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Part 2: Spectral responsivity, incidence angle and nominal module operating temperature measurements

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CONTENTS

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FOREWORD

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IEC 61853 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

This second edition cancels and replaces the first edition published in 2016. This edition constitutes a technical revision.

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

a) New Clause 3 was added;
b) New measurement methods are introduced in Clause 7;
c) A new procedure for data filtering was added to Clause 8;
d) Annex A (informative), Annex B (normative) and Annex C (informative) were added;
e) The term "calibration" was removed;

f) The wording in Clause 4 and Clause 5 was aligned with Edition 2 of IEC 61215;

g) The tilt angle for NMOT measurements was harmonized to (37 ± 5)° throughout the text;

h) The distance of the bottom edge of the test module in NMOT measurements was raised to 1 m above the local horizontal plane or ground level;

i) The tests have been modified to include methodologies for measuring bifacial PV modules.

The text of this International Standard is based on the following documents:

Draft	Report on voting
82/2626/FDIS	82/2660/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61853-2 series, published under the general title *Photovoltaic (PV) module performance testing and energy rating*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

Photovoltaic (PV) modules are typically rated at standard test conditions (STC) of 25 °C cell temperature, 1 000 W m^{-2} total irradiance, normal incidence and air mass (AM) 1,5 spectrum. However, PV modules in the field operate over a range of temperatures, total and spectral irradiances, and incidence angles. Hence, PV modules can also be rated based on the calculated energy production under a standardized set of environmental and climatic conditions.

This series proposes a standard method for energy rating and consists of four parts:

– IEC 61853-1: Irradiance and temperature performance measurements and power rating, which describes requirements for evaluating PV module performance in terms of power rating over a range of irradiances and temperatures;
– IEC 61853-2: Spectral responsivity, incidence angle, and nominal module operating temperature measurements, which describes test procedures for measuring the effect of varying angle of incidence and sunlight spectra as well as the estimation of module temperature from irradiance, ambient temperature, and wind speed;
– IEC 61853-3: Energy rating of PV modules, which describes the calculations for PV module energy ratings; and
– IEC 61853-4: Standard reference climatic profiles, which describes the standard time periods and weather conditions that can be used for the energy rating calculations.

1 Scope

The IEC 61853 series establishes IEC requirements for evaluating PV module performance based on power (watts), energy (joule or watthours) and performance ratio. It is written to be applicable to all PV technologies, including bifacial PV modules, but can be unsuitable for any technology where the module performance changes with time (e.g. modules change their behaviour with light or thermal exposure), or which experience significant non-linearities in any of their characteristics used for the modelling.

The purpose of this second part of IEC 61853 is to define procedures for measuring the effects of angle of incidence of the irradiance on the output power of the device, to determine the operating temperature of a module for a specific set of ambient and mounting conditions and measure the spectral responsivity of the module.

NOTE 1 In the IEC 61853 series, spectral responsivity measurements are used for calculating spectral correction factors, in combination with standardized and location-specific spectral irradiance data from Part 4. Then they are applied in the energy rating calculation described in Part 3 to account for mismatches from the reference AM1.5 spectrum with respect to what can be detected by a reference irradiance detector (e.g. a pyranometer). It is important to note that without spectral responsivity data, the resulting deviations in the energy rating calculation can be significant; however, spectral responsivity alone does not provide information on energy gains or losses.

The described measurements are required as inputs into the module energy rating procedure described in IEC 61853-3 [28][1]. Results of the measurements described in this part, however, can also be used for other purposes, where relevant, e.g. yield prediction with commercially available simulation tools that require spectral responsivity or angle of incidence effect.

PV modules to be installed onto buildings (either as building integrated or as building applied photovoltaics, BIPV or BAPV, respectively) can exhibit very peculiar spectral, optical and thermal properties. This document can be applied for the energy rating of these modules and their specificity is illustrated in Annex A: however, it is important for the reader to be aware that in some of these circumstances the thermal performance of the module under test can be severely affected by the specific mounting configuration.

NOTE 2 IEC TS 63126 [1] presents an informative annex that can be used as a guidance to get information on operating module temperatures for several locations and mounting configurations. From the 98th percentile maps provided therein, the reader can infer a temperature offset that could be applied to evaluate the effect of mounting configurations to the operating temperatures to be used in the energy rating calculated in Part 3 of this series. The estimation of this offset, however, is outside the scope of this document.

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

IEC 60904-2, *Photovoltaic devices - Part 2: Requirements for photovoltaic reference devices*

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[1] Numbers in square brackets refer to the Bibliography.

IEC 60904-5, *Photovoltaic devices - Part 5: Determination of equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method*

IEC 60904-8:2014, *Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device*

IEC 60904-9, *Photovoltaic devices - Part 9: Classification of solar simulator characteristics*

IEC 60904-10, *Photovoltaic devices - Part 10: Methods of linear dependence and linearity measurements*

IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules - Design qualification and type approval*

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

ISO 2859-1, *Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 9059, *Solar energy - Calibration of field pyrheliometers by comparison to a reference pyrheliometer*

ISO 9060, *Solar energy - Specification and classification of instruments for measuring hemispherical solar and direct solar radiation*

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