

# 4-20 mA Pyranometer

SP-214

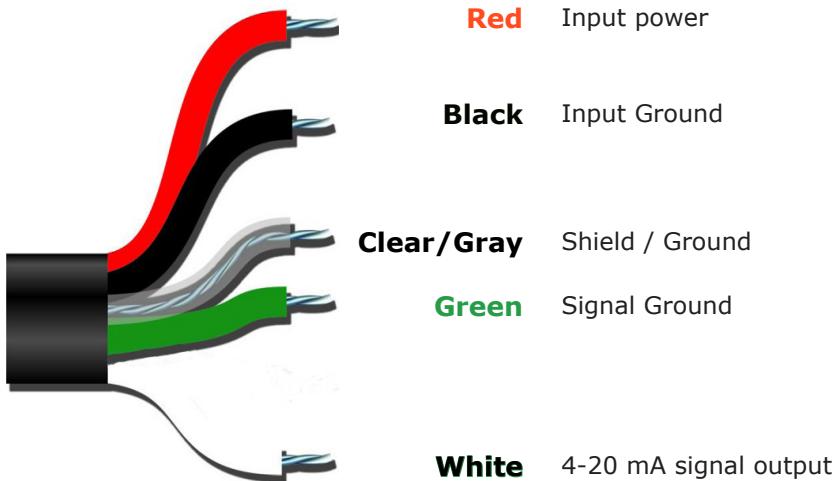


# 4-20 mA Pyranometer Sensor

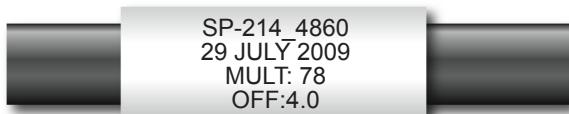
This sensor is calibrated to measure total shortwave radiation in  $\text{W m}^{-2}$ . The evaporation of water from soil and the transpiration of water from plant leaves are partly determined by the intensity of shortwave radiation, which is measured in Joules per meter squared per second or Watts per meter squared.

## Connection Instructions

**DO NOT exceed 36 Volts DC in power supply.**



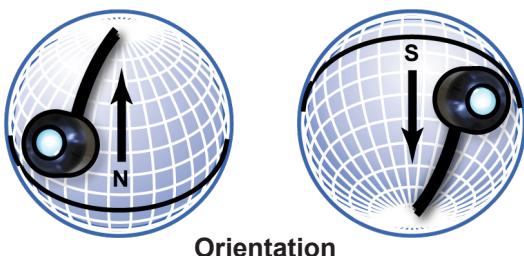
The model, serial number, production date, and calibration factor are located on the sensor cable.



## Mounting the Sensor



Mount the sensor to a solid surface with the nylon mounting screw. The sensor should be mounted level for the most accurate measurements. We recommend using our leveling plate (AL-100). The sensor should be mounted with the cable pointing toward true north in the northern hemisphere or true south in the southern hemisphere to minimize azimuth error. The azimuth error is typically less than 1%.



## Cleaning

Debris on the pyranometer is a common cause of low readings. Salt deposits can accumulate on a sensor from evaporation of sprinkler irrigation water and dust, which can accumulate during periods of low rainfall. Salt deposits should be dissolved and removed with vinegar and a soft cloth or q-tip. Dust and other organic deposits are best removed with water, rubbing alcohol or window cleaner. *Never use an abrasive cleaner on the lens.*

# Calibration



Apogee 4-20 mA pyranometers have a standard calibration of exactly:

**78 W m<sup>-2</sup> per mA**

with an offset of 4.0 mA.

