

Quantum Sensors

SQ-100 Series SQ-200 Series SQ-300 Series



www.apogeeinstruments.com

435.792.4700



- Next generation sensor head design
- Excellent cosine response
- Self-cleaning dome-shaped head
- Potted solid for extreme conditions
- Self-powered and amplified models
- Installed in growth chambers from industry leaders Conviron, Biochambers, Environmental Growth Chambers, and Percival Scientific
- Also available in multi-sensor "line quantum" models for spatially-averaged measurements
- Fully submersible
- Easily integrates with data-loggers
- Four year warranty

Apogee Instruments quantum sensors measure photosynthetic light levels in both air and water, combining accuracy and durability at a competitive price. The sensor heads feature a unique blue diffuser that reduces spectral error to less than 5 % for sunlight (direct, diffuse, under plant canopy, reflected from plant canopy) and common electric plant lights (fluorescent, metal halide, high pressure sodium), and less than 10% for LEDs (blue, green, red, cool white, neutral white, and warm white).



Line Quantums available with 3, 6, or 10 sensors



AL-100 Leveling plate
AM-110 Mounting Bracket

SPECIFICATIONS

Power Supply:

SQ-110, -120 – None
SQ-212, -222 – 5-24 VDC with a nominal current draw of 300 μ A
SQ-215, -225 – 5-24 VDC with a nominal current draw of 300 μ A
SQ-311, -313, -316, -321, -323, -326 – None

Sensitivity:

SQ-110, -120 – 0.2 mV per μ mol m⁻² s⁻¹
SQ-212, -222 – 1.0 mV per μ mol m⁻² s⁻¹
SQ-215, -225 – 2.0 mV per μ mol m⁻² s⁻¹
SQ-311, -313, -316, -321, -323, -326 – 0.2 mV per μ mol m⁻² s⁻¹

Calibration Factor (reciprocal of sensitivity):

SQ-110, -120 – 5.0 μ mol m⁻² s⁻¹ per mV
SQ-212, -222 – 1.0 μ mol m⁻² s⁻¹ per mV
SQ-215, -225 – 0.5 μ mol m⁻² s⁻¹ per mV
SQ-311, -313, -316, -321, -323, -326 – 5.0 μ mol m⁻² s⁻¹ per mV

Calibration Uncertainty: $\pm 5\%$ (see Calibration Traceability below)

Measurement Repeatability: $< 1\%$

Non-stability (Long-term Drift): $< 2\%$ per year

Non-linearity: $< 1\%$ (up to 4000 μ mol m⁻² s⁻¹)

Response Time: < 1 ms

Field of View: 180°

Spectral Range: 410 nm to 655 nm (wavelengths where response is greater than 50 % of maximum; see Spectral Response below)

Directional (Cosine) Response: $\pm 5\%$ at 75° zenith angle (see Cosine Response below)

Temperature Response: $0.06 \pm 0.06\%$ per C (see Temperature Response below)

Operating Environment: -40 to 70 C

0 to 100 % relative humidity

Can be submerged in water up to depths of 30 m

Dimensions:

SQ-110, -120 – 2.4 cm diameter and 2.8 cm height
SQ-212, -222 – 2.4 cm diameter and 2.8 cm height
SQ-215, -225 – 2.4 cm diameter and 2.8 cm height
SQ-313, -316, -323, -326 – 50 cm length, 1.5 cm width, 1.5 cm height
SQ-311, -321 – 70 cm length, 1.5 cm width, 1.5 cm height

Mass:

SQ-110, -120 – 90 g (with 5 m of lead wire)
SQ-212, -222 – 90 g (with 5 m of lead wire)
SQ-215, -225 – 90 g (with 5 m of lead wire)
SQ-313, -316, -323, -326 – 275 g (with 5 m of lead wire)
SQ-311, -321 – 375 g (with 5 m of lead wire)

Cable: 5 m of shielded, twisted-pair wire.

