

FEATURES

Apogee offers silicon-cell and thermopile pyranometers that are both rated ISO 9060:2018 Class C (fast response). Our popular silicon-cell models are less expensive and have a faster response time, but can have errors under cloudy conditions. Our thermopile pyranometers feature a unique, cost-effective design with an inexpensive diffuser and blackbody thermopile detector that provides a broader and more uniform spectral response for better performance in all atmospheric conditions.

STABLE MEASUREMENTS

Long-term non-stability determined from multiple replicate pyranometers in accelerated aging tests and field conditions is less than 2 % per year.

SP-110



SP-522



UNIQUE DESIGN

An accurate, cosine-corrected patented design sheds water and dirt for a self-cleaning performance. A heated option is available with a 0.2 W heater to minimize errors caused by dew, frost, or snow.

TYPICAL APPLICATIONS

- Solar panel arrays.
- Agricultural, ecological, and hydrological weather networks

CALIBRATION TRACEABILITY

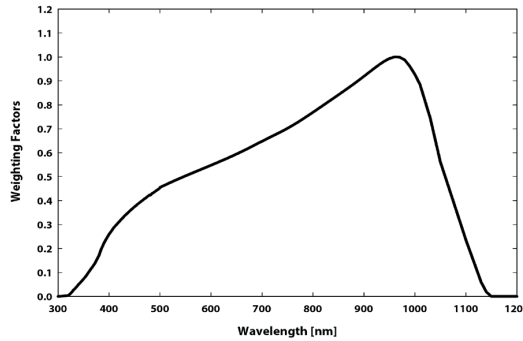
Apogee SP series pyranometers are calibrated through side-by-side comparison to the mean of four transfer standard sensors under a reference lamp. The reference sensors are recalibrated under sunlight in Logan, UT traceable to the World Radiometric Reference (WRR) in Davos, Switzerland.



Accurate and stable global shortwave (solar) radiation measurement

OUTPUT OPTION	
ITEM	DESCRIPTION
1	0 to 350 mV
2	0 to 5 V
3	USB
4	Modbus
5	0 to 2,5 V
6	4 to 20 Ma
7	SDI-12
8	Hand-held meter

SPECTRAL RESPONSE



Spectral response estimate of Apogee silicon-cell pyranometers.



MP-200



TECHNICAL SPECIFICATION									
MODEL	SP-110-SS	SP-212-SS	SP-214-SS	SP-215-SS	SP-320-SS	SP-240	SP-421-SS	SP-422-SS	
ISO 9060:2018	Class C (fast response)								
POWER SUPPLY	Self-powered	5 to 24 VDC	7 to 24 VDC	5.5 to 24 VDC	12 VDC for heater	5 V USB	5.5 TO 24 V DC		
CURRENT DRAW	–	300 μ A	22 mA maximum, 2 mA quiescent	300 μ A	15.4 mA	61 mA when logging	1.5 mA (quiescent); 1.9 mA (active)	RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA	
OUTPUT (SENSIVITY)	0.2 mV per $W m^{-2}$	1.25 mV per $W m^{-2}$	0.008 mA per $W m^{-2}$	2.5 mV per $W m^{-2}$	0.2 mV per $W m^{-2}$	USB	SDI-12	Modbus	
CALIBRATION FACTOR (RECIPROCAL OF OUTPUT)	5 $W m^{-2}$ per mV	0.8 $W m^{-2}$ per mV	125 $W m^{-2}$ per mA, 4 mA offset	0.4 $W m^{-2}$ per mV	5 $W m^{-2}$ per mV	Custom for each sensor and stored in firmware			
CALIBRATION UNCERTAINTY AT 1000 $W m^2$	Less than 3 %								
MEASUREMENT REPEATABILITY	Less than 1 %								
LONG-TERM DRIFT	Less than 2 % per year								
NON-LINEARITY	Less than 1 % up to 2000 $W m^{-2}$								
RESPONSE TIME	Less than 1 ms					Updates every second	Less than 0.6 s	Less than 200 ms	
FIELD OF VIEW	180°								
SPECTRAL RANGE	360 to 1120 nm								
DIRECTIONAL (COSINE) RESPONSE	± 5 % at 75° zenith angle								
TEMPERATURE RESPONSE OPERATING ENVIRONMENT	0.04 \pm 0.04 % per C								
DIMENSIONS	-40 to 70 C; 0 to 100 % relative humidity; can be submerged in water up to 30 m					24 mm d; 33 mm h	30.5 mm diameter, 37 mm height	24 mm d; 33 mm h	30.5 mm diameter, 37 mm height
MASS (WITH 5m OF CABLE)	90 g		140 g		90 g				
CABLE	5 m of shielded, twisted-pair wire; TPR jacket (high water resistance, high UV stability, flexibility in cold conditions); pigtail lead wires								
WARRANTY	4 years against defects in materials and workmanship								

