



APOGEE QUANTUM SENSORS

Original X & Full-spectrum Series



The photosynthetically active radiation measurement tool of choice for lighting researchers

Features

Apogee Instruments Quantum Sensors are the tool of choice for researchers and agricultural professionals measuring photosynthetically active radiation (PAR) all over the world. Apogee offers two types of quantum sensors: a **Full-spectrum Quantum** and **Original X Quantum Sensor**. Consult our spectral response graph to decide which model is right for your application.

Accurate, Stable Measurements

Cost-effective, original quantum sensors work well for broadband radiation sources (sun, high-pressure sodium, metal halide, cool white fluorescent lamps), while full-spectrum sensors are good for all light sources, including LEDs. Offers a self-cleaning, cosine-corrected head that is fully-potted for a waterproof design.

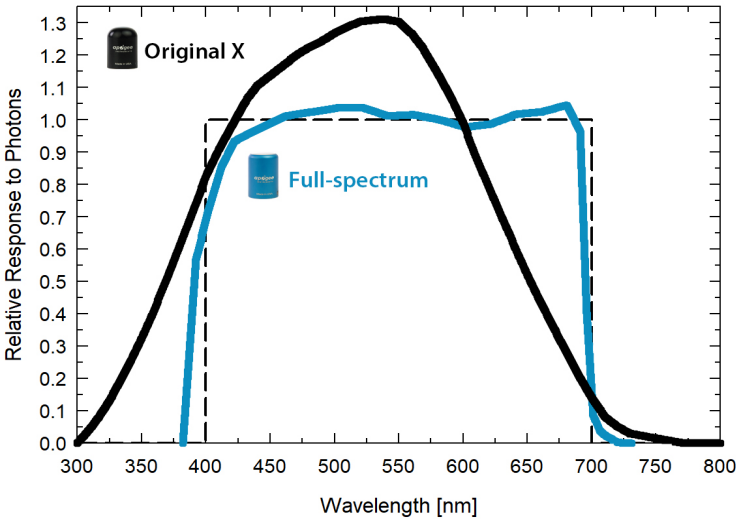
Typical PPFD Measurement Applications

- Incoming and reflected PPFD over and under plant canopies in greenhouses, in fields, and in growth chambers
- Aquatic environments including salt water aquariums and freshwater lakes and streams

Calibration Traceability

Apogee SQ series quantum sensors are calibrated through side-by-side comparison to the mean of four transfer standard sensors under a reference lamp. The reference sensors are recalibrated with a quartz halogen lamp traceable to the National Institute of Standards and Technology (NIST).

Spectral Response



Spectral response of original X quantum sensor (black) and full-spectrum quantum sensor (blue) compared to defined response of plants to radiation (dashed).

Spectral Errors

	Apogee SQ-500	Apogee SQ-100X	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	-8.8	0.4	-0.7
High Pressure Sodium	0.1	3.3	1.3	1.4
Red LED (667 nm peak, 20 nm full-width half-maximum)	2.8	-56.7	3.5	-1.8
Red, Blue, White LED Mixture (60 % Red, 25 % White, 15 % Blue)	-2.0	-21.2	2.6	-1.7

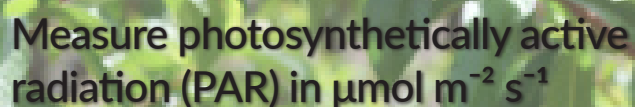
**All other models**

- 0 to 40 mV
- 0 to 5 V
- USB
- Modbus
- 0 to 2.5 V
- 4 to 20 mA
- SDI-12
- or hand-held meter