Additional cable available in multiples of 5 m

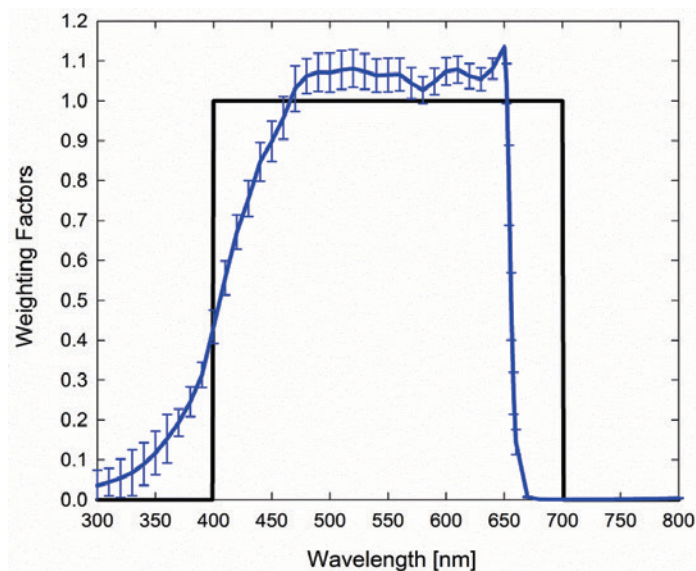
Santoprene rubber jacket (high water resistance, high UV stability, flexibility in cold conditions)

Pigtail lead wires

Calibration Traceability:

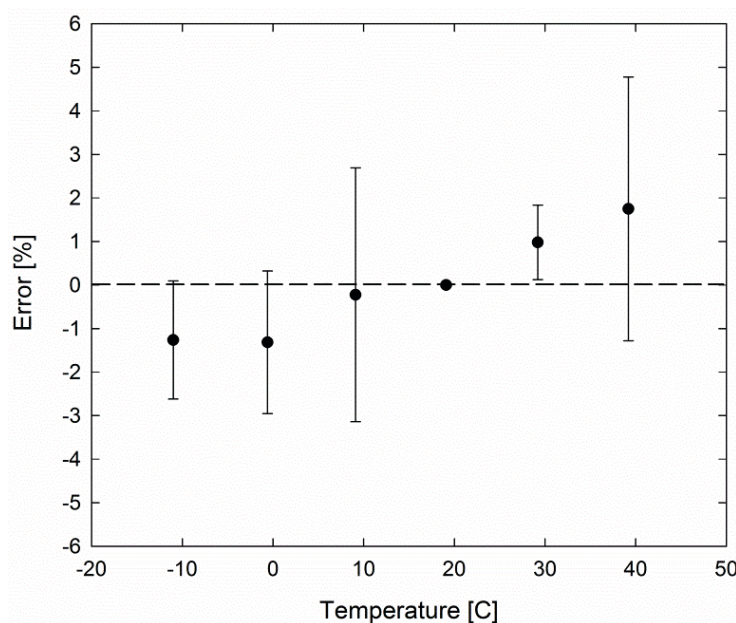
Apogee SQ series quantum sensors are calibrated through side-by-side comparison to the mean of four Apogee model SQ-110 or SQ-120 transfer standard quantum sensors under high output T5 cool white fluorescent lamps. The transfer standard quantum sensors are calibrated through side-by-side comparison to the mean of at least three LI-COR model LI-190 reference quantum sensors under high output T5 cool white fluorescent lamps. The reference quantum sensors are recalibrated on a biannual schedule with a LI-COR model 1800-02 Optical Radiation Calibrator using a 200 W quartz halogen lamp. The 1800-02 and quartz halogen lamp are traceable to the National Institute of Standards and

Spectral Response:



Mean spectral response of six SQ series quantum sensors (**error bars represent two standard deviations above and below mean**) compared to PPF weighting function. Spectral response measurements were made at 10 nm increments across a wavelength range of 300 to 800 nm in a monochromator with an attached electric light source. Measured spectral data from each quantum sensor were normalized by the measured spectral response of the monochromator/electric light combination, which was measured with a spectroradiometer.

