CPV Solar Simulators

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Features

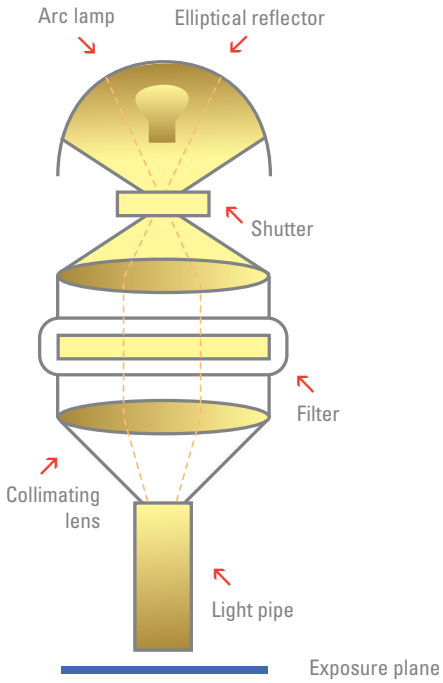
LOW DOSE CPV

- Uses OAI's Class AAA standard simulator in combination with light pipe adapter
- Has Advanced Uniform Beam Optics
- CPV range up to 50 Suns
- Cell sizes up to 2.54cm x 2.54cm
- Special 6 sun, large area 15.6cm x 15.6cm, <1° half angle available
- Upgradeable to Class A+ spectral match

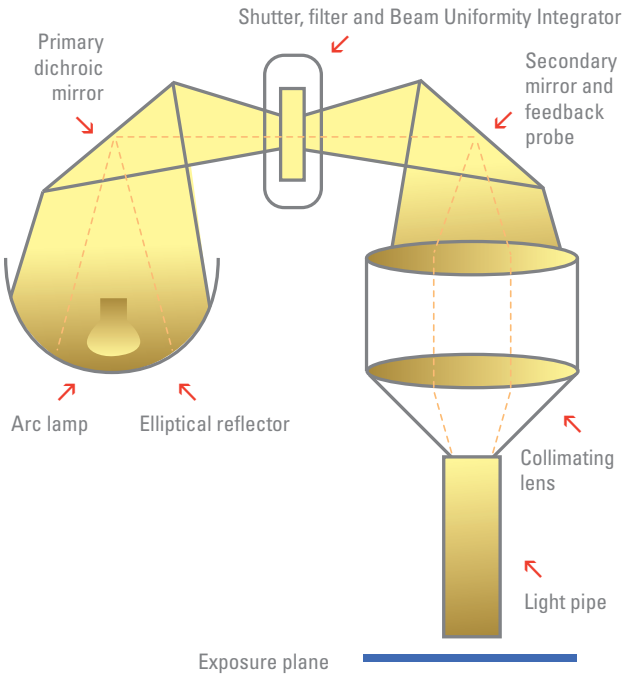
HIGH DOSE CPV

- Class AAA Performance
- Has Advanced Uniform Beam Optics
- CPV range from 20 to 1500 Suns
- Cell sizes up to 1.5cm x 1.5cm
- High speed shutter to reduce CPV cell heating
- Upgradeable to Class A+ spectral match
- Special 300 Suns, large area, 6cm x 6cm

HIGH DOSE CPV



LOW DOSE CPV



Concentrating Photovoltaics (CPV) has the promise of producing solar cells with high cell efficiencies which result in a reduction in the cost of operating a PV module. However, a CPV system requires the integration of CPV solar cells, modules and CPV optics into one efficient system. OAI's focus is CPV cell testing methodology. The CPV cells can now be tested using OAI's advanced standalone CPV Simulators for low dose and high dose configurations. The low dose CPV Solar Simulator provides exposure up to 50 Suns, whereas, the high dose CPV Solar Simulator provides exposure up to 1500 Suns. The low and high dose simulators provide exposure in varying Sun concentrations in various beam sizes from 1.5cm x 1.5cm to 7.5cm x 7.5cm, and may be configured with OAI's I-V Test Systems.

