sunbrick.™ Product Line Specifications

The Class A+A+A+ next-generation Sunbrick LED larger-area solar simulator provides world-class sunlight replication, complete with software-controlled spectra and traceable calibration - all with no fragile bulbs or moving parts.

This Sunbrick has a warm-up time incomparable to more common bulbs and can replicate the standard AM1.5G solar spectrum with the click of a button, allowing you to quickly start any experiment when you need to, with no wasted time.

With its excellent Class A+ (<1%) spatial non-uniformity, low 9% spectral mismatch, and less than 0.025% short-term temporal instability, all certified within a 10 cm x 10 cm square illumination area, the Sunbrick can accommodate a wide range of applications.

If Class A is all you require, the Sunbrick complies with that class of performance out to 15 cm x 15 cm.

And with its modular design, Sunbrick arrays can be mounted together in a grid pattern to provide its Class A+A+A+ quality solar replication over arbitrarily large areas (up to $1m^2$) to handle whatever size your experiments grow to.

Finally, Sunbrick provides the ability to customize spectra through the individual adjustment of 23 unique LED wavelength controls, 32 total channels, and over 140 LEDs, allowing you to tune the spectrum as needed for your work and be confident that your experiment is getting the best light possible, no matter where you position it.

Features and Benefits

- Rated Class A+A+A+ to IEC60904-9:2020 standards
- Spectral Mismatch <9% in all spectral bins, exceeding Class A+ standard by more than 25%
- Class A+ Temporal instability of <0.025%, exceeding the standard by 10x
- Class A+ spatial non-uniformity in a 10 cm x 10 cm square area for single unit (Class A in 15 cm x 15 cm)
- 1 second cold-start to Class A+ turn-on time
- Expected 25,000-hour solar simulator lifetime
- Variable output from 0% to 150% and individual control of 23 LED channels through software
- Includes Python API for custom automation and integrations
- Includes native Keithley 2400 and 2460 SMU software integration into the modern GUI
- Modular design allows tiling up to larger sizes (up to $1m^2$)

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CE UKCA

Sunbrick Solar Simulator

Parameter	Value	Units	Notes
Type of Solar Simulator	Steady-State	N/A	Continuous-Wave Light Emitting Diodes (LEDs)
Mounting Configuration	Vertically or Horizontally with the provided stand	N/A	
Spectral Mismatch [1]	≤ 9	%	@AM1.5G 1.0 suns exceeds IEC 60904-9, 300-1200 nm Class A+ Standard. Varies with suns level
Short-term Temporal Instability (STI) [2]	≤ 0.025	%	Exceeds IEC 60904-9 Class A+ Standard by 10X
Long-term Temporal Instability (LTI) [3]	≤ 1	%	Exceeds IEC 60904-9 Class A+ Standard
Spatial Non-Uniformity [4]	≤ 0.8	%	Class A in 15 cm x 15 cm square centered in beam[4] Class A+ in 10 cm x 10 cm square centered in beam
Illumination Angle	Lambertian	N/A	FWHM of a single white LED is 125°
Working Distance	15	cm	Co-planar with bottom edge of mirrors
Software Intensity Adjustment Range	0 - 150	%	1.5 times AM1.5G 1.0 suns
Available Spectral Presets	0.1 to 1.2 suns AM1.5 in 0.1 sun increments	N/A	AM0 and custom spectra available upon request
Calibrated Output Irradiance [5]	83.3	mW/cm^2	1.0 sun AM1.5G target irradiance
Spectral Range	350 - 1200	nm	
Irradiance Control Range	8.3 - 99.3	mW/cm^2	0.1 - 1.2 suns AM1.5G
Wavelength Channels	23	N/A	32 total channels with duplicates included
Warm-up Time to Class A+	1	Seconds	From cold start to Class A+ region (STI and LTI)
Stabilization Time Between Adjustments	1	Seconds	From cold start to Class A+ region (STI and LTI)
Standard Compliance	Class A+A+A+ to IEC60904-9:2020, Class AAA to ASTM E927-19	N/A	1.0 sun AM1.5G
LED Calibrated Operating Temperature	44	°C	Target operating temperature for LED board
Ambient Operating Temperature	20 - 27	°C	Temperature range. Above this range, the instrument may lose calibration due to thermal drift
Ambient % Relative Humidity	30 - 60	%	Relative Humidity. above ambient range may damage the instrument or lose calibration
Size	33.4 x 33.4 x 25.4	cm	W x L x H (illumination head only)
Weight	22.1, 16.5	kg	Standard leg configuration, Illumination Head Only
Unit Lifetime	25,000	Hours	Expected minimum LED lifetime

[1] Spectral Mismatch measured at 1.0 sun AM1.5G using a calibrated spectroradiometer centered in the illumination field, according to IEC60904-9:2020 spectral bins.

[2] STI measured for 120 seconds at ~1 Hz at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell centered in illumination field. STI calculated using Equation (2) from IEC 60904-9:2020 section 3.10.

