Bifacial silicon PV modules characterisation at the European Solar Test Installation
Juan Lopez-García
European Commission, Joint Research Centre (JRC), Ispra, Italy

INTRODUCTION
The European Solar Test Installation (ESTI) is a European reference laboratory for calibration of photovoltaic (PV) devices. Since its launch in the late 1970s, it also has been the forefront of the development of international standards for the assessment of electrical performance of PV products and their reliability. ESTI is located at the JRC Ispra site in Italy. The market share of bifacial crystalline Si PV modules has grown significantly over the last years, because they can produce additional output energy in comparison to conventional (monofacial) PV modules. ESTI is involved in the measurements of bifacial PV devices and the testing of the different approaches proposed in the recently published technical specification IEC TS 60904-1-2 for the measurement of current-voltage characteristics of bifacial photovoltaic devices.

IEC TS 60904-1-2: I-V CHARACTERISTICS OF BIFACIAL PHOTOVOLTAIC (PV) DEVICES

SINGLE-SIDE ILLUMINATION: EQUIVALENT IRRADIANCE METHOD

- Bifacility coefficients, at STC: \( \max(I) = \text{max REAR/Vmax FRONT} \cdot \tau_{\text{REAR}} \cdot \tau_{\text{FRONT}} \).
- Rear irradiance \( G_{\text{R}} \) and Equivalent irradiance level \( G_{\text{E}} \): \( G_{\text{E}} = 1000 \text{ W/m}^2 \cdot \tau_{\text{E}} \).
- Rear irradiance driven power gain yield, \( B_{\text{R}} \): linear fit's slope of the \( P_{\text{max}} \) versus \( G_{\text{R}} \) data series.
- Specific \( P_{\text{max}} \) for \( G_{\text{R}}=100\text{W/m}^2 \), \( G_{\text{E}}=200 \text{W/m}^2 \) \( \Rightarrow \) linear interpolation: \( P_{\text{max 100}} + B_{\text{R}} \times 100 \).
- Non-irradiated background \( G_{\text{B}} < 3 \text{W/m}^2 \) at any point (black painted panel).

Recommendation: Limit test area size \( \Rightarrow \) baffles.
JPASAN I1B pulsed solar simulator with in-house multi-flash method (25.0 ±0.1 °C).

NATURAL SUNLIGHT: individual modules

- Natural sunlight rear irradiance driven power gain yield
- Bifacial Energy Yield and rating
- Vertical E-W oriented
- Rear irradiance measurements and modelling
- Log-term and soiling degradation study

OUTDOOR TEST FIELD: array test

- Vertical E-W oriented and south oriented racks
- p-PERC 60 cells frameless modules with \( \phi > 67\%
- Preliminary data from inverters in summer: <28% tilted vs vertical
- Long-term degradation and energy yield

CONCLUSIONS

- Accredited calibration to IEC TS 60904-1-2 is now available
- Indoor and outdoor facilities for calibration using single-side and double-sided illumination
- Small bifacial testing array for energy yield and long-term degradation

ACKNOWLEDGEMENTS

The European Commission’s science and knowledge service
Joint Research Centre

Contact: Juan Lopez-García
European Commission – Joint Research Centre (JRC)
European Solar Test: Installation (ESTI)
C-2 Energy Efficiency and Renewable units, Via E. Fermi 2749, TP 10000 Ispra, Italy.
Tel: +39 0332 783720 – Email: juan.lopez-garcia@ec.europa.eu