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More Information:



Versión: M2024-1

Blackbody accuracy with a cost-effective design

TECHNICAL SPECIFICATION			
MODEL	SP-510-SS	SP-610-SS	SP-522-SS
ISO 9060:2018	Class C (fast response)	N/A	Class C (fast response)
SENSITIVITY (VARIABLE FROM SENSOR TO SENSOR, TYPICAL VALUES LISTED)	0.045 mV per W m ⁻²	0.035 mV per W m ⁻²	–
CALIBRATION FACTOR (RECIPROCAL OF SENSITIVITY)(VARIABLE FROM SENSOR TO SENSOR, TYPICAL VALUES LISTED)	22 W m ⁻² per Mv	28.5 W m ⁻² per mV	–
INPUT VOLTAGE REQUIREMENT	–	–	5.5 to 24 V
CALIBRATION UNCERTAINTY AT 1000 W m ²	Less than 3 %		
OUTPUT RANGE	0 to 90 mV	0 to 70 mV	Modbus
MEASUREMENT RANGE	0 to 2000 W m ⁻² (net shortwave radiation)		
MEASUREMENT REPEATABILITY	Less than 1 %		
LONG-TERM DRIFT	Less than 2 % per year		
NON-LINEARITY	Less than 1 %		
DETECTOR RESPONSE TIME	0.5 s	–	0.5 s (baudrate dependent)
FIELD OF VIEW	180°	150°	180°
SPECTRAL RANGE (50% POINTS)	385 nm to 2105 nm	370 nm to 2240 nm	385 nm to 2105 nm
DIRECTIONAL (COSINE) RESPONSE	Less than 30 W m ⁻² at 80° solar zenith	Less than 20 W m ⁻² for angles between 0 and 60°	Less than 30 W m ⁻² at 80° solar zenith
TEMPERATURE RESPONSE	Less than 5 % from -15 to 45 C		
ZERO OFFSET A	Less than 2 W m ⁻² ; Less than 10 W m ⁻² (heated)	Less than 2 W m ⁻² ; Less than 10 W m ⁻² (heated)	Less than 2 W m ⁻² ; Less than 10 W m ⁻² (heated)
ZERO OFFSET B	Less than 5 W m ⁻²		
UNCERTAINTY WITH DAILY TOTAL OPERATING ENVIRONMENT	Less than 5 %		
HEATER	780 Ω, 15.4 mA current draw and 185 mW power requirement at 12 V DC		4 mA (heater off); 30 mA (heater on)
DIMENSIONS	23.5 mm diameter, 28.7 mm height	23.5 mm diameter, 27.5 mm height	30.5 mm diameter, 37 mm height
MASS	90 g	100 g	140 g
CABLE	5 m of four conductor, shielded, twisted-pair wire; TPR jacket (high water resistance, high UV stability, flexibility in cold conditions); pigtail lead wires		
WARRANTY	4 years against defects in materials and workmanship		

OUTPUT OPTION

ITEM	DESCRIPTION
1	0 to 114 mV
2	Modbus
3	Downward sensor available for measuring shortwave reflectance, or combine with an upward head to measure albedo (see SP-710-SS albedometer package)

