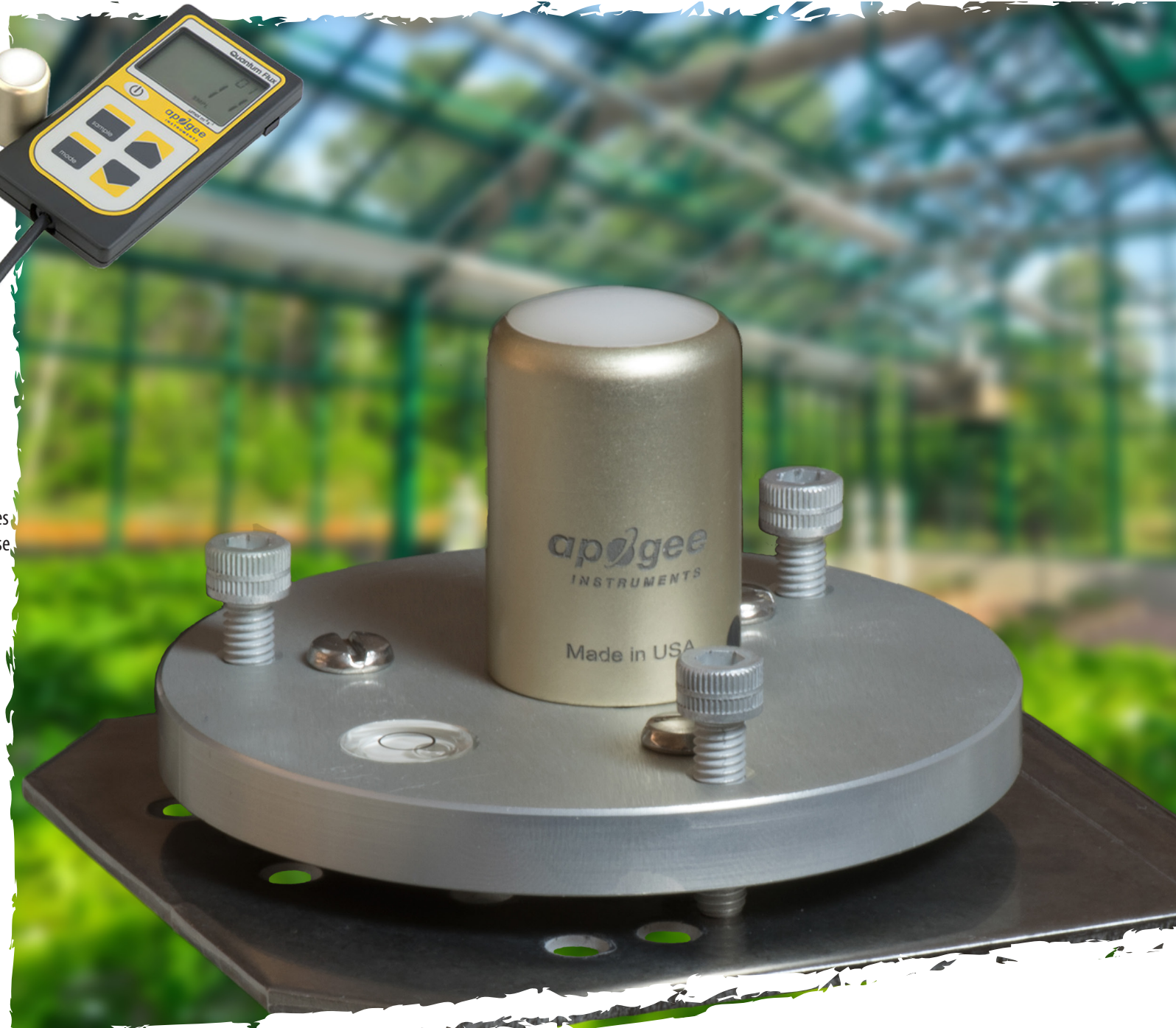


# Quantum Meter | MQ-500

Apogee 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 JSQ-500 increases the accuracy 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.

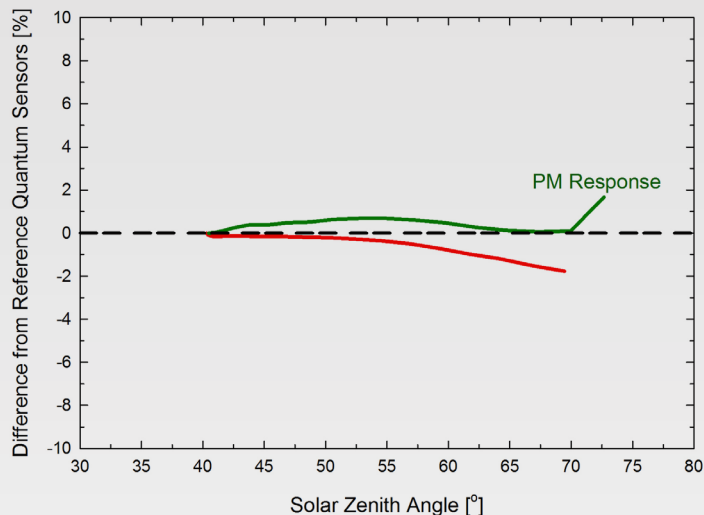
## Excellent Cosine Response

Sensors measure PPFD with a cosine response accurate within  $\pm 5\%$  at  $75^\circ$  zenith angle.