LOW DOSE CPV TO 50 SUNS

OAI's standard Class AAA Solar Simulators are fitted with optics that allow them to function both as a standard solar simulator (up to 1.2 Suns) and a low dose (up to 50 Suns) CPV Simulator. Available models are CPV LD15, CPV LD22 and CPV LD50 (as shown in the Product Specification Table). The low dose CPV Simulators are supplied with OAI's Advanced Uniform Beam Optics, which include proprietary coated mirrors, filters, and a beam uniformity integrator. These optics are then coupled with special concentrating light-pipe attachment optics. Standard Low Dose CPV beam sizes range from 2.5cm x 2.5cm up to 4.5cm x 4.5cm. Choose from either a 1KW, 1.5KW, or 4.0KW lamp housing to achieve a wide range of concentrating solar light (as shown in the Product Specification Table). Additionally, OAI offers a highly collimated 6 Suns CPV Simulator with half angle <1º,(Model CPV LA) for cells measuring up to 156mm x156mm. All of the low dose CPV Simulators use an OAI *TriSOL* Standard Solar Simulator as the base to deliver highly accurate and collimated beams to the concentrating optics. These *TriSOL* Standard Simulators are certified to ASTM E927-05, IEC 60904-9 2007, and JIS C8912 Standards for Class AAA performance (Spectral Match 400–1100nm wavelength in 100nm bandwidth increments, Non-Uniformity, and Temporal Instability). The Class A+ Spectral Match (<±12.5%) upgrade is also available using a specially designed filter.

CPV Solar Simulators

	Low Dose			
Model*	**CPV LD15**	**CPV LD22**	**CPV LD50**	**CPV LA**
Irradiance	1 - 15Suns	1 - 22Suns	1 - 50Suns	~1-6Suns
Class	AAA Spectral: ±25%, Spatial: <2%, and Temporal: <0.5% (STI) Also available in Class A+ (<±12.5%) Spectrum upgrade			
Standard	IEC 60904-9, JIS C8912, and C8933, and ASTM E927			
Beam Size (cm x cm)	2.54 x 2.54 (~15Sun) 4.5 x 4.5 (~5Sun)	2.54 x 2.54 (~22Sun) 4.5 x 4.5 (~8Sun)	2.54 x 2.54 (~50Sun) 4.5 x 4.5 (~20Sun)	15.6 x 15.6 (~6Sun)
Lamp / Wattage	Xe Short Arc 1.0KW	Xe Short Arc 1.5KW	Xe Short Arc 4.0KW	Xe Short Arc 4.0KW
Incidence Angle	Half angle < ±30°			Half angle < ±1.0°
Working Distance	~2mm			~22inch
Filters Options	AM 1.5G, AM1.5D, AM 1.0, AM 1.1 and Other Filters			
Spectral Match Options	350 - 1800nm			
Power Reduction	80% - 120% Control of Power Supply to Reduce Power			
Shutter Speed	50ms to Open and 50ms to Close			
Exposure and Shutter Control	I-V Software Allows Control of Exposure Time >100ms, and Number of Times Shutter Opens and Closes for a Measurement			
Safety	UL 60950			

**CPV LD is a Low Dose CPV Simulator and comes with an adaptor configuration. CPV LA is Large Area System. CPV HD is a High Dose CPV Simulator.*

HIGH DOSE CPV TO 1500 SUNS

The High Dose CPV Solar Simulators (Models CPV HD20, CPV HD500, CPV HD1500 & CPV HDLA300) are fully integrated, stand-alone, high concentration simulators. High Dose and small area CPV Simulators are available in three basic configurations: up to 20 Suns in a beam size of 7.5cm x 7.5cm, up to 500 Suns with a 2.54cm x 2.54cm beam size, and up to 1500 Suns with a 1.5cm x 1.5cm, beam size. OAI also manufactures a High Dose large area model (Model CPV HDLA300) simulator with 300 Suns intensity with a beam size of 60mm x 60mm. These High Dose CPV simulators are constructed with OAI's integrated Advanced Uniform Beam Optics, which includes proprietary coated mirrors, attenuation filters, a beam uniformity integrator, and fully integrated special concentrating light-pipe optics. Choose from either a 4.0KW or 7.0KW lamp housing to achieve a wide range of concentrating solar light (as shown in the Product Specification Table).

These systems come with an integrated, high speed shutter that reduces over exposure and sample heating during the measurement. The software shutter control facilitates cell exposure from 5msec to >300msec duration. In comparison to a flash type system, OAI's continuous high dose CPV simulators provide the capability for complete beam characterization. These CPV Standalone Simulators are certified to ASTM E927-05, IEC 60904-9 2007, and JIS C8912 Standards for Class AAA performance (Spectral Match 400–1100nm wavelength in 100nm bandwidth increments, Non-Uniformity, and Temporal Instability). The Class A+ Spectral Match (<±12.5%) upgrade is available using a specially designed filter.

