Integrated IV Test System

Accurate Solar Cell Performance Measurement

FEATURES

- Perfect for R&D and Production
- Verified at Fraunhofer, ISE & NREL Meets JIS, IES, & ASTM Standards
- Cell size : 52mm – 500mm
- Configured as: downward, vertical, horizontal, or 360 degree rotating head beams
- Accurate IV measurements of High Efficiency & All Types of Solar Cells
- Measures upto ±35A / ± 10V /350W IV Range
- Temperature & Light Soaking Dependent IV Curves
- Multiplexing Function to Test Various Solar Cells
- Corrected I-V Curves, Graphical / Tabular QC Monitoring
- >1,300,000 wafer passes / lamp*
- Better than >99% Uptime

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OAI's advanced fully Integrated IV Test System is designed to overcome the limitations of flash testing by providing a highly optimized pulse width and voltage sweep rate to match any type of solar cell's high capacitance and slow dielectric response speed. As a result, the system produces extremely accurate measurements of solar cell IV parameters and efficiency while leading to the most accurate test results.

This IV test system consists of a OAI's TSS Class AAA *Solar Simulator , Custom Test Fixture, Source Meter and OAI's proprietary IV Software, IV Normalization Kit, Calibrated Si Reference Cell, etc. These systems are available in various models to allow measurement* of single or multiple solar cells with sizes ranging from small size up to 500mm x 500mm (see Table next page)

By Utilizing a continuous solar simulator with a built-in auto shutter, the system provides a single long pulse whose duration can be adjusted from 50ms to ≥250ms. The integrated system also includes OAI's high power source meter which is available in various ranges from ±1A / ±10V / 10W up to ±35A / ±10V / 350W. The high power source meter overcomes the limitations of standard source meters by providing an ultra-fast sensing of the voltage.

Integrated Test System: Specifications

OAI's I-V Software adjusts and optimizes the voltage sweep rate from <0.25V/sec to >150V/sec to compensate for the high capacitance of the solar cell and matches the device's dielectric response speed. This results in the most accurate current-voltage measurements. The I-V curve is recorded in both forward and reverse sweep directions as the software adjusts the voltage sweep rate to solve any hysteresis issues. This provides highly accurate FF and other device performance parameters. The OAI I-V Software also computes all of the standard solar cell parameters : Isc, Voc, Jsc, Imp, Vmp, FF, Rs, Rsh, Pmax and Efficiency. The system can also be integrated with a Normalization Kit which consists of intensity monitoring Cell and other hardware. Utilizing this, each point of the I-V curve is corrected for the variation in intensity and temperature to provide accurate IV curve . The I-V software also provides script writing capability to program the system to do Auto IV Measurements, including light soaking based and temperature dependent IV curves.

This I-V System can also be integrated with multiplexing hardware to allow the measurements of multiple isolar cells in sequential or in parellel ways.

