



The photosynthetically active radiation measurement tool of choice for lighting researchers

Features

Apogee Instruments Quantum Sensors are the tool of choice for researchers and agricultural professionals measuring photosynthetically active radiation (PAR) all over the world. Apogee offers two types of quantum sensors: a **Full-spectrum Quantum** and **Original X Quantum Sensor**. Consult our spectral response graph to decide which model is right for your application.

Accurate, Stable Measurements

Cost-effective, original quantum sensors work well for broadband radiation sources (sun, high-pressure sodium, metal halide, cool white fluorescent lamps), while full-spectrum sensors are good for all light sources, including LEDs. Offers a self-cleaning, cosine-corrected head that is fully-potted for a waterproof design.

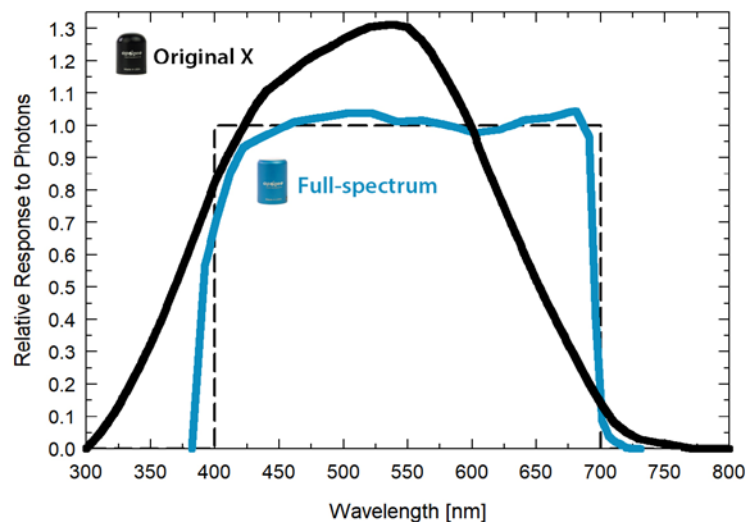
Typical PPFD Measurement Applications

- Incoming and reflected PPFD over and under plant canopies in greenhouses, in fields, and in growth chambers
- Aquatic environments including salt water aquariums and freshwater lakes and streams

Calibration Traceability

Apogee SQ series quantum sensors are calibrated through side-by-side comparison to the mean of four transfer standard sensors under a reference lamp. The reference sensors are recalibrated with a quartz halogen lamp traceable to the National Institute of Standards and Technology (NIST).

Spectral Response



Spectral response of original X quantum sensor (black) and full-spectrum quantum sensor (blue) compared to defined response of plants to radiation (dashed).

Spectral Errors

| | Apogee SQ-500 | Apogee SQ-100X | LI-COR LI-190 | Kipp & Zonen PQS 1 |
|--|---------------|----------------|---------------|--------------------|
| Sun (Clear Sky) | 0.0 | 0.0 | -0.4 | -1.0 |
| Sun (Cloudy Sky) | 0.1 | 0.2 | -0.2 | -1.3 |
| Sun (Reflected from Grass Canopy) | -0.3 | 5.0 | -0.8 | 1.1 |
| Sun (Transmitted below Wheat Canopy) | 0.1 | 7.0 | -0.1 | -0.3 |
| Cool White Fluorescent (T5) | 0.0 | 7.2 | 0.0 | 0.0 |
| Metal Halide | 0.9 | 6.9 | 0.2 | -1.7 |
| Ceramic Metal Halide | 0.3 | -8.8 | 0.4 | -0.7 |
| High Pressure Sodium | 0.1 | 3.3 | 1.3 | 1.4 |
| Red LED (667 nm peak, 20 nm full-width half-maximum) | 2.8 | -56.7 | 3.5 | -1.8 |
| Red, Blue, White LED Mixture (60 % Red, 25 % White, 15 % Blue) | -2.0 | -29.7 | 2.6 | -1.7 |

