

Full Spectrum Underwater Quantum Meter | MQ-510

Ensure proper light levels for underwater photosynthesis.

Ready for Underwater Use

The MQ-510 has the immersion effect correction factor preprogrammed in the meter firmware allowing you to make excellent underwater measurements right out of the box.

Waterproof Sensor

The meter features a waterproof sensor head that is potted solid for a complete seal, and to ensure it has no hollow cavities for water to penetrate and cause measurement errors.

Refined Spectral Response

Improved detector and custom optics provide excellent measurements under all light sources, including LEDs. The full-spectrum quantum sensor has a spectral range of 389 to 692 nm \pm 5 nm.

Accurate, Stable Measurements

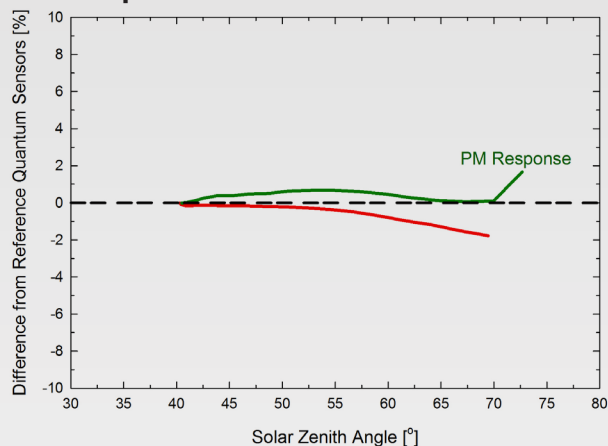
Calibration in controlled laboratory conditions is traceable to an NIST lamp. Quantum sensors are cosine-corrected, with directional errors less than \pm 5 % at a solar zenith angle of 75°. Long-term non-stability determined from multiple replicate quantum sensors in accelerated aging tests and field conditions is less than 2 % per year.

Datalogging Capabilities

The meter records up to 99 manual measurements. In logging mode the meter will make a measurement every 30 seconds. Every 30 minutes the meter will average the sixty 30 second measurements and record the averaged value. The meter can store up to 99 averages.

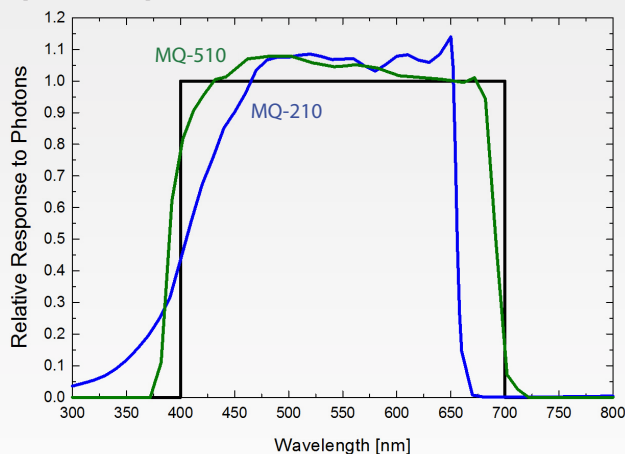


Cosine Response



Mean cosine response of seven Apogee MQ-510 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 MQ-510 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 MQ-210 and MQ-5100 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

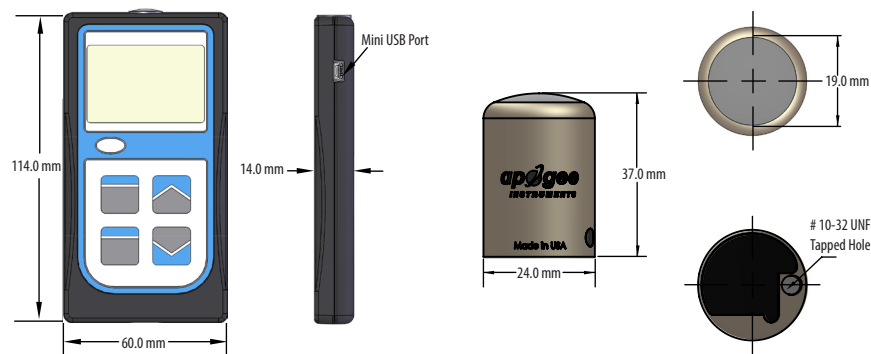
Radiation Source	Apogee MQ-510	Apogee MQ-210	LI-COR LI-190	Kipp & Zonen PQS 1
Sun (Clear Sky)	-2.2	0.0	-0.4	-1.0
Sun (Cloudy Sky)	-1.7	1.4	-0.2	-1.3
Sun (Reflected from Deciduous Leaves)	-2.0	4.9	-0.8	1.1
Sun (Transmitted below Wheat Canopy)	-1.1	6.4	-0.1	-0.3
Cool White Fluorescent (T5)	0.0	0.0	0.0	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-190R 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



MQ-510

Calibration Uncertainty	± 5 %
Measurement Range	0 to 4000 $\mu\text{mol m}^{-2} \text{s}^{-1}$
Measurement Repeatability	Less than 0.5 %
Long-term Drift (Non-stability)	Less than 2 % per year
Non-linearity	Less than 1 % (up to 4000 $\mu\text{mol m}^{-2} \text{s}^{-1}$)
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 ± 0.04 % 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 relative humidity from 30 to 50 C; separate sensors can be submerged in water up to depth of 30 m
Meter Dimensions	126 mm length, 70 mm width, 24 mm height
Sensor Dimensions	24 mm diameter, 37 mm height
Mass	180 g
Cable	2 m of shielded, twisted-pair wire; additional cable available; santoprene rubber jacket
Warranty	4 years against defects in materials and workmanship