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Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 61853-2:2016 sisaldab Euroopa standardi EN 61853-2:2016 ingliskeelset teksti.	This Estonian standard EVS-EN 61853-2:2016 consists of the English text of the European standard EN 61853-2:2016.
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English Version

Photovoltaic (PV) module performance testing and energy rating -
Part 2: Spectral responsivity, incidence angle and module
operating temperature measurements
(IEC 61853-2:2016)

Essais de performance et caractéristiques assignées
d'énergie des modules photovoltaïques (PV) - Partie 2:
Mesurages de réponse spectrale, d'angle d'incidence et de
température de fonctionnement des modules
(IEC 61853-2:2016)

Prüfung des Leistungsverhaltens von photovoltaischen
(PV-)Modulen und Energiebemessung - Teil 2: Messung
der spektralen Empfindlichkeit, des Einfallswinkels und der
Modul-Betriebstemperatur
(IEC 61853-2:2016)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 82/1133/FDIS, future edition 1 of IEC 61853-2, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61853-2:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-07-11
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-10-11

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Endorsement notice

The text of the International Standard IEC 61853-2:2016 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

Photovoltaic (PV) modules are typically rated at standard test conditions (STC) of 25 °C cell temperature, 1 000 W·m⁻² irradiance, and air mass (AM) 1.5 global (G) spectrum. However, the PV modules in the field operate over a range of temperatures, irradiance, and spectra. To accurately predict the energy production of the modules under various field conditions, it is necessary to characterize the modules at a wide range of temperatures, irradiances, angles of incidence, and spectra.

Recognizing this issue, IEC Technical Committee 82 Working Group 2 (TC 82/WG 2) has developed an appropriate power and energy rating standard (IEC 61853). The first part of this four-part standard requires the generation of a 23-element maximum power (P_{\max}) matrix at four different temperatures and seven different irradiance levels. The P_{\max} matrix can be generated using an indoor solar simulator method or outdoor natural sunlight method. The outdoor test method introduces little/no spectral mismatch error and is much less expensive than the indoor test method because it avoids the use of very expensive solar simulators. However, obtaining an accurate and repeatable P_{\max} matrix using the outdoor method over time (several months or years) would be extremely challenging.

This standard 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 (watts) rating over a range of irradiances and temperatures;
- IEC 61853-2: *Spectral responsivity, incidence angle, and 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 61853-3¹: *Energy rating of PV modules*, which describes the calculations for PV module energy (watt-hours) ratings; and
- IEC 61853-4²: *Standard reference climatic profiles*, which describes the standard time periods and weather conditions that can be used for the energy rating calculations.

Included in the IEC 61853 series of standards are: test methods designed to map module performance over a wide range of temperature and irradiance conditions (IEC 61853-1); test methods to determine spectral responsivity, incidence angle effects and the module operating temperature all as functions of ambient conditions (IEC 61853-2); methods for evaluating instantaneous and integrated power and energy results including a method for stating these results in the form of a numerical rating (IEC 61853-3); and definition of reference irradiance and climatic profiles (IEC 61853-4).

IEC 61853-1 describes requirements for evaluating PV module performance in terms of power (watts) rating over a range of irradiances and temperatures. IEC 61853-2 describes procedures for measuring the performance effect of angle of incidence, the estimation of module temperature from irradiance, ambient temperature and wind speed, and impact of spectral responsivity on module performance. IEC 61853-3 describes the calculations of PV module energy (watt-hours) ratings. IEC 61853-4 describes the standard time periods and weather conditions that can be utilized for calculating energy ratings.

¹ Under preparation: Stage at the time of publication: IEC/ACDV 61853-3:2016.

² Under preparation: Stage at the time of publication: IEC/ACDV 61853-4:2016.

IEC published the first part of the standard in January 2011. This standard specifies the performance measurements of PV modules at 23 different sets of temperature and irradiance conditions, using either a solar simulator (indoor) or natural sunlight (outdoor). There are many possible indoor and outdoor techniques, and this standard allows several of them. Validation of these techniques for repeatability over time within the same laboratory and for reproducibility among multiple laboratories is extremely important for the successful implementation of this standard.

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PHOTOVOLTAIC (PV) MODULE PERFORMANCE TESTING AND ENERGY RATING –

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

1 Scope

The IEC 61853 series establishes IEC requirements for evaluating PV module performance based on power (watts), energy (watt-hours) and performance ratio (PR). It is written to be applicable to all PV technologies, but may not work well 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 part of IEC 61853 is to define measurement 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 given set of ambient and mounting conditions and measure spectral responsivity of the module. A second purpose is to provide a characteristic set of parameters which will be useful for detailed energy predictions. The described measurements are required as inputs into the module energy rating procedure described in IEC 61853-3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60410³, *Sampling plans and procedures for inspection by attributes*

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

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, *Photovoltaic devices – Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device*

IEC 60904-9, *Photovoltaic devices – Part 9: Solar simulator performance requirements*

IEC 60904-10, *Photovoltaic devices – Part 10: Methods of linearity measurement*

³ Withdrawn.