



# APOGEE USB SMART QUANTUM SENSORS | SQ-420

## Features

**Accurate, Stable Measurements**  
Cosine-corrected with directional errors less than  $\pm 5\%$  at a solar zenith angle of  $75^\circ$ . Long-term non-stability less than  $2\%$  per year.

**Spectral Response**  
Original quantum sensors work well for broadband sources (sun, high pressure sodium, metal halide, cool white fluorescent lamps).

**Internal Data Storage**  
Sensor has internal data storage capability with the ability to hold up to 10,000 measurements. This allows the sensor to collect data while connected to most stand-alone 5 V DC USB power sources.

**No Datalogger Required**  
Sensor can be connected to a desktop, laptop, or tablet computer via a USB 2.0 type A plug. The ApogeeConnect software gives the user control of data logging and calibration settings, provides real time output display and graph of PPFD measurements, and allows the data set to be saved as a csv file for further analysis.

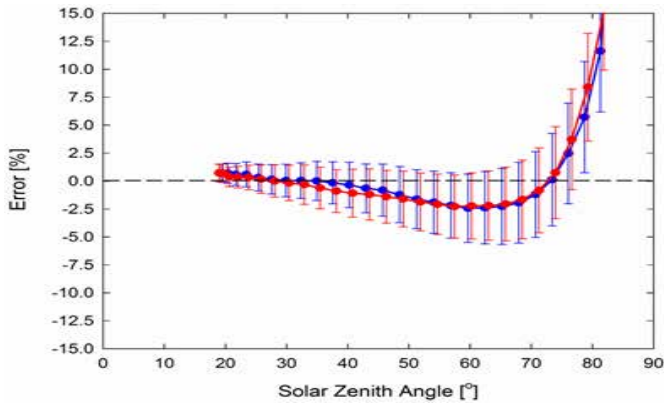
**Independent Calibration**  
The SQ-420 is calibrated independently for sunlight and electric light to improve measurement accuracy. The light source calibration can be selected in the settings menu of the Apogee software.

USB quantum sensor can be connected directly to a computer for real time measurements and data logging, or act as a stand-alone datalogger when connected to most standard 5 V DC USB power sources

## Product Specifications

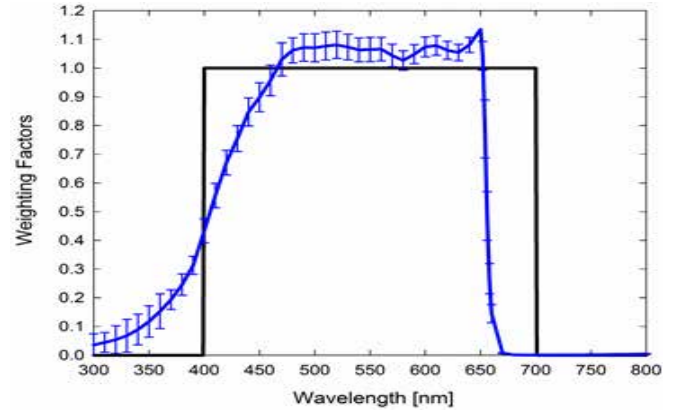
	SQ-420
Power Supply	Uses a 5 V USB power source and has a 61 mA current draw
Resolution	$0.1 \mu\text{mol m}^{-2} \text{s}^{-1}$
Calibration Factor	Custom for each sensor and stored in the firmware
Calibration Uncertainty	$\pm 5\%$
Measurement Repeatability	Less than $0.5\%$
Long-term Drift (non-stability)	Less than $2\%$ per year
Non-linearity	Less than $1\%$ (up to $4000 \mu\text{mol m}^{-2} \text{s}^{-1}$ )
Response Time	Software updates every second
Field of View	$180^\circ$
Spectral Range	410 to 655 nm (wavelengths where response is greater than $50\%$ of maximum)
Directional (Cosine) Response	$\pm 5\%$ at $75^\circ$ zenith angle
Temperature Response	$0.06 \pm 0.06\%$ 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, 33 mm height
Mass	90 g (with 5 m of lead wire)
USB Cable	4.6 m (15 ft)
Warranty	4 years against defects in materials and workmanship

## Cosine Response



Mean **cosine response** of seven Apogee SQ-500 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 SQ-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

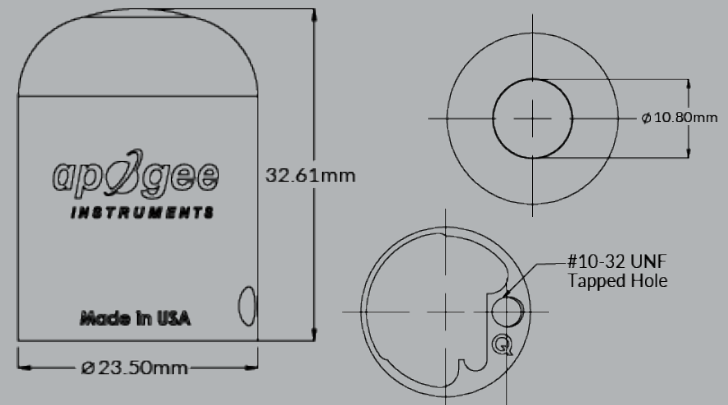


Mean **spectral response** of six SQ series quantum sensors (error bars represent two standard deviations above and below mean) compared to PPF weighting function. Spectral response measurements were made at 10 nm increments across a wavelength of 300 to 800 nm in a monochromator with an attached electric 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.

## Dimensions

### Calibration Traceability

Apogee SQ 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).



## Software Overview

**Instantaneous output display** → 81.9  $\mu\text{mol m}^{-2} \text{s}^{-1}$

**Graphic display of radiation levels** → [Line graph showing radiation levels over time]

**Setup menu with calibration type selection** → [Menu with options: Light source (Electric, Sunlight), Calibration, etc.]

**Connection status** → Device Connected

**Data capture setup with user defined logging intervals** → [Setup and Start buttons]

**Expandable data capture table**

Timestamp	Value
2015-09-22 13:23:44	78.3
2015-09-22 13:23:45	79.4
2015-09-22 13:23:46	82.2
2015-09-22 13:23:47	82.6
2015-09-22 13:23:48	81.5
2015-09-22 13:23:49	87.1
2015-09-22 13:23:50	90.4
2015-09-22 13:23:51	92.1
2015-09-22 13:23:52	94.4
2015-09-22 13:23:53	96.1
2015-09-22 13:23:54	96.9
2015-09-22 13:23:55	99.3
2015-09-22 13:23:56	99.1
2015-09-22 13:23:57	99.8
2015-09-22 13:23:58	100.8
2015-09-22 13:23:59	103.5
2015-09-22 13:24:00	104.8
2015-09-22 13:24:01	104.3
2015-09-22 13:24:02	105.5
2015-09-22 13:24:03	98.8
2015-09-22 13:24:04	109.6
2015-09-22 13:24:05	104.8
2015-09-22 13:24:06	99.3
2015-09-22 13:24:07	93.6
2015-09-22 13:24:08	73.2

**File name and location** → File Location: sq-420.csv