



Trisol™

Solar Simulator (TSS)

Featuring Advanced Uniform Beam Optics

PV/Solar
Photochemistry
Photobiology



FEATURES

- Advanced Uniform Beam Optics
- Beam size from 52mm – 300mm
- Meets JIS, IEC, ASTM Standards
- Longest working distance
- Perfect for R&D and Production
- Ideal for IV Testing & Light Soaking
- 3 year Class AAA Performance Warranty

OPTIONS

- Upgradable to 350nm-1800nm range
- Configurable for DSSC, Organic, Multi-junction & CPV solar cells
- Available with Automated Constant Intensity

OAI's *Trisol™* Solar Simulator, Class AAA, is available in a variety of models and aperture sizes (52 x 52mm, 100x100mm, 156 x 156mm, 208 x 208mm, and 300 x 300mm). With the use of advanced uniform beam optics, which includes proprietary coated mirrors, filters, and a beam uniformity integrator, OAI's solar simulator delivers highly accurate, collimated beams with the longest working distances. All of OAI's Solar Simulators are certified to ASTM E927-05, IEC 60904-9 2007, and JIS C 8912 standards for Class AAA performance (Spectral Match 400 – 1100nm wavelength in 100nm bandwidth increments, Non-Uniformity, and Temporal Instability). Available options include upgrades in the spectral match using OAI's proprietary filters for performance testing Dye Sensitized (DSSC), Organic (OPV), Concentrated Photovoltaic (CPV) and Multi-junction GaAs based solar cells. OAI's simulator filters are designed to Air Mass 1.5 Global (AM 1.5G) specifications but other air mass filters are also available. Without compromising Class A spectral match, the beam intensity can be adjusted from 0.8 – 1.1 Suns by using the one-touch button.

OAI's Solar Simulators come in standard configurations with the adjustable power mode, but can be upgraded to include both constant power or constant intensity operations. A variable power supply allows the beam intensity range to be from 0 suns to 1.1 suns. In the constant intensity mode, lamp power automatically adjusts to maintain a constant 1 Sun Intensity as lamp power starts to degrade over time.

All of OAI's solar simulators are easily integrated with OAI's IV Tester and test fixtures. However, the stand-alone solar simulator can be adapted to virtually any IV tester.

Trisol™ Solar Simulator

Featuring Advanced Uniform Beam Optics

OAI Model #	TSS-52	TSS-100	TSS-156	TSS-208	TSS-300
Special	Constant Current*	Constant Current*	Constant Current*	Constant Current*	Constant Intensity
Spectral Range**	400nm - 1100nm	400nm - 1100nm	400nm - 1100nm	400nm - 1100nm	400nm - 1100nm
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)
Collimated angle	(half angle) <±2.5°	(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)
Spatial Uniformity	≤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)
Spectral Match (400 - 1100nm)	±25% (Class A)	±25% (Class A)	±25% (Class A)	±25% (Class A)	±25% (Class A)
Working Distance	12 ± 0.5in	22 ± 0.5in	22 ± 0.5in	25 ± 0.5in	30 ± 0.5in
Lamp Power	300W	1000W	1000W	1600W	4000W
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/ 400VAC***/3Phase/25A/ 50 - 60Hz

*Upgradable to Constant Intensity

**Upgradable to 350 - 750nm in 50nm for DSSC and from 350 - 1800nm in 50nm for Organic and Multi-Junction applications

***CE Marking

Applications:

Trisol Solar Simulators are used in many applications including Photovoltaic, Photochemistry, Photobiology, and Environment Exposure Testing. Some of the key applications include: solar cell light soaking, solar cell IV Testing, performance measurement, sun screen efficacy, measurement of the biological effects of solar radiation, and studying of the effects of solar irradiance on various materials. *The chart below demonstrates solar simulator applications for various types of cells.*

Wavelength (nm)	Junction	c-Si (Mono & Multi)	a-Si	CdTe	CIGS	CZTS	DSSC	OPV	Quantum Dot	GaAs & III - V
350 - 750	SJ						350-850			
350 - 1100	SJ, TJ, MJ									
350 - 1800	MJ									

SJ: Single Junction

TJ: Tandem Junction

MJ: Multi Junction

Maintenance:

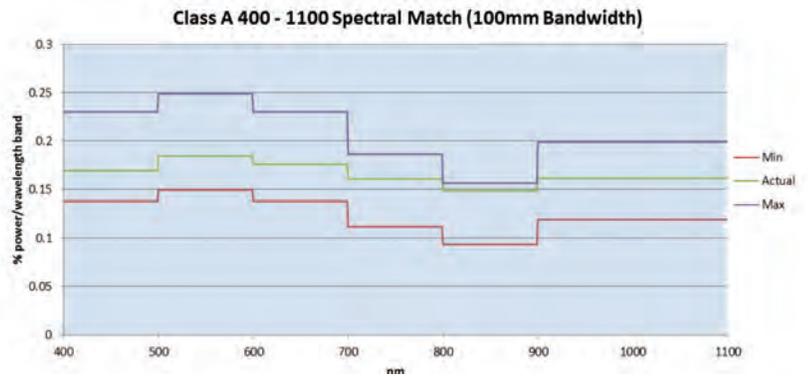
Trisol Solar Simulator is factory certified to Class AAA performance. Except for normal lamp change, which is required after specific intervals, these simulators work flawlessly. OAI maintains a full Photovoltaic Testing and Calibration Lab and welcomes customers to test their solar cells with OAI's Photovoltaic engineering team.

