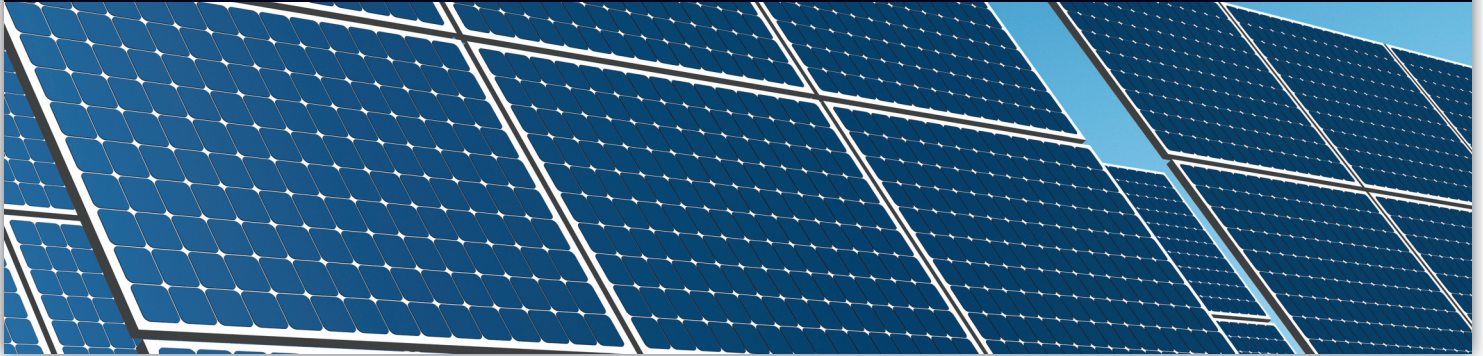


PV System Measurement - FACTS



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► What is solar irradiance?

Solar irradiance is the light intensity of the sun.

The electrical output of PV panels depends on the intensity of the sunlight falling onto the PV module surface. Specifically, it is the sunlight falling perpendicular to the PV module which is of most interest when characterising the electrical output of a PV system, this is known as in-plane irradiance.

► Why measure solar irradiance?

The electrical output will vary significantly with changes in the level of in-plane irradiance.

Solar PV panel manufacturers quote the electrical output at standard test conditions (STC) with an irradiance level of 1000W/m². Therefore, when commissioning a PV system, it is necessary to measure the level of irradiance at the same time as testing its electrical output, to know whether it is working to its potential under the existing irradiance levels. If the electrical output is different from the manufacturers' quoted values, it must be determined whether this is due to a fault in the PV installation, or simply because irradiance was different from STC.

For example, a PV module with a rated short circuit current of 8A is delivering a measured current of 4A. If the irradiance at the time of measurement is 500W/m² (i.e. 50% of the STC value), we have demonstrated that the reduced electrical output is due to a reduced irradiance level and not a fault in the system.

Simultaneous measurement and recording of irradiance, open circuit voltage (Voc) and short circuit current (Isc) is required for the PV Array Test Report for BS EN 62446 and MCS (see DTI Guide to the Installation of PV Systems).

► How is solar irradiance measured?

Energy from the sun is spread over a wide spectrum, from ultraviolet to infrared. Solar irradiance meters that assess PV modules must therefore have a spectral response close to that of a PV module in order to measure 'true irradiance' as a PV system would.

There are two irradiance measurement methods defined and accepted by International Standards covering the performance measurement of PV systems:

1. Pyranometer

High precision, high cost instruments using thermal sensors in a glass dome.

2. PV Reference Cell

Effectively a small scale version of a PV module, having the same response to solar energy. Temperature compensation ensures accuracy is not affected by heat.

Other devices such as light meters, lux meters or devices using photo diode sensors do not have the same spectral response as a PV module. They do not compensate for temperature and are likely to introduce significant measurement errors if used for solar PV applications. They are not suitable for use on PV systems.

► Comparison between Survey 200R and Lux meter

	Survey 100/200R	"Lux" meter
Same spectral response as PV module	✓	✗
Temperature compensation	✓	✗
Meets IEC 60904-2 accuracy requirements	✓	✗
Calibrated to traceable standards	✓	manufacturer dependent
Suitable for PV applications	✓	✗
Temperature measurement	✓	✗
Compass reading	✓	✗
Inclinometer	✓	✗



► What is SolarLink™?

Measuring both irradiance and electrical output at the same time presents a problem. The irradiance meter must be next to the PV modules on the roof while electrical measurements are made inside the building.

The solution – Seaward SolarLink™

SolarLink™ uses wireless technology to transfer real time measured data from the Survey 200R to the PV150.

The irradiance value from the Survey 200R is shown on both devices. True irradiance and electrical output of the PV string can now be measured and recorded simultaneously.