MP-522



MP-510



MP-610

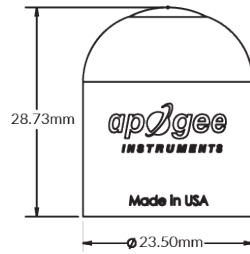


DIMENSIONS

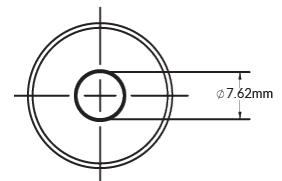
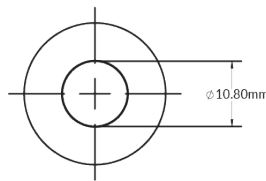
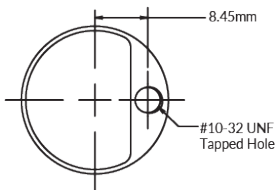
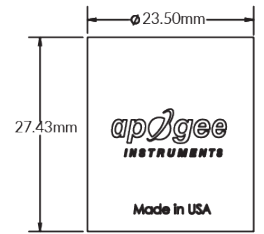
THERMOPILE MODELS



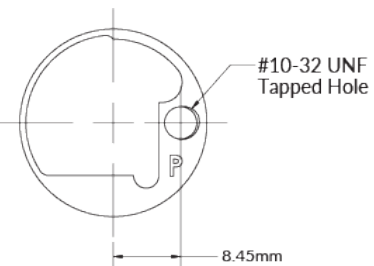
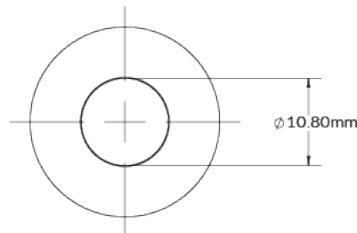
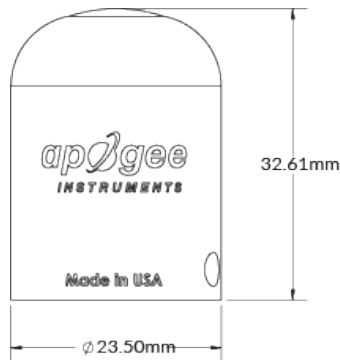
SP-510



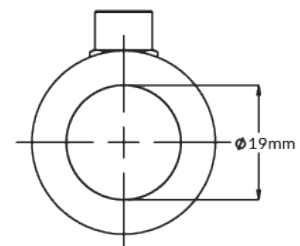
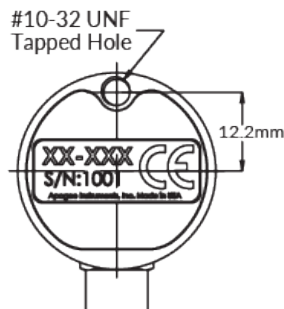
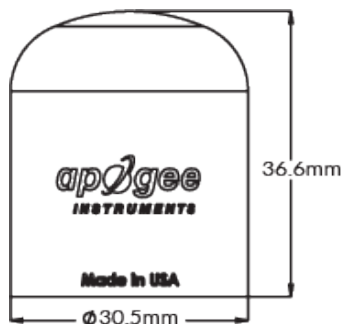
SP-610



SILICON-CELL MODELS SP-110 & PS-420



ALL OTHER SILICON-CELL PYRANO- METER MODELS & SP-522-SS



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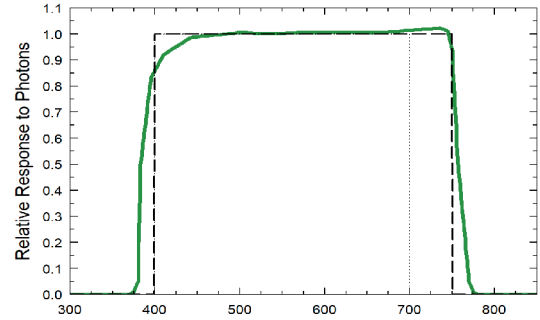


MQ-610 & SQ-610 SERIES

SQ-614



SPECTRAL RESPONSE



Spectral response of the ePAR sensor (green) compared to the "ePAR" target response (dashed) and the traditional PAR response (dotted).