	SQ-500-SS	SQ-512-SS	SQ-514-SS	SQ-515-SS	SQ-520	SQ-521-SS	SQ-522-SS
Power Supply	Self-powered	5 to 24 V DC	12 to 24 V DC	5.5 to 24 V DC	5 V USB power source	5.5 to 24 V DC	
Current Draw	—	At 12 V is 57 $\mu$ A	maximum of 20 mA	At 12 V is 57 $\mu$ A	61 mA when logging	1.4 mA (quiescent), 1.8 mA (active)	RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA
Output (sensitivity)	0.01 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	0.625 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	0.004 mA per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	1.25 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	—		
Resolution	—				0.1 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	—	
Calibration Factor (reciprocal of output)	100 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	1.6 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	250 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mA	0.8 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	Custom for each sensor and stored in the firmware		
Calibration Uncertainty	± 5 %						
Output Range	0 to 40 mV	0 to 2.5 V	4 to 20 mA	0 to 5 V	USB	SDI-12	Modbus
Measurement Repeatability	Less than 0.5 %						
Long-term Drift	Less than 2 % per year						
Non-linearity	Less than 1 % (up to 4000 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> )						
Response Time	Less than 1 ms				Software updates every second	Less than 0.6 s	Less than 200 ms
Field of View	180°						
Spectral Range	389 to 692 nm ± 5 nm (wavelengths where response is greater than 50 %)						
Directional (cosine) Response	± 5 % at 75° zenith angle						
Temperature Response	-0.11 ± 0.04 % per C						
Operating Environment	-40 to 70 C; 0 to 100 % relative humidity; can be submerged in water up to depths of 30 m						
Dimensions	24 mm diameter, 37 mm height	30.5 mm diameter, 37 mm height			24 mm diameter, 37 mm height	30.5 mm diameter, 37 mm height	
Mass (5 m of cable)	100 g	140 g			100 g	140 g	
Warranty	4 years against defects in materials and workmanship						





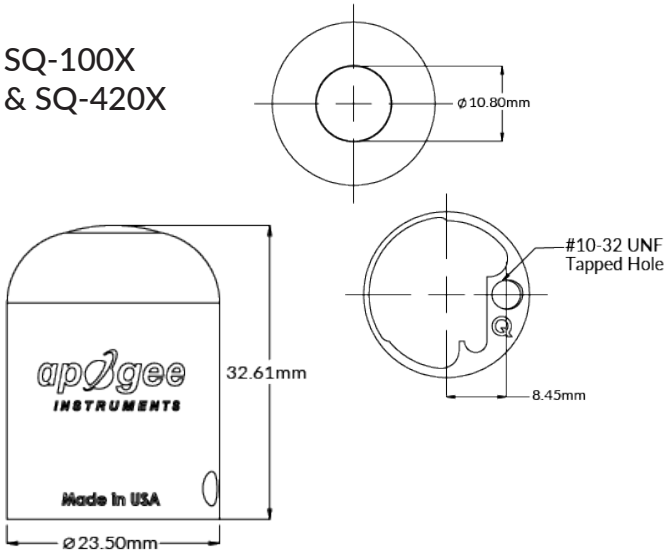
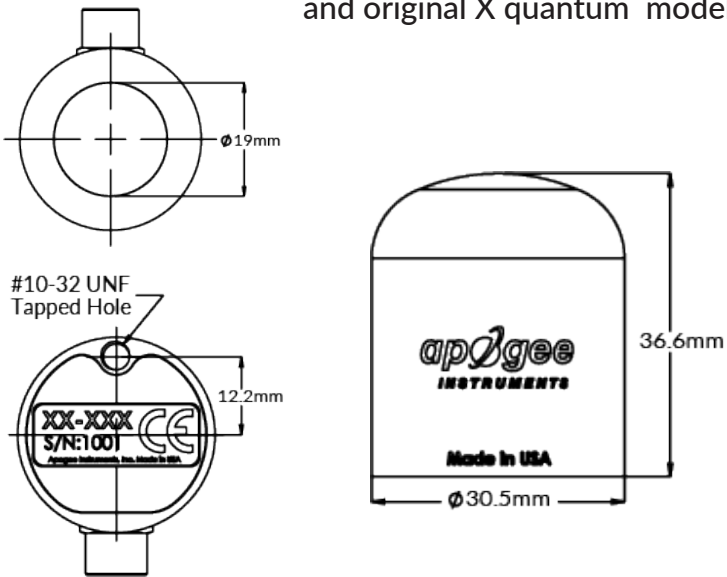
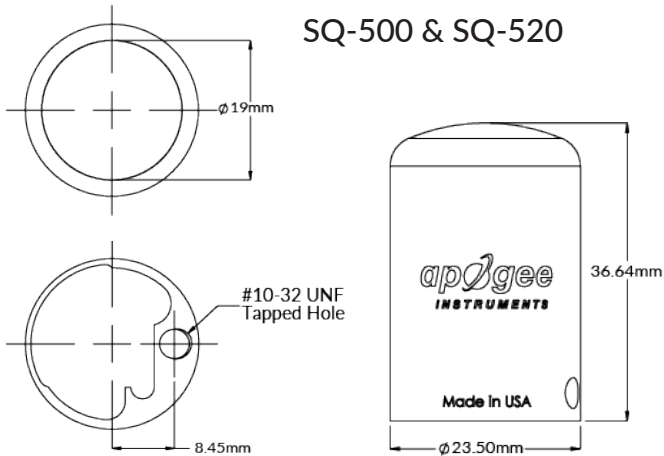
## MQ-200X