Class AAA Certification and Final Test Report:

OAI Solar Simulators are manufactured and certified by OAI's engineering staff. All Solar Simulators go through a rigorous calibration procedure that includes testing of the lamp housing, mirrors and filters. Each system is then fine-tuned to achieve a Class AAA certification. A typical final test report contains the following set of data:

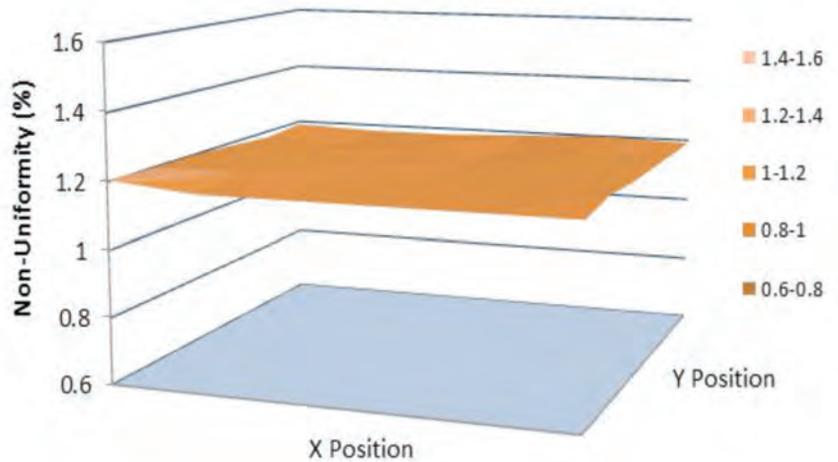
1. Spectral Match:

The Class A spectral match specification calls for spectral match in the range 0.75 – 1.25 times the ideal percentage. The chart to the right demonstrates a typical spectrum for a 156mm x 156mm system from 400nm-1100nm. Spectral Match options for DSSC, Organic, Multi-junction, and/or CPV applications are also available.



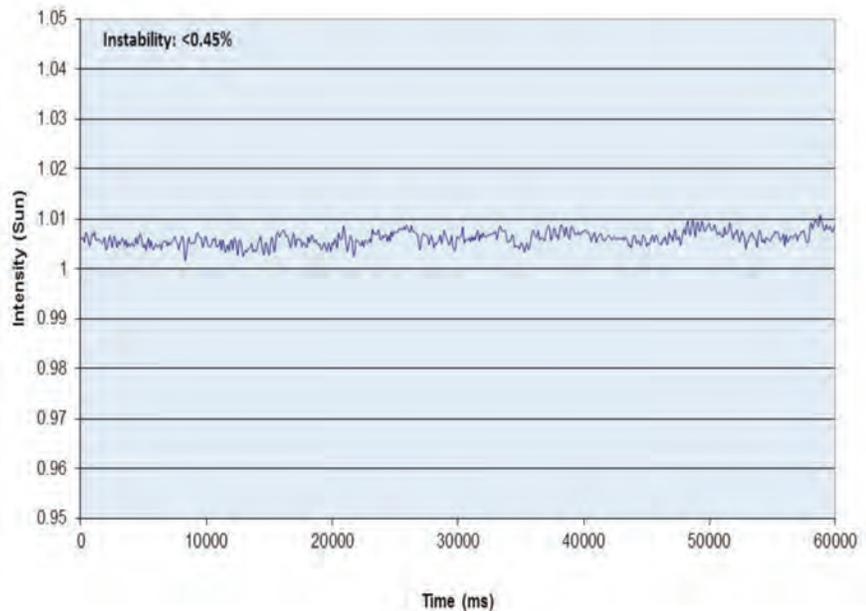
2. Irradiance Spatial Uniformity:

The Class A Spectral Spatial Uniformity Map of Irradiance for a typical 156mm x 156mm system is given in the chart to the right. With long working distances and integrated light homogenizers, all *Trisol* Solar Simulators provide $\leq 2\%$ Class A spatial uniformity over the entire working area for all aperture sizes. OAI's Advanced Uniform Beam Optics enables greater accuracy when testing for solar cell efficiency.



3. Temporal Instability:

The Class A temporal instability of OAI's typical 156mm x 156mm Solar Simulator system is shown in the graph to the right. The data is taken at 100ms time intervals. For accurate and repeatable solar cell performance measurements, lamp fluctuations from reading to reading should not cause data instability. Per the IEC 60904-9-2007 requirement as well as ASTM and JIS specifications, the measured data fluctuation for the short-term instability is within 0.5% and the long-term instability is $< 2\%$ per the specifications for Class A.





About OAI

For over 40 years, OAI has been a leader in the generation, control, and measurement of light. Supplying advanced precision equipment for both R&D and production, OAI has gained a worldwide reputation in the Photovoltaic/Solar, MEMS, Semiconductor, Microfluidics, MicroTAS, and Flat Panel industries. The company offers a broad portfolio of field-proven products that include: solar simulators, IV testers, solar power meters, calibrated reference cells, outdoor panel IV tracer, UV exposure systems, UV light sources, mask aligners, nano imprint modules, UV Measurement Instruments and numerous custom-engineered solutions. OAI's products deliver exceptional performance, high versatility and outstanding reliability. Based on a proven platform of modularized subsystems, many of these advanced tools can be custom configured to meet your specific requirements. With thousands of systems and instruments in use around the world, OAI prides itself on highly responsive customer service and superior engineering support.