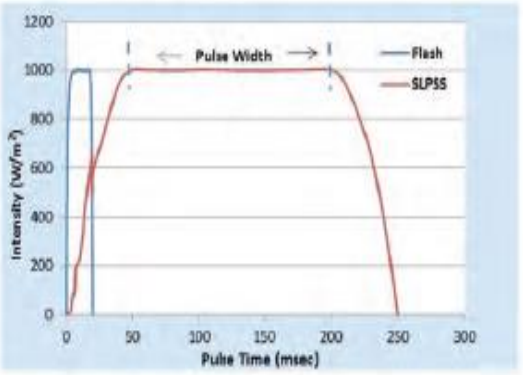
MODELS for Integrated IV Systems

OAI Model #	TSS-52	TSS-100	TSS-156	TSS-208	TSS-300	TSS-500
Special	Constant Current and Intensity	Constant Current and Intensity	Constant Current and Intensity	Constant Current and Intensity	Constant Current and Intensity	Constant Current and Intensity
Spectral Type	AM 1.5G and D, AM0	AM 1.5G and D, AM0	AM 1.5G and D, AM0	AM 1.5G and D, AM0	AM 1.5G and D, AM0	AM 1.5G and D, AM0
Spectral Range	400 - 1100nm, 300 - 1800nm, 280 - 1800nm	400 - 1100nm, 300 - 1800nm, 280 - 1800nm	400 - 1100nm, 300 - 1800nm, 280 - 1800nm	400 - 1100nm, 300 - 1800nm, 280 - 1800nm	400 - 1100nm, 300 - 1800nm, 280 - 1800nm	400 - 1100nm, 300 - 1800nm, 280 - 1800nm
Beam Direction Configuration Options	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head	1. Horizontal 2. Downward 3. Upward 4. 360° Rotating Head
Illumination Area	2in x 2in (52mm x 52mm)	4in x 4in (100mm x 100mm)	6in x 6in (156mm x 156mm)	8in x 8in (208mm x 208mm)	12in x 12in (300mm x 300mm)	20in x 20in (500mm x 500mm)
Collimated angle	Half angle: <±2.5°	Half angle: <±2°	Half angle: <±2°	Half angle: <±2°	Half angle: <±2°	Half angle: <±2°
Typical Power Output	100mW/cm^2 (1Sun)	100mW/cm^2 (1Sun)	100mW/cm^2 (1Sun)	100mW/cm^2 (1Sun)	100mW/cm^2 (1Sun)	100mW/cm^2 (1Sun)
Spatial Uniformity	≤2% (Class A)	≤2% (Class A)	≤2% (Class A)	≤2% (Class A)	≤2% (Class A)	≤2% (Class A)
Temporal (ST)	<0.5% STI & <2.0% LTI (Class A)	<0.5% STI & <2.0% LTI (Class A)	<0.5% STI & <2.0% LTI (Class A)	<0.5% STI & <2.0% LTI (Class A)	<0.5% STI & <2.0% LTI (Class A)	<0.5% STI & <2.0% LTI (Class A)
Spectral Match	≤±15% (Class A+)	≤±15% (Class A+)	≤±15% (Class A+)	≤±15% (Class A+)	≤±15% (Class A+)	≤±15% (Class A+)
Working Distance	10±1.0in	20±1.0in	22±1.0in	25±1.0in	30±1.0in	36±1.0in
Lamp Power	300W	1000W	1000W	1600W	2500W	7000W
Power Requirements	120VAC/8A or 230VAC/5A/ 50 - 60Hz	120VAC/15A or 230VAC/10A/ 50 - 60Hz	120VAC/15A or 230VAC/10A/ 50 - 60Hz	240VAC/10A or 230VAC/10A/ 50 - 60Hz	208VAC/3Phase/30A or 400VAC/3Phase/25A	208VAC/3Phase/35A or 400VAC/3Phase/30A
Source Meter Range	≤35A/±10V/350W, 10A/±10V/ 200W, 10A/±10V/ 100W, 5A/±10V/ 50W, 3A/±100V/ 30W, 1A/±10V/ 20W					
4-Wire Measurement	Available in All Options					
Computed Cell Parameters	Isc, Voc, Imp (direct), Vmp (direct), Jsc, Imp. Vmp, FF, Rs, Rsh, Pmax, Efficeincy					
Normalized IV Charactteristics	Available in All Options					

SLPSS System Characterization

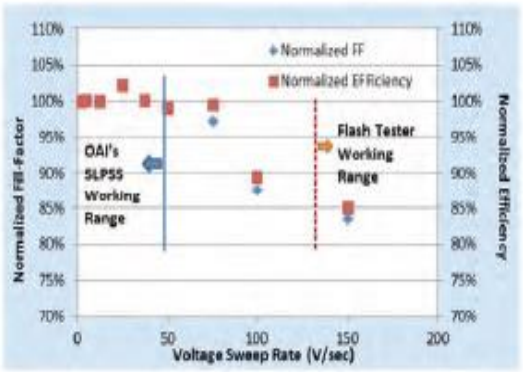
Pulse width characteristics:

The graph on the right compares the pulse width characteristics of OAI's SLPSS system to a typical Flash system pulse width. The pulse width of OAI's SLPSS system is adjustable from 5ms to >200ms and can be optimized for a given High Efficiency Solar Cell. The shutter speed can be adjusted from 50ms to 100ms so the total cell exposure and measurement time can be adjusted to below 350ms.



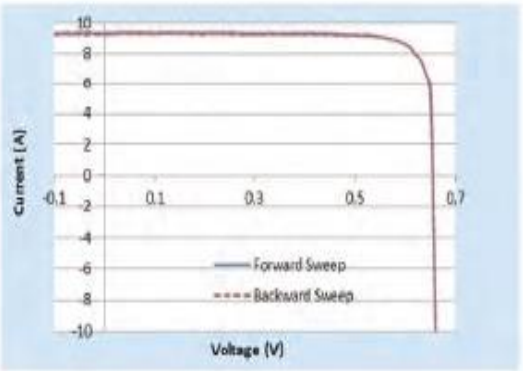
Voltage Sweep Rate:

During the I-V measurement of a High Efficiency Solar Cells, the voltage sweep rate along with pulse width and frequency at which the data is collected, determine the measurement accuracy. The graph on the right shows the dependency of the fill-factor (FF) and efficiency of a High Efficiency Solar Cell on the voltage sweep rate. OAI's SLPSS system provides the ability to adjust the sweep rate over a wide working range to get the most accurate solar cell performance measurement.



Forward/Backward Sweep:

High efficiency solar cells are characterized by their higher capacitance and higher resistance. These cells are usually measured with flash testers which provide shorter pulse duration and very fast voltage sweep rates. This results in inflated FF values for the reverse sweep and deflated values of the FF for the forward sweep. In contrast, OAI's SLPSS system, with its high power source meter, adjustable voltage sweep rates, and adjustable pulse widths provides the most accurate I-V measurements for both forward and reverse sweeps for the most consistent and accurate fill-factor and efficiency values.



Lamp Stabilization:

OAI's SLPSS system utilizes a Xe-arc lamp. The graph on the right shows the lamp's stabilization performance for the wavelength range from 400–1100nm at a resolution of 100nm. The Xe-arc lamp spectrum stabilizes within 5 minutes of turning on the lamp at which time, the system becomes available for accurate solar cell I-V measurements.