Input paper: [[1]](#footnote-1) ENG14-3.1.2.4

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM  ENG **□** PAP  Input

**□** ENAV **□** VTS **□** Information

Agenda item [[2]](#footnote-2) 3.1

Technical Domain / Task Number 2 …Technical Knowledge and Sustainability / Task 3.1.2.3…………

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Testing of solar modules

# Summary

This paper provides input to the draft guideline of what constitutes a marine solar panel, dealing with the area associated with testing.

## Purpose of the document

The paper considers the aspects of testing on marine solar module as input to the guideline.

## Related documents

Following the work progressed during ENG 13 on the working paper ENG 13-3.1.2.3 WP – What constitutes a good marine solar panel, the following are proposed sections for consideration by the task group during intersessional work.

# testing

The general view of solar modules is that they are a very low maintenance solution, with no moving parts, sealed to the environment, providing a long-term energy source. They are however, not maintenance free and at the very least require periodic cleaning to remove any environmental debris.

## Site testing

Although manufacturers make “best efforts” to eliminate sources of solar module performance loss and failure, it is known that the performance of solar modules degrades over time. Additionally failures do occur through various means as outlined earlier. To avoid any adverse impact on the AtoN, some form of inspection and testing will need to be employed at some point though the life of a solar array. This section outlines some of the common approaches adopted. Other are available, but become more specialised, both in the equipment used and the knowledge to interpret the results.

### Physical inspection

Probably the most frequent used method to initially identify possible sources of a problem. It can be quick, non-intrusive and achieved during cleaning. The level of technical knowledge needed for these checks to be done are low, allowing this to be done by non-technical personnel.

### Operational checks

There are some quick checks that can be done by technically trained personnel to confirm module operation. These are comparative measurements of the solar module open circuit voltage. These are achieved by isolating the modules and measuring and comparing the voltage relative to others in an array. This assumes the level of irradiance remains about the same during the period of the checks. These checks just confirm module operation and can identify sections of a module that have failed.

### Performance measurement of solar modules

It is known that the output of solar modules degrades and reduces over time. The rate of this reduction is usually guaranteed by the manufacturer, but as the effective performance of the power system is dependent upon the predicted output level, it is occasionally necessary to confirm the performance. This is especially the case, if the operational life of the modules is extended beyond the original design life.

As the operating point of a solar module typically lies in the range around the maximum power point (mpp), measuring the open circuit voltage and the short circuit current gives a first indication of its performance.

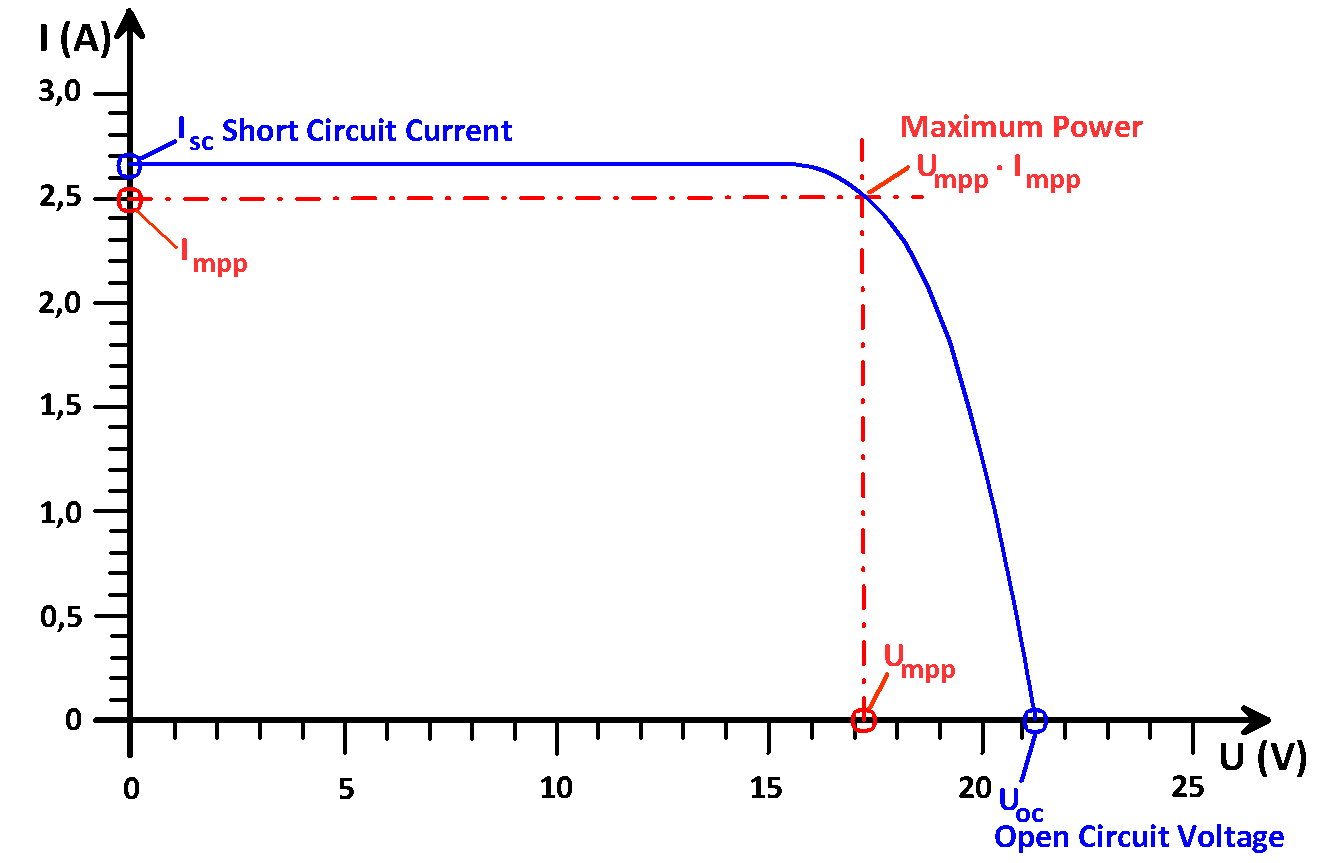
In the following, a simple method is shown with which a measurement of the solar module is possible. The open circuit voltage Uoc and the short circuit current lsc can be measured directly with a suitable multimeter.

Care is needed when measuring the short-circuit current: When removing the measuring tips, an arc may occur if the voltage is > 50 V!

Using a typical solar module IV curve (see figure 1), the position of the mpp can be estimated from the open circuit voltage and the short circuit current as described:

Umpp = (0.75 … 0.9) x Uoc

Impp = (0.85 ... 0.95) x lsc



1. IV curve

However, defects caused by shading or cell breakage may remain hidden. Therefore, a complete current-voltage characteristic curve has the greatest significance for the proper functioning of a solar module. To record such curves, devices are on the market that allow measurement on site and subsequent evaluation of the data by a computer.



1. IV module tester

### Infrared imaging

This type of testing is usually done as part of the solar module production process, but can be applied in the field. More recently, drones have been used to assess large solar array farms. This method, known as solar thermography, is another non-intrusive method of checking that all is operating correctly. It can be quick to do, but does require specialist equipment and knowledge to interpret the results. This method of testing typically identifies the following problems:

* Poor or failed connections, both in the module or junction box.
* Inactive cells.
* Short circuits.

# Action requested of the Committee

The Committee is requested to: (Body text)

1. Forward the input paper to working group 2 for review and consideration as input to the draft guideline on “what constitutes a good marine solar module”.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)