

Light sources for solar simulation

Solar simulators

- Efficient optical design
- One sun (1000 W/m²) irradiance for up to 260 mm x 260 mm fields
- Different solar spectra with interchangeable filters

These light sources have been especially developed to simulate solar radiation and are therefore called solar simulators. They produce a uniform, collimated (parallel) output beam with a spectral match close to sun light.

We offer several types with the different spectra and irradiance outputs, depending on the beam size and filters used. We use Xe short arc lamps as radiation source because they provide the closest spectral match to the solar spectrum available from any commercial source.

Compact design

The entire source, power supply, control electronic, shutter, lamp and optical compartment can be housed in a compact area of approx. 900 x 900 x 500 mm³ in size. A housing base raises the unit to a working height of typically 200 mm. The design produces a well-balanced unit which is usually used standing free. For OEM applications the self contained optical bench design cage can be easily integrated into a more complex system.

Having the igniter in a single enclosure ensures that EMI (Electro Magnetic Interference) generated during lamp ignition is contained inside the housing.

Optical system

An ellipsoidal reflector surrounds the lamp and collects over 70% of the lamp output. The radiation is focused onto an advanced illumination homogenizer which produces a uniform diverging beam. This beam is deflected 90° by a mirror to a final collimating lens. The output is a uniform collimated beam. The optical compartment also contains an electronic shutter, optics cooling fan, precision lamp adjusters as well as filters and mirrors needed to produce the desired spectral shape, uniformity and irradiance level. All systems ordered with an AirMass 1,5G filter are equipped with a glass lens for UV protection. If a quartz lens is required, please add -Q to the corresponding part number.



Optical engine



Solar simulator

For AM 0 a quartz lens is mandatory for the spectral match.

There are no tools needed to replace the Xe lamp. Focusing the lamp does not expose the operator to any unsafe light levels (other than the usual high light levels in the work plane).

All of the lamp adjustments are conveniently located on the side of the source enclosure. They are equipped with indicator dials that provide positive feedback on the alignment status and assure stable operation once aligned. The focusing and centering (XYZ stage) are smooth and precise and allow maximum control and ease in optimizing the uniformity and irradiance.

Output orientation

Standard systems are delivered in "beam down" configuration. However, "beam up" or horizontal output direction can be achieved easily because the beam turning and collimating lens compartment can be rotated and fixed every 90°. For your convenience just add -U (beam up) or -H (horizontal) to the corresponding order number and your system will be delivered in the desired orientation

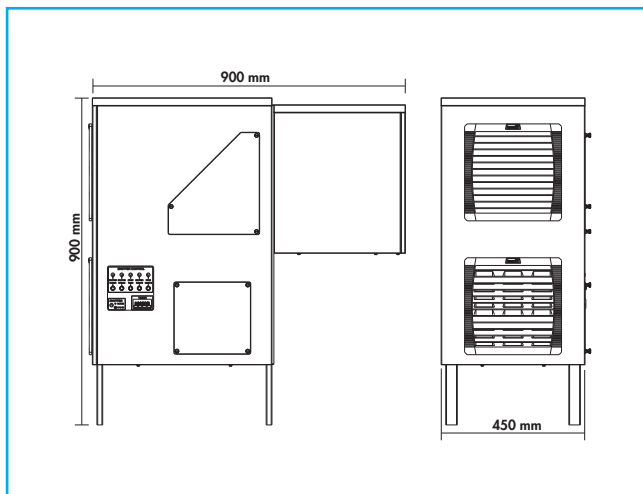
System cooling

The bulb temperature of arc lamps should not exceed 600 - 900 °C, because the bulb is not able to withstand the high gas pressure due to a temperature-related change of the quartz structure (recrystallization). To avoid current conductor oxidation, the socket temperature must not exceed 230 °C. Lamps with 200 W and higher require a forced cooling of the base connection parts and bulb cooling for higher wattage lamps is essential. Any dust or dirt particles introduced into the optical system can degrade the system performance and shorten the life of critical optical components. To avoid this our sources utilize an air dust filter cooling fan.

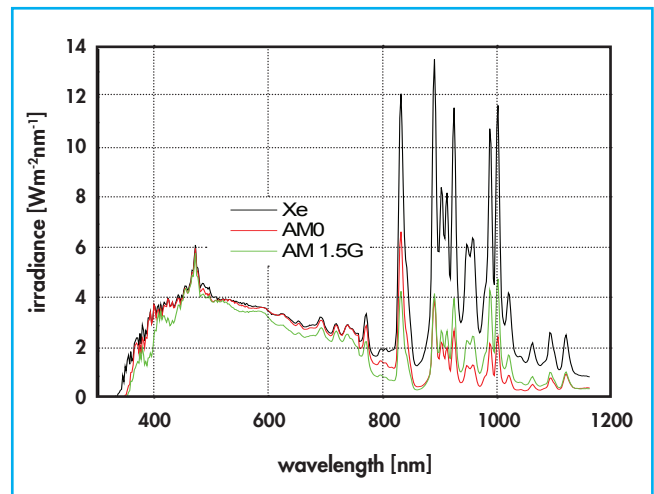


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Approx. dimensions of a 160 x 160 mm² field size solar simulator



Different solar spectra

Interlocks

In case of a fan failure that could cause a system overheat safety interlocks will shut down the entire system. Door interlocks shut down the system to prevent exposure to hazardous voltage, current or radiation if the door is opened during system operation.

