

SEMI PV73-0216 (Withdrawn 0922) TEST METHOD FOR THIN-FILM SILICON PHOTOVOLTAIC (PV) MODULES LIGHT SOAKING

This Standard was technically approved by the Photovoltaic Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 5, 2022. Available at www.semiviews.org and www.semi.org in September 2022; originally published February 2016.

NOTICE: This Document was balloted and approved for withdrawal in 2022.

1 Purpose

1.1 This Standard provides a performance test method for the initial light-induced degradation in thin-film silicon photovoltaic (PV) modules.

1.2 The current standard for stabilization in thin-film silicon PV modules is IEC 61646 (module output power <2% change after successive 43 kW/m² exposure periods). According to the IEC standard, light soaking time less than 200 hours is usually sufficient for 1 kW/m² intensity. However, stabilized power to be achieved in such a short time and the power will continue to degrade. Thus, longer light soaking time is necessary to determine the module's stabilized output power.

1.3 Therefore, a standard test method for thin-film silicon PV modules is needed to obtain an accurate module stabilized output power value.

2 Scope

2.1 This Standard describes procedures for the measurement of initial light-induced degradation of thin-film silicon modules in simulated sunlight.

2.2 These test methods are applicable to thin-film silicon PV modules.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 IEC® Standards¹

IEC 60904-1 — Photovoltaic Devices – Part 1: Measurements of Photovoltaic Current-Voltage Characteristics

IEC 60904-9 — Photovoltaic Devices – Part 9: Solar Simulator Performance Requirements

IEC 61646 — Thin-Film Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 Definitions

4.1.1 *initial light-induced degradation of thin-film silicon PV module* — the output power of module tends towards stability after significant decline in the early period of use. Stabilization occurs when measurements from two consecutive periods, when the ambient temperature is between 40°C and 60°C, meet the following criteria: $(P_{\max} - P_{\min}) / P_{\text{average}} < 0.5\%$.

4.2 Symbols

4.2.1 *D* — the initial light-induced degradation.

¹ International Electrotechnical Commission, 3 rue de Varembe, Case Postale 131, CH-1211 Geneva 20, Switzerland; Telephone: +41.22.919.02.11, <http://www.iec.ch>. IEC trademark is owned by International Electrotechnical Commission.

4.2.2 P_O — the initial maximum output power of the module at standard test conditions.

4.2.3 $P_{average}$ — the average maximum output power of the module at standard test conditions after exposure.

5 Summary of Test Method

5.1 The initial light-induced degradation of a thin-film silicon PV module is determined by exposing the module to simulated sunlight at a defined temperature range to compare the maximum output power before and after exposure.

5.2 The maximum output power measurement procedures are in accordance with IEC 60904-1.

6 Apparatus

6.1 A Class CCC or better solar simulator (refer to IEC 60904-9) to make the initial light-induced degradation of thin-film silicon PV module.

6.2 Equipment for measuring the irradiance over the range of interest with the accuracy of $\pm 1\%$.

6.3 A means to mount the modules, as recommended by the manufacturer, co-planar with the reference device.

6.4 A means for controlling the temperature of the test module to an accuracy of $\pm 2^\circ\text{C}$.

6.5 Any equipment necessary to change the temperature of the test module over the range of interest.

7 Test Specimens

7.1 Test modules shall be taken at random from a production batch or batches and covered during the delivery to the test platform. Measurement shall start within 30 minutes after the modules are uncovered.

8 Procedure

8.1 Place the module in the test plane of solar simulator with at least Class CCC.

8.2 Set the irradiance at $1000 \text{ W}\cdot\text{m}^{-2} \pm 100 \text{ W}\cdot\text{m}^{-2}$ while open-circuited.

8.3 Record the irradiance.

8.4 During the simulator exposure, ambient temperature must stay in the range of $50^\circ\text{C} \pm 10^\circ\text{C}$.

8.5 Subject each module to irradiation until its maximum power value stabilizes. Stabilization occurs when measurements from two consecutive periods of at least $48 \text{ k Wh}\cdot\text{m}^{-2}$, each integrated over periods when the ambient temperature is between 40°C and 60°C , meet the following criteria $(P_{\max} - P_{\min}) / P_{\text{average}} < 0.5\%$.

9 Calculations

9.1 The initial light-induced degradation is calculated as follows:

$$D = \frac{P_O - P_{average}}{P_O} \times 100\%$$

10 Report

10.1 Each test report shall include at least the following information:

10.1.1 Name and address of the test laboratory and location where the tests were carried out.

10.1.2 Unique identification of each page.

10.1.3 Characterization and condition of the test item.

10.1.4 Date of receipt of test item and date of test, where appropriate.

10.1.5 Ambient temperature and relative humidity.

10.1.6 Condition of the test.

10.1.7 Type of test equipment.

10.1.8 A statement of the estimated uncertainty of the test result.