

# Quantum Meters

MQ-100 MQ-200 MQ-300 Series



[www.apogeeinstruments.com](http://www.apogeeinstruments.com)

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Quantify photosynthetic radiation



MQ-100

- Next generation sensor head design
- Excellent cosine response
- Self-cleaning dome-shaped head
- Sensors are potted solid for extreme conditions
- Also available in multi-sensor "line quantum" models for spatially-averaged measurements
- 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).

Each meter can store up to 99 manually recorded measurements. In automatic mode, measurements are made every 30 seconds with averages stored every 30 minutes. Daily totals are also calculated recording up to 99 days.



MQ-200



Line Quantum Meters available with 3, 6, or 10 sensors



AL-100 Leveling plate  
AM-110 Mounting Bracket

# SPECIFICATIONS

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

**Measurement Repeatability:**  $< 1\%$

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

**Non-linearity:**  $< 1\%$  (up to  $3000 \mu\text{mol m}^{-2} \text{s}^{-1}$ )

**Response Time:**  $< 1 \text{ ms}$

**Field of View:**  $180^\circ$

**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  $75^\circ$  zenith angle (see Cosine Response below)

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

**Operating Environment:** 0 to 50 C

$< 90\%$  non-condensing relative humidity up to 30 C

$< 70\%$  non-condensing relative humidity from 30 to 50 C

Separate sensors can be submerged in water up to depths of 30 m

**Meter Dimensions:** 12.6 cm length, 7.0 cm width, 2.4 cm height

## Sensor Dimensions:

MQ-200: 2.4 cm diameter and 2.8 cm height

MQ-301: 70 cm length, 1.5 cm width, 1.5 cm height

MQ-303, -306: 50 cm length, 1.5 cm width, 1.5 cm height

## Mass:

MQ-100: 150 g

MQ-200: 180 g

MQ-301: 380 g

MQ-303, -306: 300 g

**Cable:** 2 m of shielded, twisted-pair wire.

Additional cable available

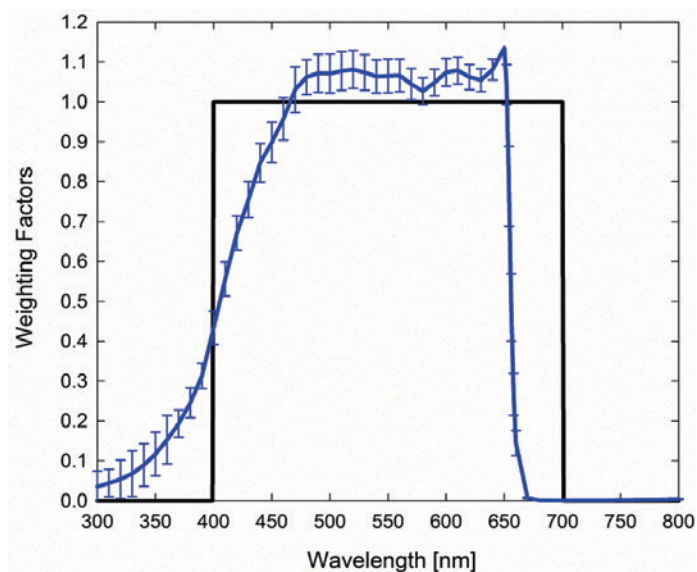
Santoprene rubber jacket (high water resistance, high UV stability, flexibility in cold conditions)

## Calibration Traceability:

Apogee MQ series quantum meters 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 Technology (NIST).

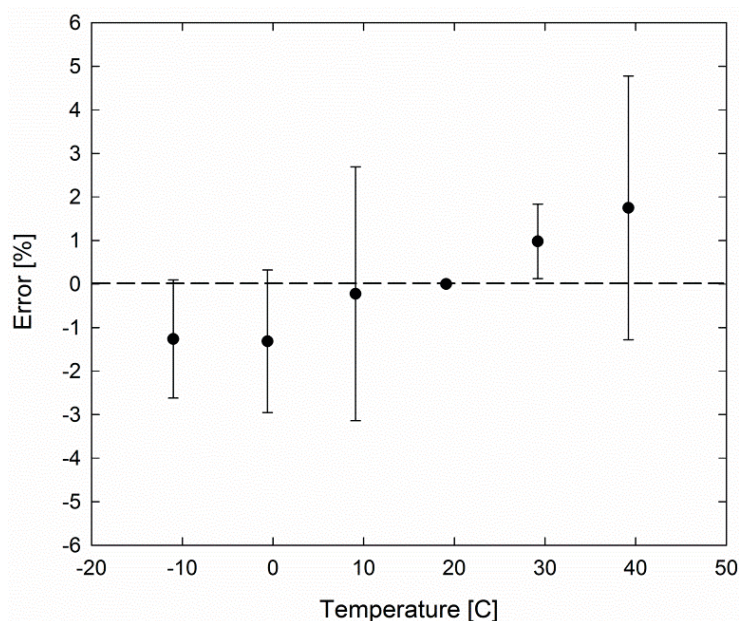


## Spectral Response:



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.

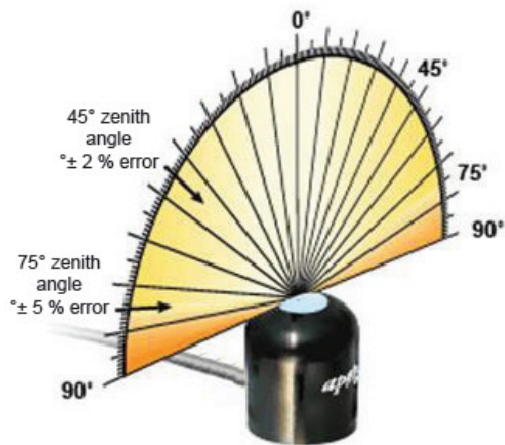
## Temperature response:



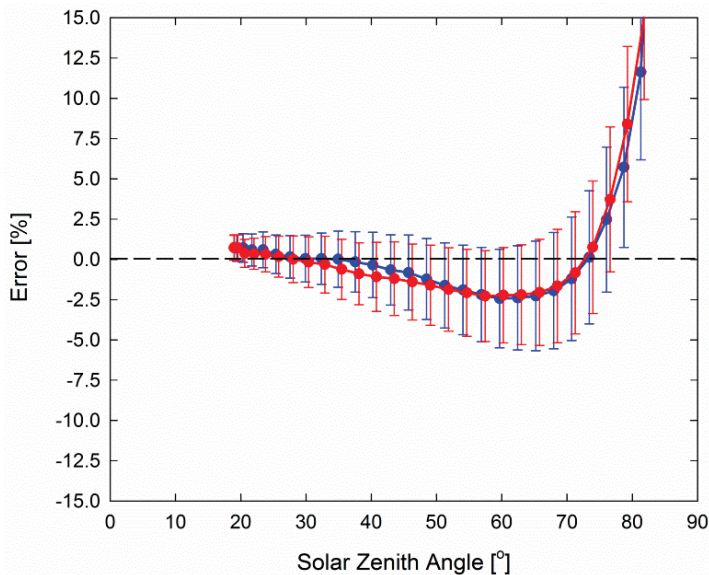
Mean temperature response of eight SQ series quantum sensors (*errors bars represent two standard deviations above and below mean*). Temperature response measurements were made at 10 C intervals across a temperature range of approximately -10 to 40 C in a temperature controlled chamber under a fixed, 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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