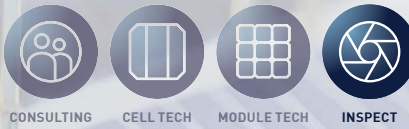


GP SUN-TEST ONE/PRO

OFFLINE CHARACTERISATION UNIT FOR SOLAR CELL PERFORMANCE AND LOSS ANALYSIS (ILLUMINATED IV, DARK IV, AND ISC/VOC)



SITUATION

Solar cell performance measurements for the determination of open-circuit voltage, short circuit current and power conversion efficiency are standard measurements for process control and cell characterisation. The cells are mostly tested inline, using Xenon flasher units. Modern systems are also capable of deriving the series and the shunt resistance from two subsequent measurements at different illumination levels. This is all that is needed for inline quality control and cell classification.

Detailed loss analysis, process optimisation, and trouble shooting often require a deeper insight into what happens in the cell, making it necessary to carry out measurements at different conditions. Typical applications include investigation of the injection- and temperature dependence, or measuring the cell at constant injection under long-term illumination. Where inline flashers provide fast classification and quality control based on the solar cell characteristics, the GP SUN-TEST offers the tools needed to understand the behaviour of the cell and identify loss mechanisms.

DESCRIPTION

The GP SUN-TEST is a tool for offline measurements of dark and illuminated I/V (current/voltage) characteristics as well as Isc/Voc characteristics of processed solar cells. An easy-to-use software tool controls the measurement cycle, gives full control over measurement parameters and allows for fast and easy evaluation of the measured data. The solar cell is placed onto a liquid cooled massive metal chuck that serves for back side contacting and temperature stabilisation. A metal frame

with adjustable contact bars optimized for low shading serves for front contacting. After closing the loading chuck, the cell is automatically transported to the different measurement positions by computer-controlled movement of a linear axis, and measurement of illuminated I/V, dark I/V, and Isc/Voc characteristics is carried out as a batch process. Current/voltage curves are measured using an industrial current source (Kepco BOP) and measurement electronics from National Instruments. The maximum current output is 20 A, sufficient for 210 mm cells. Illuminated measurements are carried out under a continuous discharge lamp with spectral filters to match standard test conditions. For dark IV and Isc/Voc measurements, a separate measurement position with a flashing quartz-tungsten lamp is included in the setup. Depending on the exact measurement parameters and the desired accuracy, the complete measurement of one cell (dark IV, bright-IV and Isc/Voc) typically takes 15 to 50 seconds.

The GP SUN-TEST software provides easy tools for the derivation of shunt and series resistance from the measured curves. Semi-automatic routines allow for simultaneous fitting of illuminated and dark IV and Isc/Voc curves using a two diode model. The measured data and if available the fit data are saved into ascii files for later post-processing. A loss analysis software will be available to combine the GP SUN-TEST with the GP 4-TEST Pro and the GP SR-TEST. This will give industrial users a fast access to most of the cell data needed to optimise the production processes. The stable construction allows for full industrial use. The system is delivered as a table-top system, completely with an industrial pc system, calibrated measurement units, cooling unit, and a pre-installed software system ready for use.

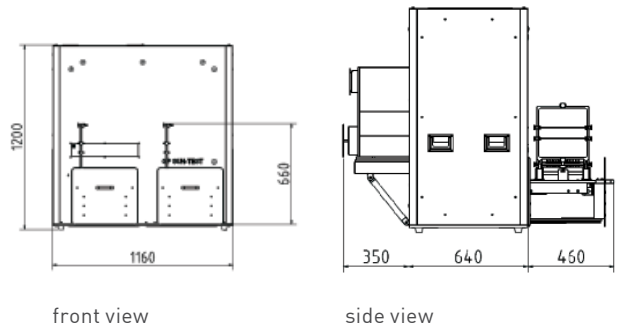


.GPsolar

INSPECT



GP SUN-TEST Pro helps to identify loss mechanisms



GP SUN-TEST Pro

| TOPIC | DESCRIPTION |
|----------------------------------|--|
| System Layout | <ul style="list-style-type: none"> › Continuous discharge lamp for light IV curve › GP SUN-TEST Pro class A light source (IEC 60904) › GP SUN-Test One class B light source (IEC 60904) › Tungsten lamp for I_{sc}/V_{oc} measurements |
| Samples to be measured | <ul style="list-style-type: none"> › Mono- and multi-crystalline solar cells › Square or pseudo square › Textured or non-textured surface |
| Wafer size | 125 ... 210 mm |
| Measurements | <ul style="list-style-type: none"> › Illuminated current/voltage curve › Dark current/voltage curve › I_{sc} versus V_{oc} measurement (under different illumination intensity) |
| Repeatability | +/- 3% |
| Accuracy | +/- 5% (when calibrated with reference cell with same size and characteristics as test specimen) |
| Measurement Time | 2 - 15 sec. (depending on measurements and parameters) |
| Evaluation models | <ul style="list-style-type: none"> › Standard parameters from curve fitting (I_{sc}, V_{oc}, FF, efficiency, R_s, R_p) › Simultaneous fitting of all curves with two-diode-model |
| Optional setup | <ul style="list-style-type: none"> › Three busbar setup › Special options (rear contacts and others) available on request |
| System dimensions (W x H x D) | Housing 1210 mm x 1200 mm x 730 mm 19" Rack 560 mm x 850 mm x 600 mm |
| Order Information/Article Number | GP SUN-TEST: 04.01.0009 GP SUN-TEST Pro: 04.01.0175 |

Note: some of the mentioned features are optional. Technical details subject to change without prior notice.
Only technical specifications in quotations and duty books are binding.

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