

फोटोवोल्टिक (पीवी) मॉड्यूल प्रदर्शन
परीक्षण और ऊर्जा रेटिंग
भाग 4 मानक संदर्भ जलवायु प्रोफाइल

Photovoltaic (PV) Module
Performance Testing and Energy
Rating
Part 4 Standard Reference Climatic
Profiles

ICS 27.160

© BIS 2023

© IEC 2018



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002

www.bis.gov.in www.standardsbis.in

NATIONAL FOREWORD

This Indian Standard (Part 4) which is identical with IEC 61853-4 : 2018 ‘Photovoltaic (PV) module performance testing and energy rating — Part 4: Standard reference climatic profiles’ issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on recommendation of the Solar Photovoltaic Energy Systems Sectional Committee and approval of the Electrotechnical Division Council.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’.
- b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC TS 61836 Solar photovoltaic energy systems — Terms, definitions and symbols	IS 12834 : 2013 Solar photovoltaic energy systems — Terms, definitions and symbols (<i>first revision</i>)	Identical with IEC TS 61836: 2007
IEC 61853-3 Photovoltaic (PV) module performance testing and energy rating — Part 3: Energy rating of PV modules	IS 16170 (Part 3) : 2022 Photovoltaic (PV) module performance testing and energy rating: Part 3 Energy rating of PV modules	Identical with IEC 61853-3:2018

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding of numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

CONTENTS

INTRODUCTION.....	iv
1 Scope.....	1
2 Normative references	1
3 Terms and definitions	1
4 Standard reference climatic profiles for energy rating	1
4.1 General.....	1
4.2 Data format.....	2
4.3 Reference climatic profiles	2
Table 1 – List of the climatic data sets for energy rating.....	3

INTRODUCTION

This International Standard series establishes IEC requirements for determining PV module performance in terms of power (watts), specific module energy rating (kWh/kW) and climatic specific energy rating (dimensionless). It is written to be applicable to all PV technologies including non-linear devices. The methodology does not take into account either progressive degradation or transient behaviour such as light induced changes and/or thermal annealing.

This series consists of four parts:

- IEC 61853-1: *Photovoltaic (PV) module performance testing and energy rating – Part 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: *Photovoltaic (PV) module performance testing and energy rating – Part 2: Spectral responsivity, incidence angle, and module operating temperature measurements*, which describes test procedures for measuring the effect of varying angles of incidence and sunlight spectra as well as the estimation of module temperature from irradiance, ambient temperature, and wind speed;
- IEC 61853-3: *Photovoltaic (PV) module performance testing and energy rating – Part 3: Energy rating of PV modules*, which describes the calculations for PV module ratings; and
- IEC 61853-4: *Photovoltaic (PV) module performance testing and energy rating – Part 4: Standard reference climatic profiles*, which describes the standard time periods and environmental data set that shall be used for the energy rating calculations.

Indian Standard

PHOTOVOLTAIC (PV) MODULE PERFORMANCE TESTING AND ENERGY RATING

PART 4 STANDARD REFERENCE CLIMATIC PROFILES

1 Scope

This part of IEC 61853 describes the standard reference climatic profiles used for calculating energy ratings.

IEC 61853-1 describes requirements for evaluating PV module performance in terms of power (watts) rating. IEC 61853-2 describes test procedures for determining module temperature from irradiance, ambient temperature and wind speed, a method for measuring angle of incidence effects, and spectral responsivity. IEC 61853-3 describes the calculation of PV module energy rating values, using the data from IEC 61853-1, IEC 61853-2 and IEC 61853-4.

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

IEC 61853-3, *Photovoltaic (PV) module performance testing and energy rating – Part 3: Energy rating of PV modules*

3 Terms and definitions

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

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>

4 Standard reference climatic profiles for energy rating

4.1 General

The defined conditions contained within this document shall be used in IEC 61853-3 to obtain an energy rating. A fixed number (6) of standard reference climatic profiles are tabulated, representative of global regions relevant for the application of photovoltaics. The irradiance and ambient temperature data are representative of typical conditions over each region, but are to be considered as average values. The spectrally resolved irradiances are derived from satellite data.

4.2 Data format

For each standard reference climatic profile the following are defined:

- a) The PV module mounting conditions. The modules are assumed to be mounted in a fixed position on free-standing racks.
- b) The orientation and a fixed inclination angle (β). The inclination angle β is fixed at 20° from horizontal, and the module orientation is facing towards the equator.
- c) Climatic data tabulated as hourly values over one full year, listed as days one through 365. For each standard reference climatic profile the following are defined:
 - The total of the hourly global in-plane irradiance values for the reference climatic profile (H_p)
 - Climatic data tabulated as hourly values over one full year, listed as days one through 365. The parameters reported are:
 - Year
 - Month
 - Day
 - Hour (local solar time)
 - Ambient temperature (T_{amb})
 - Wind speed at module height (v)
 - Sun elevation
 - Sun incidence angle (to the normal of the module) (θ)
 - Global horizontal irradiance (G_h)
 - Direct horizontal irradiance (B_h)
 - Global in-plane irradiance (G)
 - Direct in-plane irradiance (B)
 - Spectrally resolved global in-plane irradiance (W/m^2) for a set of discrete bands ($G(\lambda)$), with band intervals given in the tabulated data sets.

4.3 Reference climatic profiles

For all the climatic profiles, the following fixed conditions are applicable;

Fixed open-rack module mounting conditions;

The rack is equator-facing with a fixed inclination angle of 20° .

The climatic data are defined for the locations listed in Table 1.

Table 1 – List of the climatic data sets for energy rating

Data set number	Latitude	Type	Total yearly global in-plane irradiance H_p (kWh/m²)
1	1°S	Tropical humid	1677,7
2	33°30'N	Subtropical arid (desert)	2295,5
3	33°22'N	Subtropical coastal	1496,6
4	56°N	Temperate coastal	972,9
5	34°N	High elevation (above 3 000 m)	2139,1
6	57°N	Temperate continental	1266,0

The climatic data is tabulated in attached files in the form of zip files.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: ETD 28 (18550).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	{ 2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.