

Quantum Sensor

Owners Manual

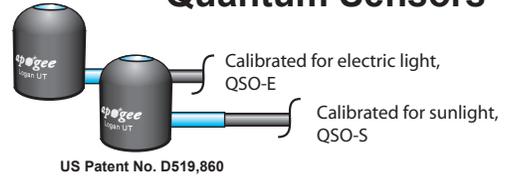
Model: QSO-E
 QSO-S
 LQS-E
 LQS-S



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 $\mu\text{mol m}^{-2} \text{s}^{-1}$.

Quantum Sensors



Line Quantum Sensors

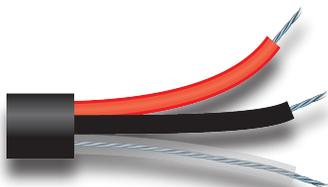
Specify calibration for sunlight or electric light (8% difference)



Setup Instructions

1. Attach the sensor to a meter or datalogger that can display or record a mV output. The sensor is self-powered.

Never attach a power source to the sensor

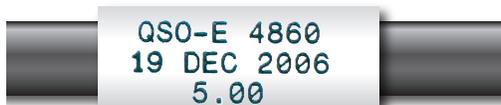


Red: positive (signal from sensor)

Black: negative (signal from sensor)

Clear: shield/ground

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



Mounting the QSO-E and QSO-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

All quantum sensor models have a standard calibration of exactly:



5.00 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV

Use the conversion factor (5.00 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV) to convert the mV signal from the sensor to photosynthetic photon flux in $\mu\text{mol m}^{-2} \text{s}^{-1}$ (multiply the mV output by the conversion factor to yield $\mu\text{mol m}^{-2} \text{s}^{-1}$).



Sensor Output (400 mV)

$$\text{PPF} = \text{sensor output} \times \text{conversion factor}$$

$$= 400 \text{ mV} \times 5.00 \mu\text{mol m}^{-2} \text{s}^{-1} = 2000 \mu\text{mol m}^{-2} \text{s}^{-1}$$

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 | 2% low | 6% high |
|  | High Pressure Sodium | 8% low | 0% error |
|  | Sunlight | 8% low | 0% error |

2

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

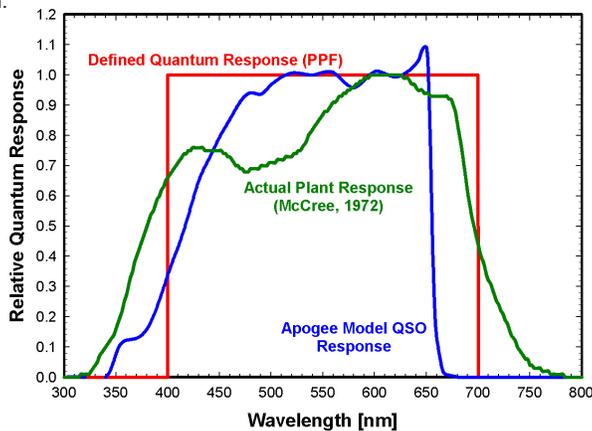
The temperature response is less than 0.1% per degree Celsius. This temperature error is not significant in most applications.

Long-term stability

Our research indicates that the 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.



3

Specifications

| | | |
|------------------------------|---|--|
| Application | Measuring Photosynthetic Photon Flux | |
| Output | Responsivity | 0.200 mV per $\mu\text{mol m}^{-2} \text{s}^{-1}$ |
| | In full sunlight | 400 mV (2000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) |
| | Linear range | 1000 mV (5000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) |
| Sensitivity | Calibrated to exactly 5.00 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV | |
| Input power | None, self-powered | |
| Operating environment | -40 to 55 °C; 0 to 100% relative humidity. Designed for continuous outdoor use. Can be submerged underwater (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-LQS, 240 g-LQS50, 400 g-LQS70 | |
| Warranty | 1 year parts and labor | |



435-792-4700

✉ www.apogeeinstruments.com
techsupport@apogee-inst.com

4