## Under Full Sunlight

Sensor Output: 18.1 mA  
Output Offset: 4 mA  
Conversion Factor: 78

## Equation to Convert Measured Output to Solar Radiation

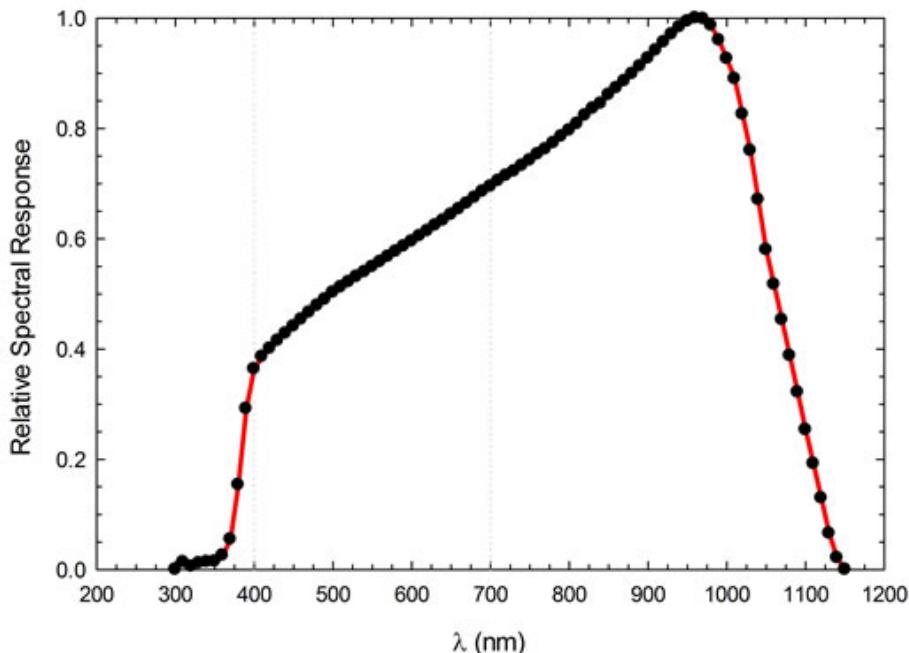
Solar radiation = (sensor output - output) \* conversion factor  
= (18.1 mA - 4.0 mA) \* 78 W m<sup>-2</sup> per mA = 1100 W m<sup>-2</sup>

# Spectral Response and Calibration

An ideal pyranometer measures the entire solar spectrum, 280 to 2800 nm. However, about 90% of sunlight energy is between 300 to 1100 nm.

The calibration of the SP-214 is based on a side-by-side comparison under a high intensity discharge metal halide lamp using four Apogee silicon transfer standard pyranometers. The Apogee transfer standards are calibrated annually under clear sky conditions and Apogee Instruments in Logan, Utah against a minimum of two ISO classified pyranometers, recalibrated on a biennial schedule at NREL in Boulder, Colorado. NREL reference standards are calibrated to the World Radiometric Reference in Davos, Switzerland.