[3] LTI measured for 6 hours at ~2 samples/min at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell centered in illumination field. LTI calculated using Equation (2) from IEC 60904-9:2020 section 3.10.

[4] Spatial Non-uniformity measured at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell. Detector is moved in 64 square-grid measurements across the illumination plane, a 20 cm x 20 cm square area. Non-uniformity calculated using Equation (1) from IEC 60904-9:2020 section 3.9.

[5] These values are equivalent to the often-quoted 100 mW/cm^2 standard value for 1-sun solar simulators. For more information, see our article explaining calibrated spectral irradiance.

Warranty	2	Years	Optional extension available
Automation Capability	Through the included Python API	N/A	Python API available upon customer request
Sunbrick GUI Compatibility	Windows: Windows 10 or later Mac: Monterey and up Linux: - Ubuntu 18.04 and newer - Fedora 32 and newer - Debian 10 and newer	N/A	1920 x 1080 resolution for best viewing
Software Features	Dashboard, One Click Sun (beta), Custom Spectra, Import/Export Spectrum, Tunable Spectra, Spectral Match, Tile Dashboard, IV Capture	N/A	See Sunbrick Manual for software features
I/O Comm / Control Protocol	Ethernet	N/A	
I/O Comm Connector	Ethernet	N/A	
Included Hardware	Sunbrick, stand, power supply	N/A	
Setup	10 cm clear space behind for cables. Airflow is in through the top and out via the perimeter of the bottom		Recommend clear space around the unit to maintain continual optimal thermal performance

Sunbrick Power Supply

Parameter	Value	Units	Notes
Input voltage (AC)	85 - 264	V	AC
Input current	2.5 - 6.9	A	Varies with input voltage
Inrush current (max.)	95A/115VAC, 120A/230VAC	A	Cold start, varies with input voltage
Input Power	360	W	
AC Phase	1	N/A	
AC Frequency	47 – 63	Hz	
Input AC Receptacle	IEC320-C14	N/A	UL 94-V2 or better
Output Power	220	W	
Output Voltage	24	V	
Ambient operating temperature	-30 to 70	°C	
Case Flammability	UL94V-0	N/A	
Size	22 x 9.5 x 4.6	cm	
Weight	1.4	kg	
Certification	CE (European conformity), UKCA (UK Conformity Assessed), UL623681 (USA – CSA C22.2 No.623681), BS EN/EN623681 (Europe – Dekra), IEC623681 (CB scheme), CNS14336 (BSMI – Taiwan), GB4943.1 (CCC – China), J623681 (PSE – Japan), IS13252 (BIS – India), KC623681 (Korea), EAC TP TC 004 (Russia/Eurasian Economic Union), FCC Part 15 / CISPR22 (USA), CAN ICES3(B)/NMB3(B) (Canada), EAC TP TC 020 (Eurasian EMC), MSIP KN32 (Korea EMC), Energy Efficiency Level VI (DoE/EISA 2007 – USA, NRCan – Canada)	N/A	

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Single Sunbrick Support Stands

Parameter	Value		
Stand options	Vertical/Standard, Wide leg, Horizontal	N/A	
Size	33 x 33 x 25	cm	
Weight	5.7	kg	
Materials	Aluminum extrusion	N/A	

Note: Multijunction Reference Validation

For the case of multijunction cells/devices/arrays, G2V is currently unable to validate the Sunbrick for out-of-the-box performance and calibrated output for use with multijunction-based solar devices due to the lack of standardization among formulations and designs of multijunction devices. Different junction designs will sample different portions of the solar spectrum as well as have their own spectral responsivities, potentially resulting in spatial non-uniformity and spectral mismatch characterization outside of the Class A standards for those junctions and spectral responsivities.

Thus, G2V recommends that customers working with multijunction cells perform their own validation on-site in order to ensure their G2V product is performing to the customers' desired standards for specific junctions.

If you are willing to submit a sample of your device that you are wanting to be tested prior to the purchase of a Sunbrick, it is possible for G2V to calibrate a unit for that device for an extra fee.