TECHNICAL SPECIFICATION

MODEL	MQ-610	SQ-610-SS	SQ-612-SS	SQ-614-SS	SQ-615-SS	SQ-616	SQ-617-SS	SQ-618-SS
POWER SUPPLY	–	Self-powered	5 to 24 V DC	12 to 24 V DC	5.5 to 24 V DC	5 V USB	5.5 to 24 V DC	
CURRENT DRAW	–	–	at 12 V is 57 μ A	Maximum of 20 mA	at 12 V is 57 μ A	61 mA when logging	1.4 mA (quiescent), 1.8 mA (active)	RS-232 37mA; RS-485 quiescent 37mA, active 42mA
SENSITIVITY	–	0.01 mV per μ mol m ⁻² s ⁻¹	0.625 mV per μ mol m ⁻² s ⁻¹	0.004 mA per μ mol m ⁻² s ⁻¹	1.25 mV per μ mol m ⁻² s ⁻¹	–		
OUTPUT TYPE	–	0 to 40 mV	0 to 2.5 V	4 to 20 mA	0 to 5 V	USB	SDI-12	Modbus
RESOLUTION	–	–			0.1 μ mol m ⁻² s ⁻¹			–
CALIBRATION FACTOR	–	100 μ mol m ⁻² s ⁻¹ per mV	1.6 μ mol m ⁻² s ⁻¹ per mA	250 μ mol m ⁻² s ⁻¹ per mA	0.8 μ mol m ⁻² s ⁻¹ per mV	Custom for each sensor and stored in the firmware		
CALIBRATION UNCERTAINTY	± 5 %							
MEASUREMENT RANGE	0 to 4000 μ mol m ⁻² s ⁻¹							
MEASUREMENT REPEATABILITY	Less than 0.5 %							
LONG-TERM DRIFT	Less than 2 % per year							
NON-LINEARITY	Less than 1 % (up to 4000 μ mol m ⁻² s ⁻¹)							
RESPONSE TIME	Less than 1 ms						0.6 s	–
FIELD OF VIEW	180°							
SPECTRAL RANGE	383 to 757 nm ± 5 nm (wavelengths where response is greater than 50 % of maximum)							
DIRECTIONAL (COSINE) RESPONDE	± 2 % at 45° zenith angle, ± 5 % at 75° zenith angle							
AZMUTH & TILT ERROR	Less than 0.5 %		–					
TEMPERATURE RESPONSE	-0.11 ± 0.04 % per C							
UNCERTAINTY IN DAILY TOTAL	Less than 5 %				–			
OPERATING ENVIROMENT	-40 to 70 C; 0 to 100 % relative humidity; sensor head can be submerged in water up to depths of 30 m; meter is not waterproof							
DIMENSIONS	126 mm L, 70mm W, 24mm H			30.5 mm diameter, 37 mm height				



OVERVIEW

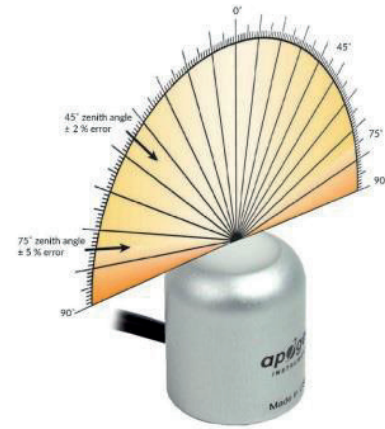
The new Apogee ePAR (extended photosynthetically active radiation) sensor was created to measure the wider 400-750 nm radiation range that cutting-edge research is showing to be photosynthetically active, beyond the traditional 400-700 nm range defined by McCree. Most of this transformative work to refine and define the ePAR range is being conducted by Dr. Shuyang Zhen and Dr. Bruce Bugbee at Utah State University.

TYPICAL APPLICATIONS

ITEM	DESCRIPTION
1	Total ePAR intensity measurements over plant canopies in all growing environments.
2	Monitor and adjust grow lights.
3	Research plant morphogenic activity.
4	Photobiology studies.

MULTIPLE OUTPUT OPTIONS

ITEM	DESCRIPTION
1	0 to 40 mV
2	0 to 5 V
3	USB
4	Modbus
5	0 to 2.5 V
6	4 to 20 mA
7	SDI-12
8	or hand-held meter



ACCURATE, STABLE MEASUREMENTS

Cosine-corrected with directional errors less than $\pm 5\%$ at a solar zenith angle of 75° . Long-term non-stability less than 2% per year.

