subassemblies, as detailed in [Clause 4](#).

3.8

very large module

module that exceeds the size of standard 2,2 m × 1,5 m commercially-available simulators

Note 1 to entry: A very large module exceeds 2,2 m in length or width, or exceeds 1,5 m in both dimensions. Thus a 3 m × 0,3 m module is considered very large, as is a 2,2 m × 2,2 m module.

Note 2 to entry: Very large modules are exempt from class A simulator spatial irradiance uniformity requirements, as detailed in IEC 61215-2 MQT 02.

Note 3 to entry: During test sequences representative samples may be substituted for very large modules, within the limits described in [Clause 4](#).