Specifications

		QSOA-S (sunlight)	QSOA-E (electric)
Calibration		Natural sunlight	Electric lamps (8% difference)
Absolute accuracy		± 5 %	± 5 %
Uniformity		± 3 %	± 3 %
Repeatability		± 1 %	± 1 %
Application		Measuring Photosynthetic Photon Flux	
2.5 V option	**Output**	0 to 2.5 V (2.0 V = full sunlight 2,000 µmol m^{-2} s^{-1})	
	Input power	2.5 to 5.5 VDC	
	Sensitivity	Custom calibrated to exactly 1.00 µmol m^{-2} s^{-1} / mV	
5.0 V option	**Output**	0 to 5 V (4.0 V = full sunlight 2,000 µmol m^{-2} s^{-1})	
	Input power	5 to 5.5 VDC	
	Sensitivity	Custom calibrated to exactly 0.50 µmol m^{-2} s^{-1} / mV	
Current draw		285 µA	
Operating environment		- 40 to 55 °C; 0 to 100% relative humidity. Designed for continuous outdoor use. Can be submerged under water (with or without mounting screw).	
Materials		Anodized aluminum with acrylic lens	
Cable		3 meters of shielded, twisted-pair wire with Santoprene casing, ending in pigtail leads. Additional cable $1.95/meter.	
Dimensions		2.4 cm diameter, 2.75 cm high	
Mass		70 g (with 3 m lead wire)	
Warranty		1 year against defects in materials and workmanship	

435-792-4700
www.apogeeinstruments.com
techsupport@apogee-inst.com

Amplified Quantum Sensor

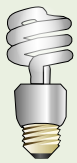
Owners Manual

Model: QSOA-E
QSOA-S

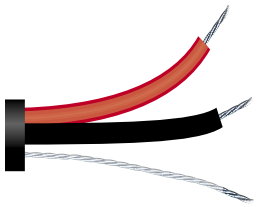
2.5 and 5.0 V options

Calibration

Quantum sensors are calibrated for electric light or sunlight. Average spectral errors associated with each calibration are shown below.

	Electric Calibration	Sunlight Calibration
 Cool White Fluorescent	0% error	8% high
 Metal Halide	0% error	8% high
 High Pressure Sodium	6% low	2% high
 Sunlight	8% low	0% error

Setup Instructions



Red: positive (signal from sensor)

Black: input power

Clear: ground (for sensor signal and input power)

	2.5 option	5.0 option
Power Supply	2.5 to 5.5 V	5.0 to 5.5 V
Conversion factor	1.0 µmol m^{-2} s^{-1} per mV	0.5 µmol m^{-2} s^{-1} per mV
Output (volts)	0.0 to 2.5 V	0.0 to 5.0 V
Full sunlight	2.0 V (2,000 µmol m^{-2} s^{-1})	4.0 V (2,000 µmol m^{-2} s^{-1})

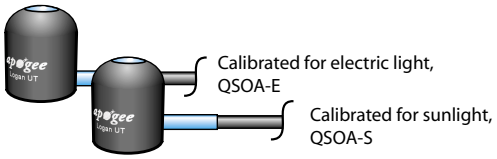
Do not exceed 5 Volts in power supply.

Quantum Sensor Models

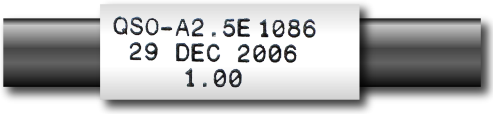
A quantum refers to the amount of energy carried by a photon. Apogee quantum sensors approximate the quantity of photons between 400 and 700 nanometers. Photosynthesis is largely driven by the number of photons between these wavelengths, so this radiation is called the Photosynthetic Photon Flux (PPF) and is measured in µmol m^{-2} s^{-1}.

Amplified Quantum Sensors:

US Patent No. D519,860



The model, serial number, production date, and calibration factor are located on the sensor cable.