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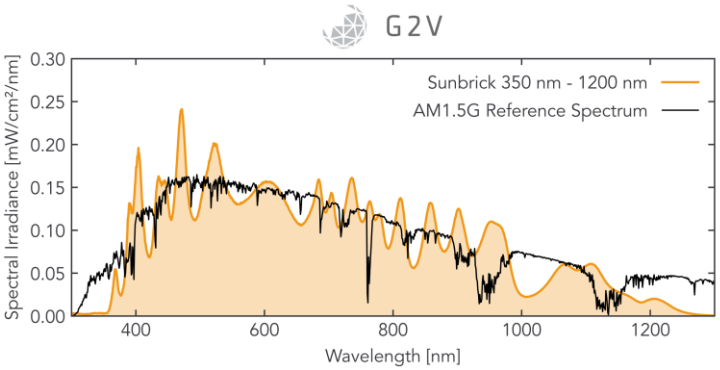
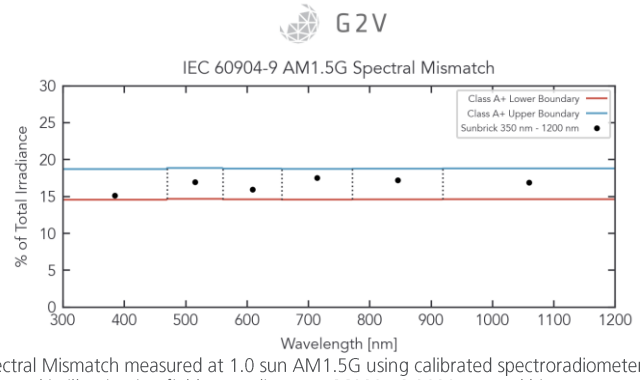
Sunbrick IEC Standard Compliance

AM1.5G Spectrum and Reference

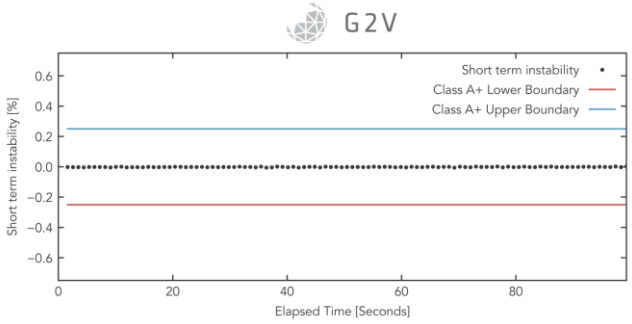


AM1.5G Spectral Mismatch



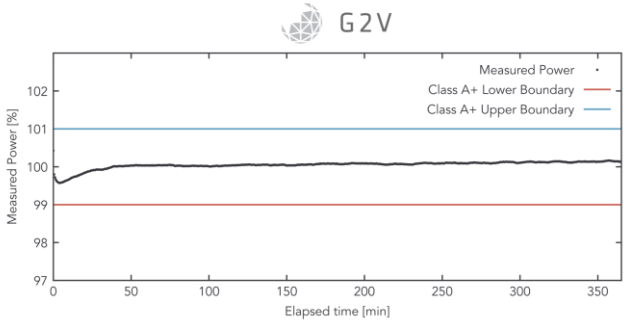
Spectral Mismatch measured at 1.0 sun AM1.5G using calibrated spectroradiometer centered in illumination field, according to IEC60904-9:2020 spectral bins.

Short-Term Temporal Instability (STI)



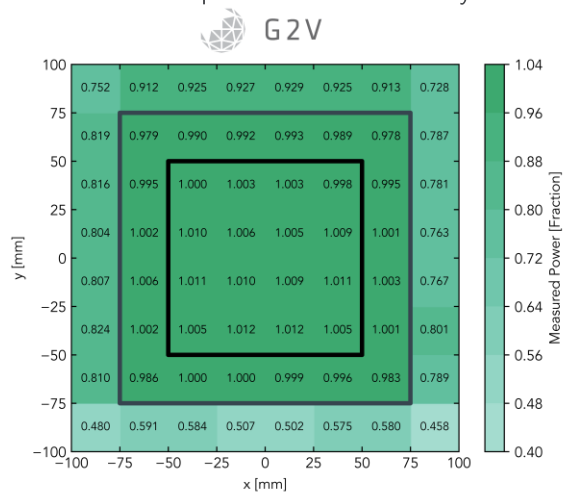
STI measured from cold-start for 120 seconds at ~1 Hz at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell centered in illumination field. STI calculated using Equation (2) from IEC 60904-9:2020 section 3.10.

Long-Term Temporal Instability (LTI) – cold start



LTI measured from cold-start for 6 hours at ~2 samples/min at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell centred in the illumination field. LTI calculated using Equation (2) from IEC 60904-9:2020 section 3.10.

Spatial Non-Uniformity



Spatial Non-uniformity measured at 1.0 sun AM1.5G using a 20 mm x 20 mm monocrystalline silicon cell. Detector is moved in 64 square-grid measurements across the illumination plane, a 20 cm x 20 cm square area. Class A area is denoted by the grey square, and Class A+ area is denoted by the black square. Non-uniformity calculated using Equation (1) from IEC 60904-9:2020 section 3.9.

Modern Intuitive Graphical User Interface (GUI)

A modern interface with click and drag spectrum control, import and export functions to collaborate with partners, Day-night cycle testing at unique simulated geographical locations with the One-Click Sun (beta) program, and native support for Keithley 2400 and 2460 Source Measurement Units to take IV data for your samples along with a Python API give the Sunbrick the most comprehensive testing capabilities ever offered by G2V Optics.