Quantum Sensor | SQ-500 Series

Apogee Instruments is proud to announce our new quantum sensor with an improved spectral response providing accurate PAR/PPFD measurements under all light sources, including LEDs.

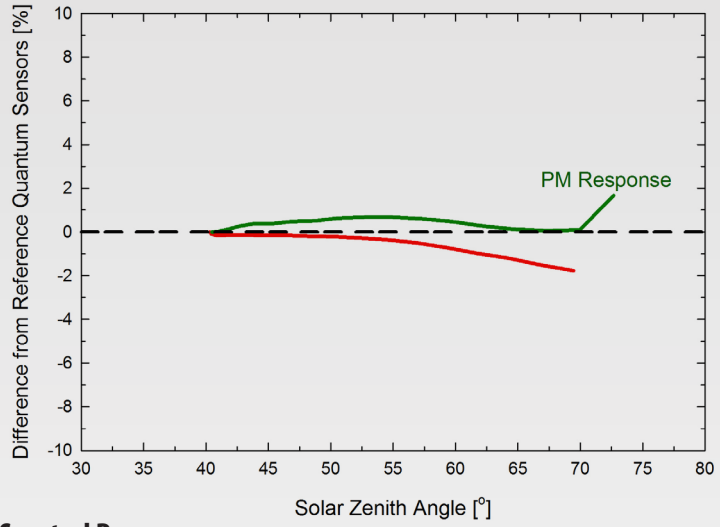
Refined Spectral Response
The improved spectral response of the SQ-500 increases the acuracy of LED measurements making it ideal for use with both natural and electric light sources.

Rugged Design
Head is submersible and suitable for use in all climate conditions.

Excellent Cosine Response
Sensors measure PPFD with a cosine response accurate within ± 5 % at 75° zenith angle.

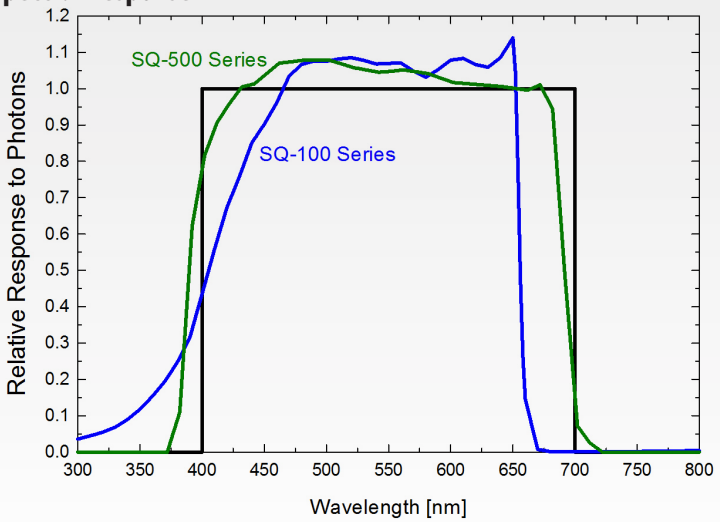
Reliable Accuracy
To ensure accuracy each sensor is carefully calibrated in controlled conditions and traceable to NIST reference standards.

Cosine Response



Mean cosine response of seven Apogee SQ-500 quantum sensors. Cosine response measurements were made on the rooftop of the Apogee building in Logan, UT. Cosine response was calculated as the relative difference of SQ-500 quantum sensors from the mean of replicate reference quantum sensors (LI-COR models LI-190 and LI-190R, Kipp & Zonen model PQS 1). The red data are AM measurements; the green data are PM measurements.

Spectral Response



Mean spectral response measurements of six replicate Apogee SQ-100 and SQ-500 series quantum sensors. 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.

Spectral Errors of Commercial Quantum Sensors

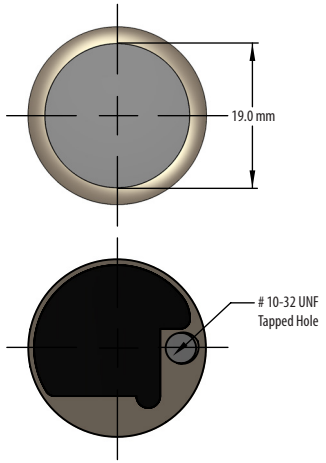
Radiation Source	Apogee SQ-500	Apogee SQ-110 SQ-120	LI-COR LI-190	Kipp & Zonen PQS 1
Sun (Clear Sky)	-2.2	0.0	-0.4	-1.0
Sun (Cloudy Sky)	-1.7	1.4	-0.2	-1.3
Sun (Reflected from Deciduous Leaves)	-2.0	4.9	-0.8	1.1
Sun (Transmitted below Wheat Canopy)	-1.1	6.4	-0.1	-0.3
Cool White Fluorescent (T5)	0.0	0.0	0.0	0.0
Metal Halide	0.9	-3.7	0.2	-1.7
Ceramic Metal Halide	-0.3	-6.0	0.4	-0.7
High Pressure Sodium	0.0	0.8	1.3	1.4
Red/Blue LED (16 % 444 nm, 84 % 667 nm peaks)	-3.4	-65.3	3.5	-1.8
Red/White LED (6.5 % 436 nm, 4.5 % 531 nm, 89 % 668 nm peaks)	-3.0	-60.3	2.6	-1.7

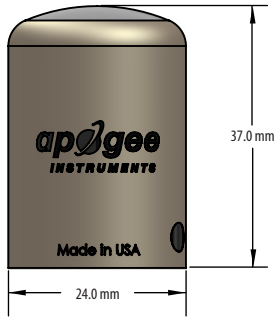
Spectral errors are theoretical errors calculated from sensor spectral responses (Apogee SQ-100 and SQ-500 series shown in graph above) and spectral output of radiation sources (measured with a spectroradiometer). Only spectral errors are listed in the table. Calibration, cosine, and temperature error can also contribute to measurement error.

Calibration Traceability

Apogee Instruments SQ-500 series quantum sensors are calibrated through side-by-side comparison to the mean of four Apogee model SQ-500 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 and quartz halogen lamp that are traceable to the National Institute of Standards and Technology (NIST).

Dimensions





Power Supply	self-powered
Output (sensitivity)	0.01 mV per µmol m^{-2} s^{-1}
Calibration Factor (reciprocal of output)	100.0 µmol m^{-2} s^{-1} per mV
Calibration Uncertainty	± 5 % (see Calibration Traceability above)
Output Range	0 to 40 mV
Measurement Range	0 to 4000 µmol m^{-2} s^{-1}
Measurement Repeatablilty	less than 0.5 %
Long-term Drift (Non-stability)	less than 2 % per year
Non-linearity	less than 1 % (up to 4000 µmol m^{-2} s^{-1})
Response Time	less than 1 ms
Field of View	180°
Spectral Range	389 to 692 nm ± 5 nm (wavelengths where response is greater than 50% of maximum)
Spectral Selctivity	less than 10 % from 412 to 682 nm ± 5 nm (see Spectral Response; left)
Directional (Cosine) Response	± 5 % at 75° zenith angle
Azimuth Error	less than 0.5 %
Tilt Error	less than 0.5 %
Temperature Response	-0.11 ± 0.03 % C^{-1}
Uncertainty in Daily Total	less than 5 %
Detector	blue-enhanced silicon photodiode
Housing	anodized aluminum body with acrylic diffuser
IP Rating	IP68
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; 35 mm height
Mass	100 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
Warranty	4 years against defects in materials and workmanship