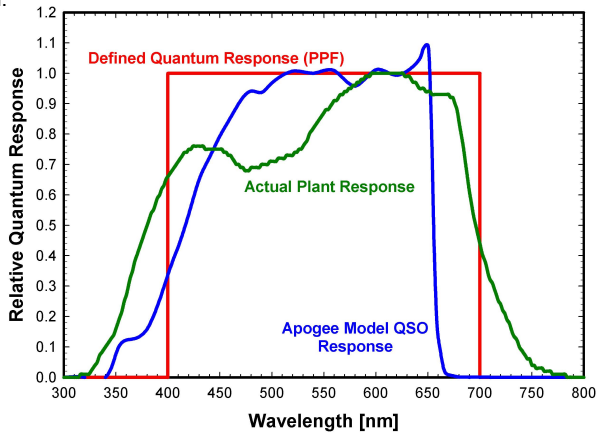


Cosine response
Some of the radiation coming into a sensor at low angles is reflected, which causes low readings. The convex optical disc is designed to capture radiation at low angles and minimize cosine response errors. The cosine error for typical applications is less than 2%.

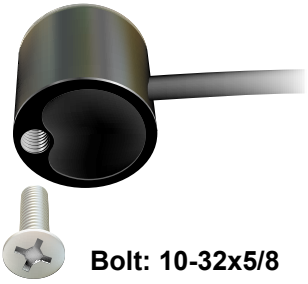
Temperature response
The temperature response is less than 0.1% per degree Celsius. This temperature error is not significant in most applications.

Long-term stability
Our research indicates that the average output increases approximately 1% per year because of changes in the optical transparency of the diffusion disk. We recommend returning the sensor for recalibration every 2 years.

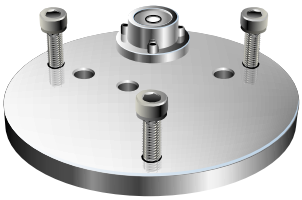
Spectral Response
As shown in the graph below, quantum response by definition is from 400 to 700 nm, and gives equal emphasis to all photons in that range. The spectral response of the Apogee sensor, as well as a typical plant response, are also shown.



Mounting the QSOA-E and QSOA-S

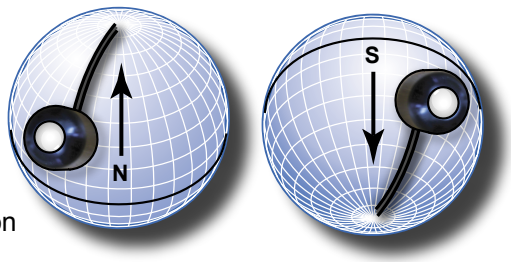


Bolt: 10-32x5/8



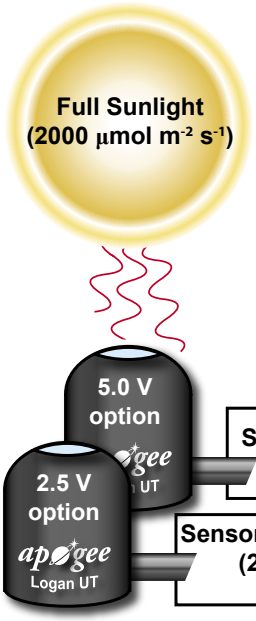
Model LEV

Each sensor is equipped with a mounting bolt. Mount the sensor as level as possible. Small changes in level can cause measurement errors. We recommend using our leveling plate (model LEV) for the most accurate measurements. The sensor should be mounted with the cable pointing toward the nearest magnetic pole to minimize azimuth error.



Orientation

Calibration



Use the designated conversion factor (0.5 or 1.0 µmol m^{-2} s^{-1} per mV) to convert the mV signal from the sensor to photosynthetic photon flux in µmol m^{-2} s^{-1} (multiply the mV output by the conversion factor to yield PPF in µmol m^{-2} s^{-1}).

Sensor Output	Conversion factor
(4 V)	**(0.5 µmol m^{-2} s^{-1}** per mV)
Sensor Output	**Conversion factor**
(2 V)	**(1.0 µmol m^{-2} s^{-1}** per mV)

PPF = sensor output x conversion factor
= 4,000 mV x 0.5 **µmol m^{-2} s^{-1}** per mV **= 2,000 µmol m^{-2} s^{-1}**