## Spectral Response of the Apogee Pyranometer

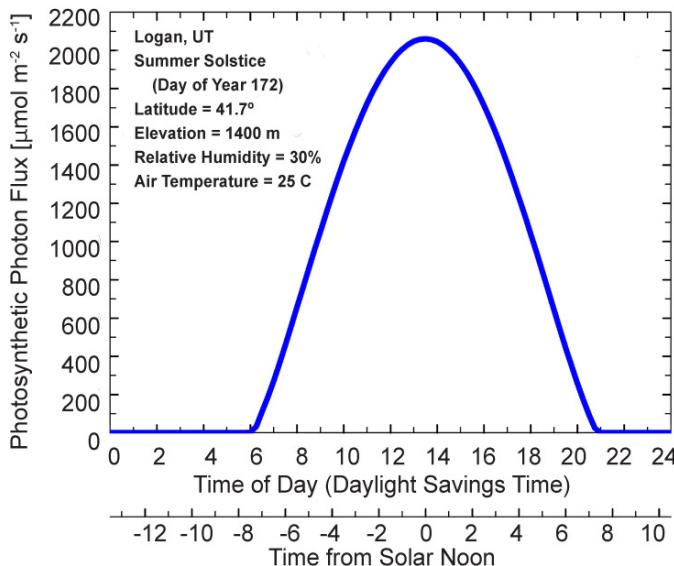




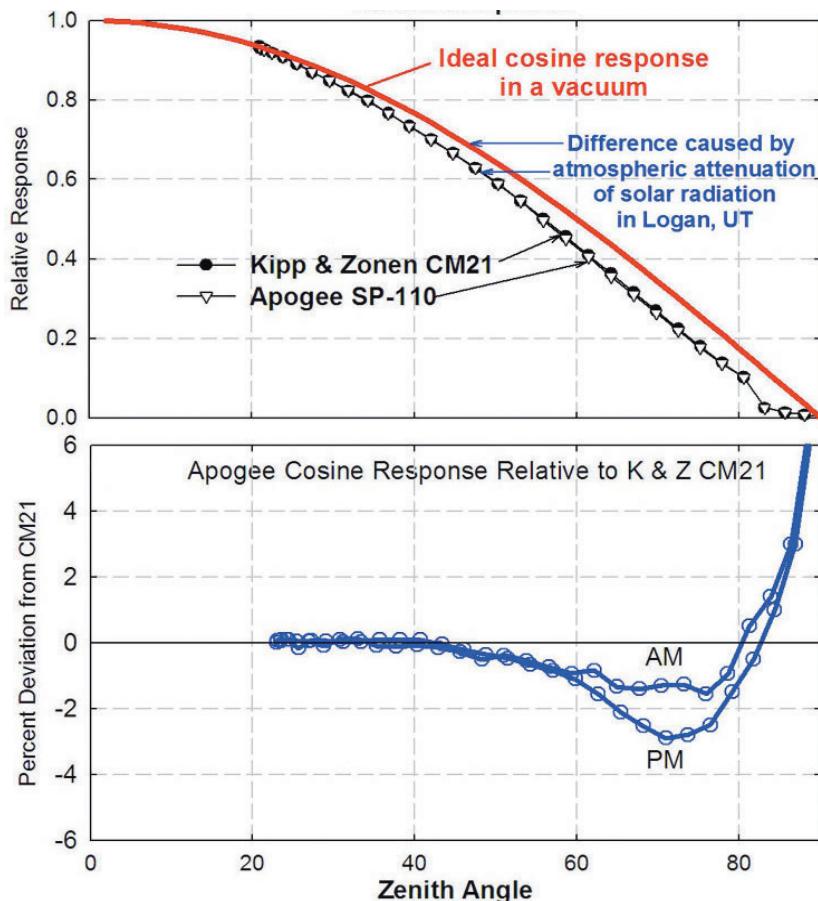
The Clear Sky Calculator is designed to determine the need for radiation sensor recalibration. It determines the intensity of radiation falling on a horizontal surface at any time of the day in any location in the world. It is most accurate when used near solar noon in the summer months.

The calculator is found at [www.clearskycalculator.com](http://www.clearskycalculator.com) and is used by typing conditions into the Clear Sky model and comparing measured values with the calculated value for a clear sky. If the output of the sensor over multiple days at solar noon is consistently less than the model value (by more than 8%), the sensor should be cleaned and re-leveled. If the output is still low after a second test, email [calibration@apogeeinstruments.com](mailto:calibration@apogeeinstruments.com) to discuss test results and the possible return of sensors. When used near solar noon over multiple clear, unpolluted days during the spring and summer months, it is estimated that the accuracy of the model can be  $\pm 4\%$  in all climates and locations around the world.

## Example of Model Output



# Cosine Response



## Temperature Response

The temperature response is less than 0.1% per degree Celsius. This temperature error is not significant in most applications.

## Long-Term Stability

Our research indicates that the output increases about 1% per year because of changes in the optical transparency of the diffusion disk. We recommend returning the sensor for recalibration every 2 years.

# Specifications

## Cosine Response

- 45° zenith angle:  $\pm 1\%$
- 75° zenith angle:  $\pm 5\%$

## Absolute Accuracy

- $\pm 5\%$

## Repeatability

- $\pm 1\%$

## Output

- 4 to 20 mA (18.1 mA = full sunlight  $1100 \text{ W m}^{-2}$ )

## Output Offset

- 4.0 mA

## Input Power

- 5 - 36 VDC

## Sensitivity

- Sensitivity: Custom calibrated to exactly  $78 \text{ W m}^{-2}$  per mA

## Long-Term Drift

- Less than 3% per year

## Operating Environment

- -25 to 55 C
- 0 to 100% relative humidity
- Designed for continuous outdoor use
- Can be submerged in water

## Current Draw

- $20 \text{ mA} = 1250 \text{ W m}^{-2}$
- 2 mA = quiescent current
- $22 \text{ mA} = \text{max current at } 1250 \text{ W m}^{-2}$

## Materials

- Anodized aluminum with cast acrylic lens

## Cable

- 5 meters of twisted-pair wire
- Foil shield
- Santoprene jacket
- Ending in pigtail leads
- Additional cable is available in multiples of 5 meters

## Dimensions

- 2.85 cm diameter by 2.83 cm height

## Mass

- 140 g (with 5 meter lead wire)

## Warranty

- 1 year against defects in materials and workmanship



www.apogeeinstruments.com  
techsupport@apogeeinstruments.com  
435.792.4700  
Fax: 435.787.8268