

Title: Towards an energy based parameter for photovoltaic classification

Abstract

The photovoltaic (PV) world market volume is about 50 billion Euros per year. PV devices are sold according to their output power measured under standard test conditions. These conditions represent a cloudless sunny day in the middle of the USA. But the climate conditions in Europe differ significantly from this and efficiency depends on a combination of device properties and the environmental conditions. Thus the current peak-efficiency metric leads to wrong estimates for energy generated under real operating conditions. Hence a classification of PV devices regarding their energy production is urgently needed. An appropriate metric must be defined and the requisite measurement methods must be established.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Energy and Environment on pages 14 and 42.

Keywords

Photovoltaic, Energy rating, PV device classification, Standard-Test-Conditions, Metric for Euro-Efficiency, Solar energy prediction, Day-ahead prognosis, Security of energy supply.

Background to the Metrological Challenges

Strong political and economic arguments exist for the continuing uptake of PV as a major contributor to the EU directive to increase the percentage of renewables in the total energy consumption to 20 % by 2020.

The current photovoltaic peak-efficiency metric (Standard-Test-Conditions according to IEC 60904-3) was developed for an easy comparison of solar cells at the end of the production process, with the consequence that the solar devices are optimised for this unrealistic metric, and as a consequence the energy yield for typical end-user operation is not maximised. In addition, the current test condition does not take into account other important factors including: the angle of irradiation, nor the temperature of operation.

An intercomparison of thin film solar modules between seven European calibration laboratories within the European PERFORMANCE project showed a spread of efficiency from -10 % to +8 % between the mean value of all laboratories and the reported calibration values [1].

As a consequence there is a strong metrological need to develop a new, energy based, metric for PV efficiency; along with standardised procedures for the assessment process.

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-Protocol.

The JRP shall focus on the traceable measurement and characterisation of an energy based parameter for PV classification.

The specific objectives are

1. Develop a new metric (energy based) for PV efficiency and define standardised environmental parameters.
2. Develop robust and improved characterisation methods with a sufficient accuracy for parameters necessary for the new metric (e.g. spectrally resolved angular dependency of the responsivity, low light performance, temperature dependency, harmonisation of contacting scheme). This should include solving metrological challenges due to new PV technologies.
3. Improve the traceability for the absolute measurement of the natural and simulator irradiation conditions, spectrally and angularly resolved. The upper limit of the measured wavelength must be extended from 1050 nm to 2000 nm.
4. Validate the spectrally and angularly resolved measurements by comparison with integral measurements. Establish primary traceability and harmonisation of indoor/outdoor characterisation methods through NMI level intercomparison
5. New reference devices have to be developed for an accurate SI traceable calibration process from the cell to the solar park. In addition procedures for their application must be developed

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the R&D work, the involvement of the user community such as industry, and standardisation and regulatory bodies, as appropriate, is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. In particular, proposers should outline the achievements of the EMRP project IND07 Thin films and how their proposal will build on those.

EURAMET expects the average size of JRPs in this call to be between 3.0 to 3.5 M€ and has defined an upper limit of 5 M€ for any project. The available budget for integral Research Excellence Grants is 30 months of effort.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the PV manufacturing sector.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology and includes the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

- [1] Herrmann W, Zamini S, Fabero F, Betts T, Van Der Borg N, Kiefer K, Friesen G and Zaaiman W: "2008 Results of the European PERFORMANCE project on the development of measurement techniques for thin-film PV modules" Proc. 23rd European PVSEC (Valencia, Spain, 1–5 Sept. 2008) pp 2719–22