Only the PV150 does all this...



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With Solarlink™ and USB download, the PV150 is the only way to assess the performance and safety of PV systems with complete traceability.

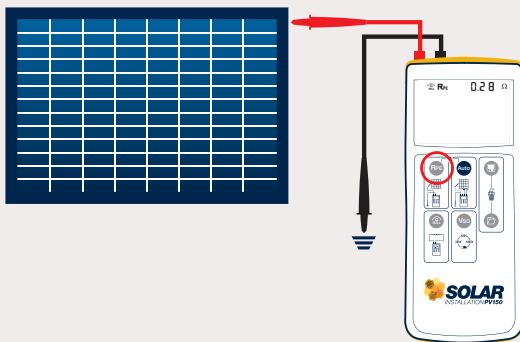
	PV150	DMM / Clamp / Insulation tester	Comments
Open circuit voltage measurement	YES	Conditions apply	DMM requires special test leads for safe connection to PV cables
Short circuit current measurement	YES	Conditions apply	Clamp can measure current if a short circuit has been applied
Short circuit current test	YES	NO	Extra kit needed to apply a short circuit safely
Insulation resistance measurement	YES	Conditions apply	Needs special test leads for safe connection to PV system. May also need a way of applying a short circuit for some systems.
Zero risk of damage to PV modules	YES	NO	Insulation tester could damage PV modules if test incorrectly applied
Single annual calibration	YES	NO	3 instruments to calibrate
Complete traceability	YES	NO	No way to record measurements
Irradiance data relating directly to electrical measurements	YES	NO	No link between irradiance data and electrical measurements
Download to PC	YES	NO	Speed up your commissioning docs. Knock out errors. Easy with the all-in-one PV150

PV System Electrical Commissioning Tests

The PV150 enables simple, safe and fast testing of photovoltaic systems to BS EN 62446 and various state regulations as shown below.

5.4.2 Earth Continuity

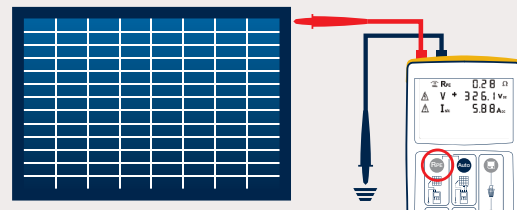
Where protective earthing and/or equipotential bonding conductors are fitted, such as bonding of the array frame, the continuity should be tested.



5.4.5.2 PV String Short Circuit Current

Short circuit of current is measured to ensure correct installation and operation of each PV string. Measured values should be compared with expected values. For systems with multiple identical strings, values should be within 5% of other PV strings in array.

The PV150 stores results for up to 200 strings and enables these to be compared to identify deviations of greater than 5% for both the PV string open circuit voltage.



5.4.3 Polarity Test

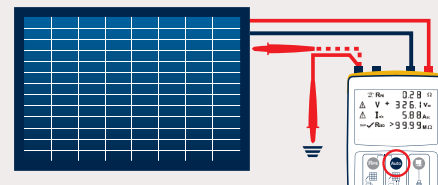
For reasons of safety and prevention of damage to other equipment in the system, the polarity of all DC cables should be verified before other tests are performed. The PV150 does this automatically as part of the PV String Open Circuit Voltage test.

5.4.7 Array Insulation Resistance

Measured from the array positive and negative to ground and compared with minimum acceptable values specified by national requirements and IEC 62446.

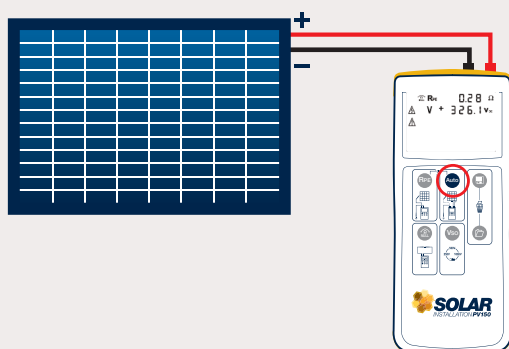
Test voltage is selected according to the PV system voltage ($V_{oc} \text{ stc} \times 1.25$), this determines the minimum acceptable values:

- 250V is used for systems less than 120V
- 500V for systems between 120V and 500V
- 1000V for systems over 500V.



5.4.4 PV String Open Circuit Voltage

Measured to ensure correct installation and operation of each PV string. Measured values should be compared with expected values. For systems with multiple identical strings, values should be within 5% of other PV strings in array.



5.4.5.3 PV String Operational Current

Operational current is measured with the system in normal operation mode and compared with the expected value. For systems with multiple identical strings, values should be within 5% of other PV strings in array.