Provides research-grade measurements under all light sources, including LEDs

SQ-500
& SQ-520

All other models

Output Options

- 0 to 40 mV
- 0 to 5 V
- USB
- Modbus
- 0 to 2.5 V
- 4 to 20 mA
- SDI-12
- or hand-held meter

MQ-500



Product Specifications

| | SQ-500-SS | SQ-512-SS | SQ-514-SS | SQ-515-SS | SQ-520 | SQ-521-SS | SQ-522-SS |
|---|---|--|--|---|---|-------------------------------------|--|
| Power Supply | Self-powered | 5 to 24 V DC | 12 to 24 V DC | 5.5 to 24 V DC | 5 V USB power source | 5.5 to 24 V DC | |
| Current Draw | — | At 12 V is 57 μ A | maximum of 20 mA | At 12 V is 57 μ A | 61 mA when logging | 1.4 mA (quiescent), 1.8 mA (active) | RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA |
| Output (sensitivity) | 0.01 mV per μ mol m ⁻² s ⁻¹ | 0.625 mV per μ mol m ⁻² s ⁻¹ | 0.004 mA per μ mol m ⁻² s ⁻¹ | 1.25 mV per μ mol m ⁻² s ⁻¹ | — | | |
| Resolution | — | | | | 0.1 μ mol m ⁻² s ⁻¹ | — | |
| Calibration Factor (reciprocal of output) | 100 μ mol m ⁻² s ⁻¹ per mV | 1.6 μ mol m ⁻² s ⁻¹ per mV | 250 μ mol m ⁻² s ⁻¹ per mA | 0.8 μ mol m ⁻² s ⁻¹ per mV | Custom for each sensor and stored in the firmware | | |
| Calibration Uncertainty | ± 5 % | | | | | | |
| Output Range | 0 to 40 mV | 0 to 2.5 V | 4 to 20 mA | 0 to 5 V | USB | SDI-12 | Modbus |
| Measurement Repeatability | Less than 0.5 % | Less than 1 % | Less than 0.5 % | Less than 1 % | Less than 0.5 % | Less than 1 % | |
| Long-term Drift | Less than 2 % per year | | | | | | |
| Non-linearity | Less than 1 % (up to 4000 μ mol m ⁻² s ⁻¹) | | | | | | |
| Response Time | Less than 1 ms | | | | Software updates every second | Less than 0.6 s | 320 ms |
| Field of View | 180° | | | | | | |
| Spectral Range | 389 to 692 nm ± 5 nm (wavelengths where response is greater than 50 %) | | | | | | |
| Directional (cosine) Response | ± 2 % at 45°, ± 5 % at 75° zenith angle | | | | | | |
| Temperature Response | -0.11 ± 0.04 % per C | | | | | | |
| Operating Environment | -40 to 70 C; 0 to 100 % relative humidity; can be submerged in water up to depths of 30 m | | | | | | |
| Dimensions | 24 mm diameter, 37 mm height | 30.5 mm diameter, 37 mm height | | | 24 mm diameter, 37 mm height | 30.5 mm diameter, 37 mm height | |
| Mass (5 m of cable) | 100 g | 140 g | | | 100 g | 140 g | |
| Warranty | 4 years against defects in materials and workmanship | | | | | | |

SQ-100X
& SQ-420X



Measure photosynthetically active radiation (PAR) in $\mu\text{mol m}^{-2} \text{s}^{-1}$