## Reliable Accuracy

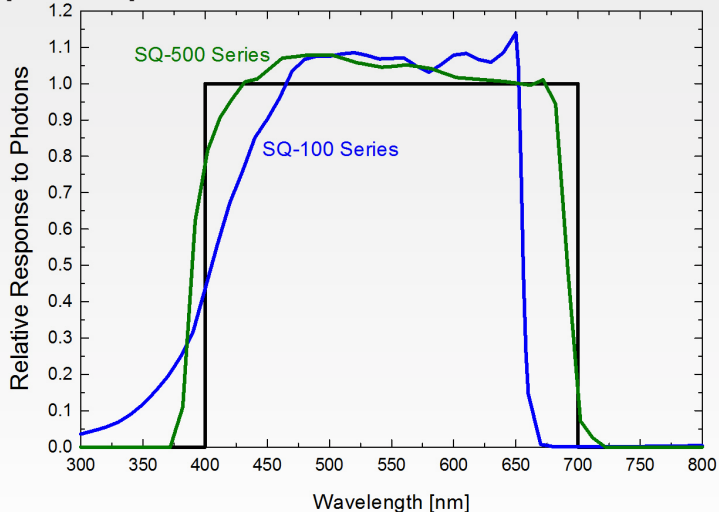
To ensure accuracy each sensor is carefully calibrated in controlled conditions and traceable to NIST reference standards.

## Cosine Response



Mean cosine response of seven JSQ-500 quantum sensors. Cosine response measurements were made on the rooftop of the building in Logan, UT. Cosine response was calculated as the relative difference of JSQ-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 JSQ-100 and JSQ-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

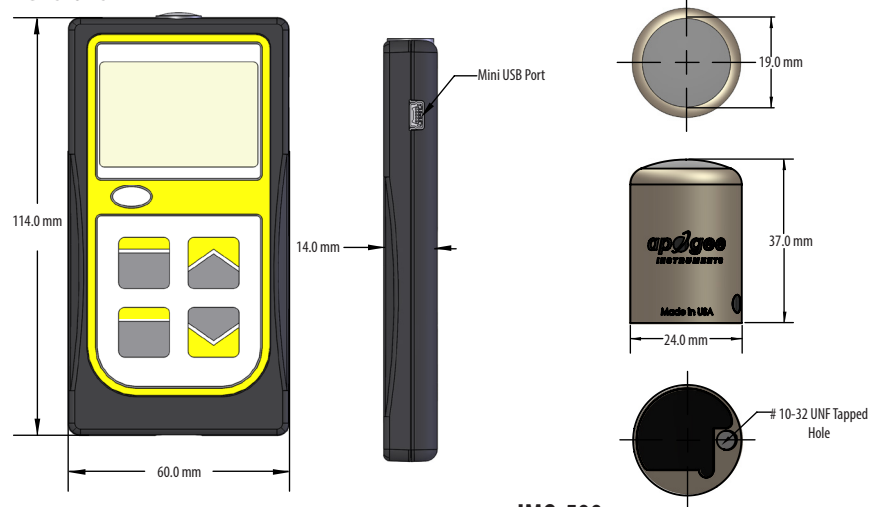
Radiation Source	JSQ-500	JSQ-110 JSQ-120	LI-COR LI-190	Kipp & Zonen PQS 1
Sun (Clear Sky)	-2.2	0.0	-0.4	-1.0
Sun (Cloudy Sky)	-1.7	1.4	-0.2	-1.3
Sun (Reflected from Deciduous Leaves)	-2.0	4.9	-0.8	1.1
Sun (Transmitted below Wheat Canopy)	-1.1	6.4	-0.1	-0.3
Cool White Fluorescent (T5)	0.0	0.0	0.0	0.0
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 (JSQ-100 and JSQ-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

JSQ-500 series quantum sensors are calibrated through side-by-side comparison to the mean of four model JSQ-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



### JSQ-500

Calibration Uncertainty	± 5 % (see calibration traceability above)
Measurement Range	0 to 4000 $\mu\text{mol m}^{-2}\text{s}^{-1}$
Measurement Repeatability	less than 1 %
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 (see spectral response; left)
Directional (Cosine) Response	± 5 % at 75° zenith angle (see directional response; left)
Azimuth Error	less than 0.5 %
Tilt Error	less than 0.5 %
Temperature Response	-0.11 ± 0.03 % C <sup>-1</sup>
Uncertainty in Daily Total	less than 5 %
Detector	blue-enhanced silicon photodiode
Housing	anodized aluminum body with acrylic diffuser
IP Rating	IP86
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	100 g (with 5 m of lead wire)
Cable	2 m of shielded, twisted-pair wire; additional cable available; santoprene rubber jacket
Warranty	4 years against defects in materials and workmanship