Air mass filters

The evaluation of the sun above horizon, or conversely the angle of the sun from the vertical (zenith) determines what is called air mass. Air mass values are higher when the sun is lower in the sky. For example, air mass is 1 when the sun is directly overhead and the angle of sun to zenith direction is 0°. Air mass is 2 when the angle is 60°. The extraterrestrial spectrum is called air mass 0, because it passes through no air mass.

Digital shutter timer

All solar simulators are supplied with a digital shutter timer which can be activated from a control panel or via an RS 232 connection.

Dust filtering

Solar simulators are normally not used in a clean room environment. Typical laboratories contain airborne dust. Pulling room cooling air with a powerful fan into a system with delicate coated optical components, can degrade the optical performance or, worse, reduce the components lifetime. Cooling air for all of our systems is filtered to ensure that the inside of the simulator remains dust free. New filters are inexpensive and can be replaced in a matter of seconds, no tool required.

AAA or ABA

According to the American ASTM E927-5 and European IEC 60904-9 norm the performance of solar simulators is classified in three different categories. For each category the system can reach Class A, B or C.

“Spectral match” describes the ability to follow the natural sun spectrum. The spectral shape of the Xenon lamp already provides a close match. Fine tuning is then done by the selected AirMass filter. All offered systems reaching Class A for this criterion.

“Irradiance uniformity” provides information about the homogenous distribution over the specified illumination area. Depending on the application and requirement class A or B solar simulators are available.

“Temporal stability” of the emitted light is specified in the last category. Thanks to carefully designed electronic components like power supply and igniter all systems are Class A specified.

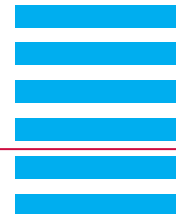
A word on safety

Our solar simulators include safety features to prevent lamp damage and accidental exposure. A door interlock prohibits the operation of the lamp while the door is open. Overheating of the lamp caused by a defect is avoided by a thermal interlock which shuts down the power supply.

These systems emit high levels of ultraviolet radiation. Exposure to UV, even for short periods, can cause severe skin and eye burns. Always wear protective eye-wear and gloves or clothing, when working near these sources. For more about UV safety go to “[Ultraviolet safety considerations](http://www.lot-qd.com/lightsources)” on www.lot-qd.com/lightsources (Basics).

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Ordering information

Specification class AAA systems		
Spectral match (with filter AM1,5G)	IEC 6 0904-9	Class A
	ASTM E927-5	
Irradiance uniformity	IEC 60904-9	Class A ($\leq \pm 2\%$)
	ASTM E927-5	
Temporal stability	IEC 60904-9	Class A
	ASTM E927-5	

Part number	Illuminated field size	Lamp type	Typ. output power @200 mm distance from last lens	Lens material
LS0911	110 mm x 110 mm	550 W Xe	min. 1 sun	glass
LS0916	160 mm x 160 mm	1600 W Xe	min. 1 sun	glass
LS0921	210 mm x 210 mm	1600 W Xe	min. 1 sun	glass
LS0911-Q	110 mm x 110 mm	550 W Xe	min. 1 sun	quartz
LS0916-Q	160 mm x 160 mm	1600 W Xe	min. 1 sun	quartz
LS0921-Q	210 mm x 210 mm	1600 W Xe	min. 1 sun	quartz

Note 1: For use with AM 0 filter LSZ185 a quartz lens is mandatory.

Note 2: Standard systems are delivered in "beam down" configuration. The beam turning and collimating lens compartment can be rotated and fixed every 90°. "Beam up" or horizontal output direction can be achieved easily in the field. Add -U (beam up) or -H (horizontal) to the corresponding order number and your system will be delivered in the desired orientation.

Part Number	Air mass filters
LSZ289	Air mass 1.5 global filter, (direct and diffuse) through atmosphere, 48°
LSZ185	Air Mass 0 filter (outer space)

Part Number	Xenon lamps
LSB545	550 W Xenon arc lamp, ozone-free average life time: 1500 h
LSB562	1600 W Xenon arc lamp, ozone-free average life time: 2000 h

Specification class ABA systems		
Spectral match (with filter AM1,5G, AM0)	IEC 60904-9	Class A
	ASTM E927-5	
Irradiance uniformity	IEC 60904-9	Class B ($\leq \pm 5\%$)
	ASTM E927-5	
Temporal stability	IEC 60904-9	Class A
	ASTM E927-5	

Part number	Illuminated field size	Lamp type	Typ. output power @200 mm distance from last lens	Lens material
LS0811	110 mm x 110 mm	550 W Xe	min. 1 sun	glass
LS0816	160 mm x 160 mm	1000 W Xe	min. 1 sun	glass
LS0821	210 mm x 210 mm	1600 W Xe	min. 1 sun	glass
LS0826	260 mm x 260 mm	1600 W Xe	min. 1 sun	glass
LS0811-Q	110 mm x 110 mm	550 W Xe	min. 1 sun	quartz
LS0816-Q	160 mm x 160 mm	1000 W Xe	min. 1 sun	quartz
LS0821-Q	210 mm x 210 mm	1600 W Xe	min. 1 sun	quartz
LS0826-Q	260 mm x 260 mm	1600 W Xe	min. 1 sun	quartz

Note 1: For use with AM 0 filter LSZ185 a quartz lens is mandatory.

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Part Number	Air mass filters
LSZ289	Air mass 1.5 global filter, (direct and diffuse) through atmosphere, 48°
LSZ185	Air mass 0 filter (outer space)

Part Number	Xenon lamps
LSB545	550 W Xenon arc lamp, ozone-free average life time: 1500 h
LSB552	1000 W Xenon arc lamp, ozone free average life time: 2000 h
LSB562	1600 W Xenon arc lamp, ozone free average life time: 2000 h