- 

	SQ-100X-SS	SQ-202X-SS	SQ-204X-SS	SQ-205X-SS	SQ-420X	SQ-421X-SS	SQ-422X-SS
Power Supply	Self-powered	5 to 24 V DC	7 to 24 V DC	5.5 to 24 V DC	5 V USB power source	5.5 to 24 V DC	
Current Draw	—	10 $\mu$ A	22 mA maximum; 2 mA quiescent	10 $\mu$ A	61 mA when logging	1.4 mA (quiescent), 1.8 mA (active)	RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA
Output (sensitivity)	0.1 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	0.6 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	0.004 mA per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	1.25 mV per $\mu$ mol m <sup>-2</sup> s <sup>-1</sup>	—		
Calibration Factor (reciprocal of output)	10 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	1.6 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	250 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mA	0.8 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> per mV	Custom for each sensor and stored in the firmware		
Calibration for Uncertainty	± 5 %						
Output Range	0 to 250 mV	0 to 2.5 V	4 to 20 mA	0 to 5 V	USB	SDI-12	Modbus
Measurement Repeatability	Less than 0.5 %						
Long-term Drift	Less than 2 % per year						
Non-linearity	Less than 1 % (up to 2500 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> )	Less than 1 % (up to 4000 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> )			Less than 1 % (up to 2500 $\mu$ mol m <sup>-2</sup> s <sup>-1</sup> )		
Response Time	Less than 1 ms				Software updates every second	Less than 0.6 s	Less than 200 ms
Field of View	180°						
Spectral Range	370 to 650 nm (wavelengths where response is greater than 50 % maximum)						
Directional (cosine) Response	± 5 % at 75° zenith angle						
Temperature Response	-0.04 % per C						
Operating Environment	-10 to 60 C; 0 to 100 % relative humidity; can be submerged in water up to 30 m						
Dimensions	24 mm diameter, 33 mm height	30.5 mm diameter, 37 mm height			24 mm diameter, 33 mm height	30.5 mm diameter, 37 mm height	
Mass (5 m of cable)	90 g	140 g			90 g	140 g	
Warranty	4 years against defects in materials and workmanship						

## Dimensions

All other full-spectrum quantum and original X quantum models



## Case Study

The **Kuwait Institute for Scientific Research** used Apogee’s **MQ-510** underwater full-spectrum quantum meters to help model algal species and their growth rate in Kuwait Bay. This research advances the researchers’ understanding of the frequent algal bloom and fish kill incidents that typically occur in the summer.

