apogee® INSTRUMENTS

APOGEE FULL-SPECTRUM QUANTUM METER | MQ-501

Easy-to-use handheld quantum meter designed for spot-check measurements

Features

Accurate, Stable Measurements
Long-term non-stability determined from multiple replicate quantum sensors in accelerated aging tests and field conditions is less than 2 % per year.

Unique Design
Measure photosynthetically active radiation with a research grade, full-spectral response sensor. Offers a self-cleaning, cosine-corrected head to minimize errors and is fully-potted for a waterproof design.

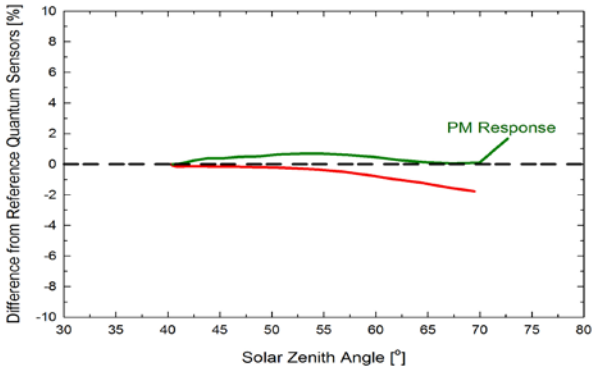
Mounting
The MQ-501 is designed to be an easy-to-use handheld meter for spot-check measurements. The meter includes the AM-001 meter mounting bracket to mount the sensor on a horizontal plane to the meter and shortened cable to accommodate the bracket length.

Calibration Traceability
Apogee SQ-500 sensors are calibrated through side-by-side comparison to the mean of (4) Apogee model SQ-500 transfer standard sensors under T5 cool white fluorescent lamps. The transfer standard sensors are calibrated through side-by-side comparison to the mean of at least (3) LI-COR model LI-190R reference quantum sensors under T5 cool white fluorescent lamps. The reference 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).

Product Specifications

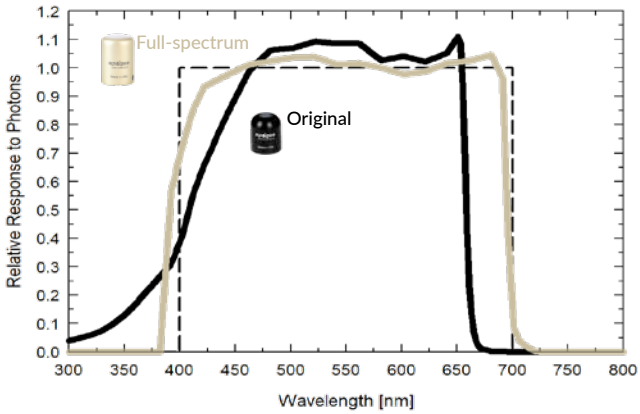
	MQ-501
Calibration Uncertainty	± 5 %
Measurement Range	0 to 4000 µmol m^{-2} s^{-1}
Measurement Repeatability	Less than 0.5 %
Long-term Drift (Non-stability)	Less than 2 % per year
Non-linearity	Less than 1 % (up to 4000 µmol m^{-2} s^{-1})
Response Time	Less than 1 ms
Field of View	180°
Spectral Range	389 to 692 nm ± 5 nm (wavelengths where response is greater than 50 % of maximum)
Spectral Selectivity	Less than 10 % from 412 to 682 nm ±5 nm
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 % per C
Uncertainty in Daily Total	Less than 5 %
Detector	Blue-enhanced silicon photodiode
Housing	Anodized aluminum body with acrylic diffuser
IP Rating	IP68
Operating Environment	0 to 50 C; less than 90 % non-condensing relative humidity up to 30 C; less than 70 % non-condensing relativity humidity from 30 to 50 C; separate sensors can be submerged in water up to depth of 30 m
Cable	2 m of shielded, twisted-pair wire; additional cable available; TPR jacket
Warranty	4 years against defects in materials and workmanship

Cosine Response



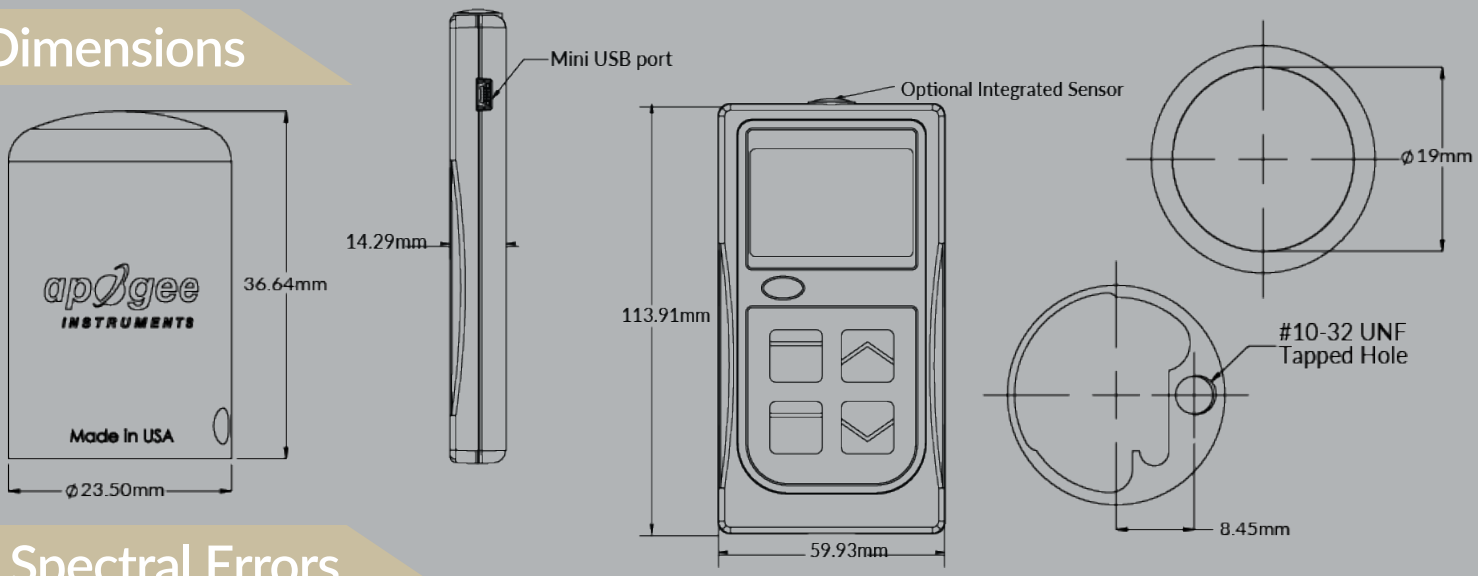
Mean **cosine response** of seven Apogee SQ-500 quantum sensors. Cosine response was calculated as the relative difference of SQ-500 quantum sensors from the mean of replicate reference quantum sensors (LI-COR models LI-190 and LI-190R, Kipp & Zonen model PQS 1). The red data are AM measurements; the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

Dimensions



Spectral Errors

	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 of Commercial Quantum Sensors

Spectral errors are theoretical errors calculated from sensor spectral responses and spectral output of radiation sources. Only spectral errors are listed in the table. Calibration, cosine, and temperature error can also contribute to measurement error.