I-V Measurement Systems & Software

All CPV Solar Simulators may be supplied as stand-alone systems or can be integrated with OAI's I-V Measurement System which includes OAI's Rider I-V Software and custom designed test fixtures. The measurement system utilizes an integrated I-V Source Meter (Current/Voltage/power Rating: ±1A/±20V/20W, ±3A/±20V/60W, ±5A/±40V/50W, ±10A/±20V/200W and ±20A/±10V/200W), I-V Rider Software, and accessories to allow both manual and automatic I-V Measurement. The integrated I-V software allows the plotting of an I-V Curve, plus calculation of various solar cell parameters such as Isc, Jsc, Voc, FF, Vmax, Imax, Pmax, Cell Efficiency, Rs and Rsh. OAI can also integrate an I-V Source Meter to match your specifications. Additionally, the software and optical feedback control correct each data point for any short term intensity fluctuation giving the most repeatable results available. The I-V Rider Software also allows data storage in an ASCII file. OAI works with its customers in OAI's Solar Test Lab to analyze the CPV cells and to select the correct I-V test parameters for optimizing the testing of CPV cells.

General Description: OAI's *TriSOL* Solar Simulators

OAI's TriSOL 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:

CPV Solar Simulators

High Dose			
CPV HD20	**CPV HD500**	**CPV HD1500**	**CPV HDLA300**
1 - 20Suns	20 - 500Suns	200 - 1500Suns	260 - 300Suns
AAA Spectral: ±25%, Spatial: <2%, and Temporal: <0.5% (STI) Also available in Class A+ (<±12.5%) Spectrum upgrade			
IEC 60904-9, JIS C8912, and C8933, and ASTM E927			
7.5 x 7.5	2.54 x 2.54	1.5 x 1.5	6.5 x 6.5
Xe Short Arc 4.0KW	Xe Short Arc 7.0KW	Xe Short Arc 7.0KW	Xe Short Arc 7.0KW
Half angle <30°			
~2mm			
AM 1.5G, AM1.5D, AM 1.0, AM 1.1 and Other Filters			
350 - 1800nm			
80% - 120% Control of Power Supply to Reduce Power			
50ms to Open and 50ms to Close			
I-V Software Allows Control of Exposure Time >100ms, and Number of Times Shutter Opens and Closes for a Measurement			
UL 60950			

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 the typical spectrum for the CPV Simulators from 400mm-1100mm. The Class A spectrum can further extend from 350 – 2000nm range with the use of an upgradable filter.

Temporal Instability

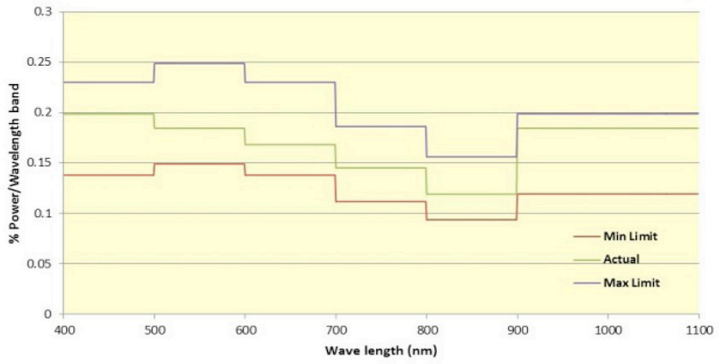
The Class A temporal instability of OAI's all concentrated CPV solar simulator systems is shown in the graph to the right. The data is taken at 100ms time intervals. For accurate and repeatable solar cell performance measurements, lamp fluctuations from reading to reading should not cause data instability. 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.

Irradiance Spatial Uniformity

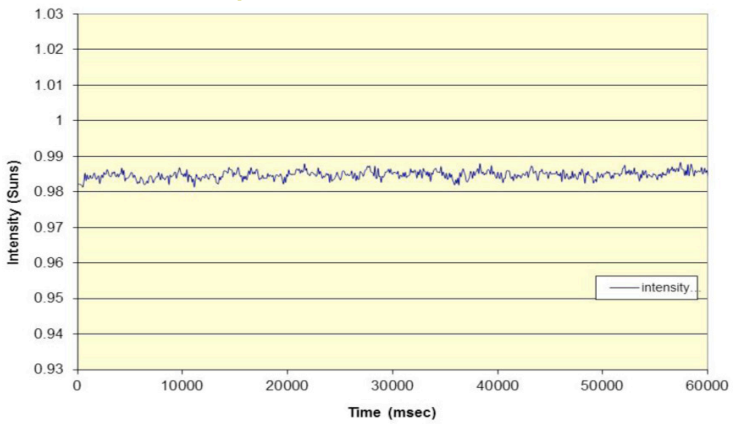
All CPV Solar Simulator Systems use Advanced Uniform Beam Optics to provide ≤2% Class A spatial uniformity over the entire working area for all aperture sizes.

OAI's Advanced Uniform Beam Optics delivers greater accuracy for solar cell efficiency. All of OAI's CPV based Solar Simulators also have integrated feedback control, touch screen interface, remote shutter activation and real-time beam intensity signal for calibration of I-V test data.

Spectral Match



Short Term Temporal Instability



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, I-V testers, solar power meters, calibrated reference cells, outdoor panel I-V 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.

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