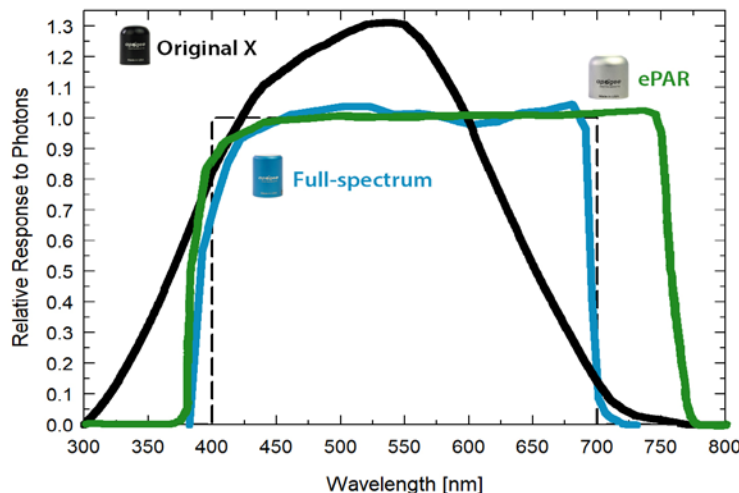




### Spectral Responses

Research-grade measurements of underwater photosynthetically active radiation



Mean **spectral response** measurements of six replicate Apogee MQ-210X (black), MQ-650 (green), and MQ-510 (blue) series quantum sensors compared to traditionally defined PAR 400-700 nm (dotted).

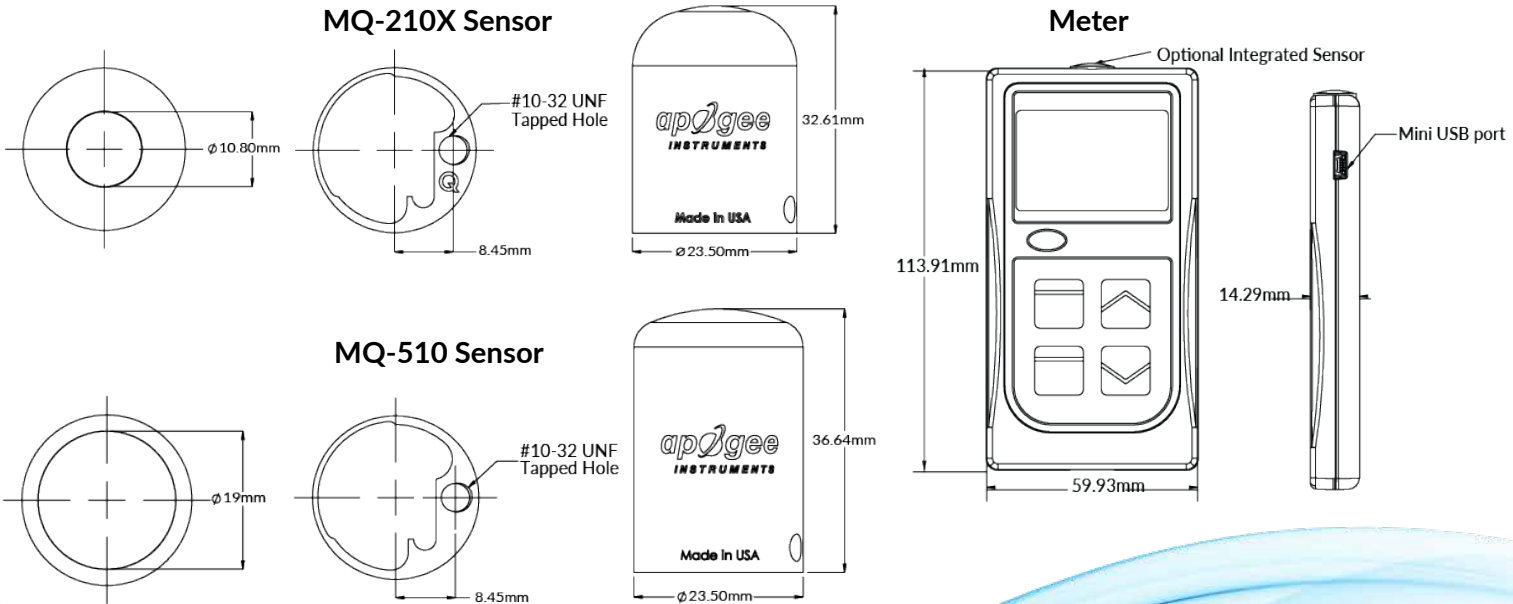
### Product Specifications

	MQ-650	MQ-510	MQ-210X
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	380 to 760 nm ± 5 nm	389 to 692 nm ± 5 nm	370 to 650 nm ± 5 nm
Directional (Cosine) Response	± 5 % at 75° zenith angle		
Temperature Response	-0.11 ± 0.04 % per C		-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 depth		
Sensor Dimensions	30.5 mm diameter, 37 mm height	24 mm diameter, 37 mm height	24 mm diameter, 33 mm height
Mass	180 g		
Cable	2 m of shielded, twisted-pair wire; additional cable available; TPR jacket		
Warranty	4 years against defects in materials and workmanship		

# Overview

Apogee Instruments PAR meters are the tool of choice for cost-effective, scientific-grade measurement of underwater PAR levels. Accurate tank PAR mapping, daily light integral measurements, and the adjusting of photosynthetic radiation levels to mimic nature are all critical to specimen health. Apogee offers three different underwater calibrated meters at three different price points. The basic MQ-210X features our original X detector that is excellent for broadband light sources. The research-grade MQ-510 features an improved detector excellent for all light sources, including LEDs, and matches LI-COR and Kipp & Zonen PAR sensors in accuracy while costing much less. The cutting-edge MQ-650 measures the newly confirmed UV and far-red extended (ePAR) photosynthetic wavelengths (380-760 nm).

## Dimensions



## Spectral Errors

## Features

### DESIGNED FOR UNDERWATER USE

Sensor heads are fully epoxy potted to be completely waterproof. Diffuser is cosine corrected for accurate 2- $\pi$  PAR-mapping. Sensor readings are adjusted in firmware to correct for the immersion effect.

### 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.

### DATALOGGING CAPABILITIES

The meter records up to 99 measurements in logging mode, making automatic measurements every 30 seconds and recording 30-minute averages. Data can be downloaded to calculate DLI.

	Apogee SQ-500	Apogee SQ-210X	LI-COR LI-190	Kipp & Zonen PQS 1
Sun (Clear Sky)	0.0	0.0	-0.4	-1.0
Sun (Cloudy Sky)	0.1	0.2	-0.2	-1.3
Sun (Reflected from Grass Canopy)	-0.3	5.0	-0.8	1.1
Sun (Transmitted below Wheat Canopy)	0.1	7.0	-0.1	-0.3
Cool White Fluorescent (T5)	0.0	7.2	0.0	0.0
Metal Halide	0.9	6.9	0.2	-1.7
Ceramic Metal Halide	0.3	-0.9	0.4	-0.7
High Pressure Sodium	0.1	3.2	1.3	1.4
Red LED (667 nm peak, 20 nm full-width half-maximum)	2.8	-30.9	3.5	-1.8
Red, Blue, White LED Mixture (60 % Red, 25 % White, 15 % Blue)	-2.0	-21.2	2.6	-1.7

### NIST TRACEABLE CALIBRATION

Apogee Quantum sensors are calibrated by comparison to the mean of four transfer standard sensors under a reference lamp. The reference sensors are recalibrated regularly to a halogen lamp traceable to the National Institute of Standards and Technology. Calibration certificates are available upon request.