Output Options

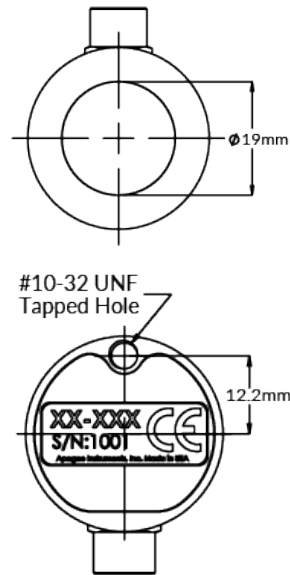
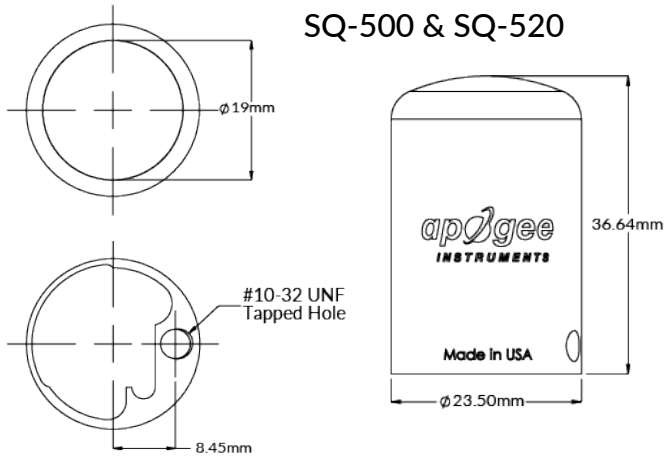
- 0 to 400 mV
- 0 to 5 V
- USB
- Modbus
- 0 to 2.5 V
- 4 to 20 mA
- SDI-12
- or hand-held meter

MQ-200X



Product Specifications

| | SQ-100X-SS | SQ-202X-SS | SQ-204X-SS | SQ-205X-SS | SQ-420X | SQ-421X-SS | SQ-422X-SS |
|---|--|---|---|--|---|-------------------------------------|--|
| Power Supply | Self-powered | 5 to 24 V DC | 7 to 24 V DC | 5.5 to 24 V DC | 5 V USB power source | 5.5 to 24 V DC | |
| Current Draw | — | 10 μA | 22 mA maximum; 2 mA quiescent | 10 μA | 61 mA when logging | 1.4 mA (quiescent), 1.8 mA (active) | RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA |
| Output (sensitivity) | 0.1 mV per $\mu\text{mol m}^{-2} \text{s}^{-1}$ | 0.625 mV per $\mu\text{mol m}^{-2} \text{s}^{-1}$ | 0.004 mA per $\mu\text{mol m}^{-2} \text{s}^{-1}$ | 1.25 mV per $\mu\text{mol m}^{-2} \text{s}^{-1}$ | — | | |
| Calibration Factor (reciprocal of output) | 10 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV | 1.6 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV | 250 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mA | 0.8 $\mu\text{mol m}^{-2} \text{s}^{-1}$ per mV | Custom for each sensor and stored in the firmware | | |
| Calibration for Uncertainty | ± 5 % | | | | | | |
| Output Range | 0 to 400 mV | 0 to 2.5 V | 4 to 20 mA | 0 to 5 V | USB | SDI-12 | Modbus |
| Measurement Repeatability | Less than 0.5 % | | | | | Less than 1 % | |
| Long-term Drift | Less than 2 % per year | | | | | | |
| Non-linearity | Less than 1 % (up to 4000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) | | | | | | |
| Response Time | Less than 1 ms | | | | Software updates every second | Less than 0.6 s | — |
| Field of View | 180° | | | | | | |
| Spectral Range | 370 to 650 nm (wavelengths where response is greater than 50 % maximum) | | | | | | |
| Directional (cosine) Response | ± 5 % at 75° zenith angle | | | | | | |
| Temperature Response | -0.04 % per C | | | | | | |
| Operating Environment | 10 to 60 C; 0 to 100 % relative humidity; can be submerged in water up to 30 m | | | | | | |
| Dimensions | 24 mm diameter, 33 mm height | 30.5 mm diameter, 37 mm height | | | 24 mm diameter, 33 mm height | 30.5 mm diameter, 37 mm height | |
| Mass (5 m of cable) | 90 g | 140 g | | | 90 g | 140 g | |
| Warranty | 4 years against defects in materials and workmanship | | | | | | |



All other full-spectrum quantum and original X quantum models