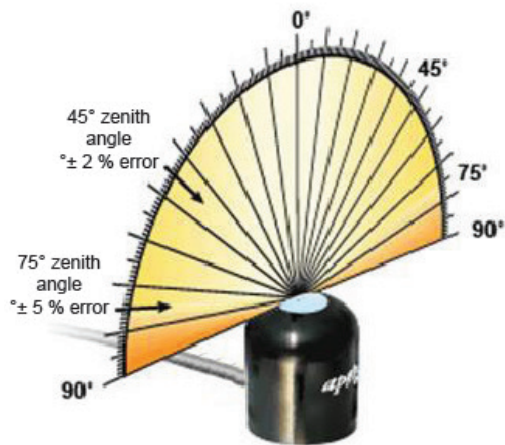
Temperature response:



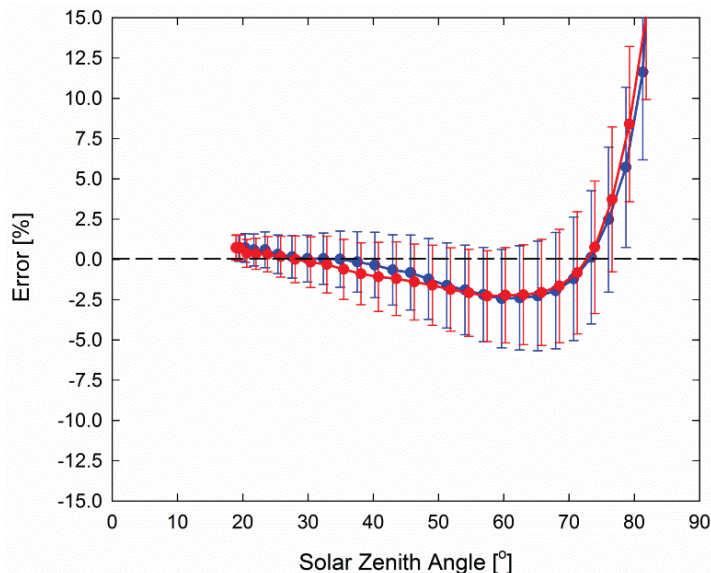
Mean temperature response of eight SQ series quantum sensors (**errors bars represent two standard deviations above and below mean**). Temperature response measurements were made at 10 C intervals across a temperature range of approximately -10 to 40 C in a temperature controlled chamber under a fixed, broad spectrum, electric lamp. At each temperature set point, a spectroradiometer was used to measure light intensity from the lamp and all quantum sensors were compared to the spectroradiometer. The spectroradiometer was mounted external to the temperature control chamber and remained at room temperature during the experiment.

Cosine Response:

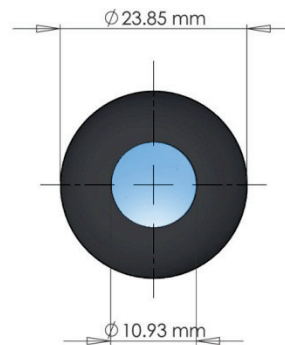
Cosine Response of Apogee SQ Series Quantum Sensors



Directional, or cosine, response is defined as the measurement error at a specific angle of radiation incidence. Error for Apogee MQ series quantum meters is approximately $\pm 2\%$ and $\pm 5\%$ at solar zenith angles of 45° and 75° , respectively.



Mean cosine response of twenty-three SQ series quantum sensors (***error bars represent two standard deviations above and below mean***). Cosine response measurements were made by direct side-by-side comparison to the mean of four reference thermopile pyranometers, with solar zenith angle-dependent factors applied to convert total shortwave radiation to PPF. Blue points represent the AM response and red points represent the PM response.



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