

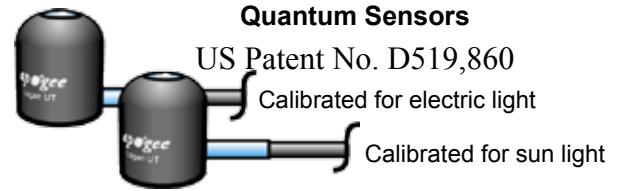
# Amplified Quantum Sensor

apogee  
Logan UT

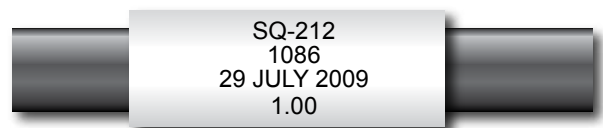
**Owner Manual**  
Model: SQ-200 Series

## Quantum Sensor Models

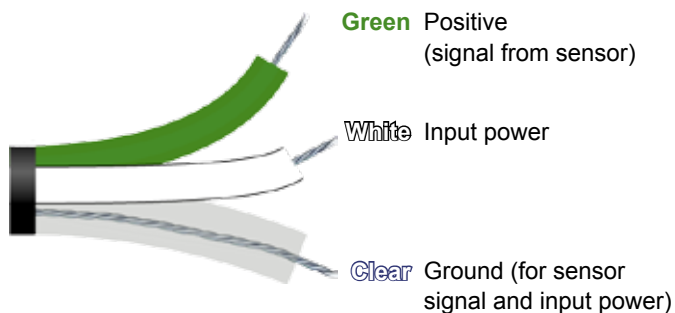
A quantum refers to the amount of energy carried by a photon. Apogee quantum sensors approximate the quantity of photons between 400 and 700 nm. Photosynthesis is largely driven by the number of photons between these wavelengths, so this radiation is called the Photosynthetic Photon Flux (PPF) and is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



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



## Setup Instructions



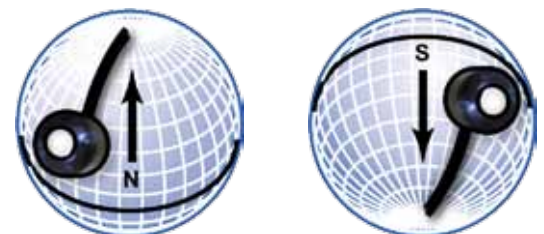
	<u>2.5 Option</u>	<u>5.0 Option</u>
<b>Power Supply</b>	2.5 to 5.5 V	5.0 to 5.5 V
<b>Conversion Factor</b>	1.0 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV	0.5 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV
<b>Output</b>	0.0 to 2.5 V	0.0 to 5.0 V
<b>Full Sunlight</b>	2.0 V (2,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ )	4.0 V (2,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ )

**Do not exceed 5 Volts in power supply.  
Do not connect green wire to power supply.**

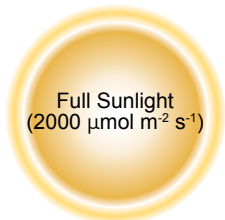
## Mounting the Sensor



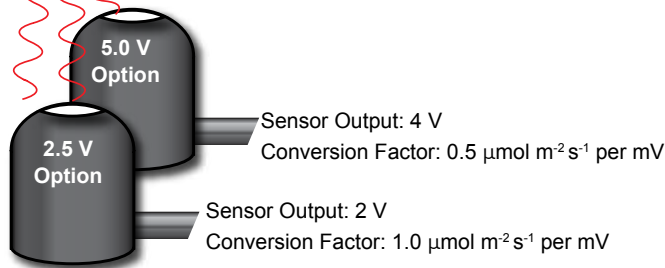
Each sensor is equipped with a mounting bolt. Mount the sensor as level as possible. Small changes in level can cause measurement errors. We recommend using our leveling plate (model AL-100) for the most accurate measurements. The sensor should be mounted with the cable pointing toward the nearest magnetic pole to minimize azimuth error.



# Calibration



Use the designated conversion factor (0.5 or 1.0  $\mu\text{mol m}^{-2} \text{s}^{-1}$  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 PPF in  $\mu\text{mol m}^{-2} \text{s}^{-1}$ )



PPF = sensor output x conversion factor  
 4,000 mV x 0.5  $\mu\text{mol m}^{-2} \text{s}^{-1}$  per mV = 2,000  $\mu\text{mol m}^{-2} \text{s}^{-1}$

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# 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%	12% high
Metal Halide	1% low	11% high
High Pressure Sodium	1% low	11% high
Sunlight	11% low	0%

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## Cosine Response

Some of the radiation coming into a sensor at low angles is reflected, causing 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

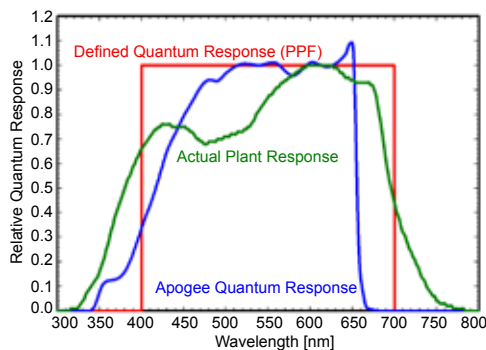
The temperature response is less than 0.1% per degree Celsius. This temperature error is not significant in most applications.

## 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.



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# Specifications

## Calibration - Natural Sunlight

- Absolute Accuracy: 5%
- Uniformity: 3%
- Repeatability: 1%

## Calibration - Electric Lamps (8% difference)

- Absolute Accuracy: 5%
- Uniformity: 3%
- Repeatability: 1%

## 2.5 V Option

- Output: 0 to 2.5 V (2.0 V = full sunlight 2,000  $\mu\text{mol m}^{-2} \text{s}^{-1}$ )
- Input Power: 2.5 to 5.5 VDC
- Sensitivity: Custom calibrated to exactly 1.00  $\mu\text{mol m}^{-2} \text{s}^{-1}/\text{mV}$

## 5.0 V Option

- Output: 0 to 5 V (4.0 V = full sunlight 2,000  $\mu\text{mol m}^{-2} \text{s}^{-1}$ )
- Input Power: 5 to 5.5 VDC
- Sensitivity: Custom calibrated to exactly 0.50  $\mu\text{mol m}^{-2} \text{s}^{-1}$

## Current Draw

- 285  $\mu\text{A}$

## 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/m

## 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



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