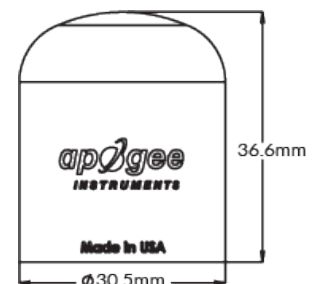
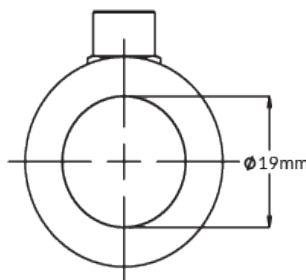
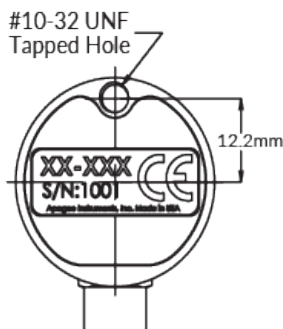
HIGH QUALITY CABLE

Pigtail-lead sensors feature on IP68, marine-grade stainless-steel cable connectors attached directly to the sensor head to simplify sensor removal for maintenance and recalibration.

CALIBRATION TRACEABILITY

Apogee Instruments SQ-600 series ePAR sensors are calibrated through side-by-side comparison to the mean of four transfer standard sensors under a reference lamp. The transfer standard sensors are recalibrated with a quartz halogen lamp traceable to the National Institute of Standards and Technology (NIST).

DIMENSIONS



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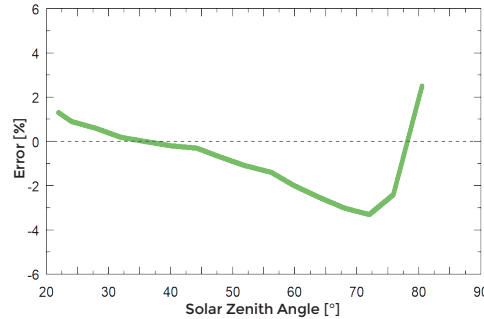
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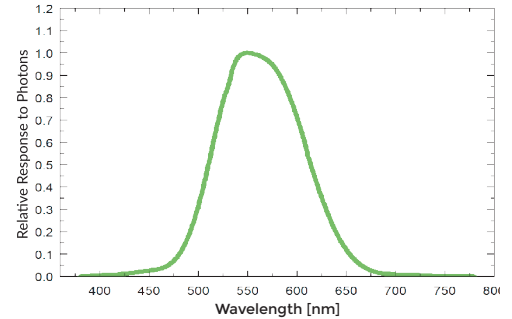


Versión: M2024-1

RESPONSE GRAPHS



Cosine response of four photometric sensors. These data are the average of the AM and PM response.



Spectral response of photometric sensors (green) compared to the CIE 1931 photopic curve.

TECHNICAL SPECIFICATION						
MODEL	SE-100-SS	SE-202-SS	SE-205-SS	SE-212-SS	SE-215-SS	SE-421-SS
POWER SUPPLY	–	5 to 24 V DC	5.5 to 24 V DC	5 to 24 V DC	5.5 to 24 V DC	
CURRENT DRAW	–	Maximum of 10 µA				1.4 mA (quiescent); 1.8 mA (active)
OUTPUT (SENSITIVITY)	0.001 mV per lux	0.5 mV per lux	1 mV per lux	0.0167 mV per lux	0.033 mV per lux	–
CALIBRATION FACTOR	1000 lux per mV	2 lux per mV	1 lux per mV	60 lux per mV	30 lux per mV	Custom for each
CALIBRATION UNCERTAINTY	± 5 %					
OUTPUT RANGE	0 to 200 mV	0 to 2500 mV	0 to 5000 mV	0 to 2500 mV	0 to 5000 mV	SDI-12
MEASUREMENT RANGE	0 to 150000 lux	0 to 5000 lux		0 to 150000 lux		
MEASUREMENT REPEATABILITY	Less than 0.5 %					
LONG-TERM DRIFT	Less than 2 % per year					
NON-LINEARITY	Less than 1 %					
RESPONSE TIME	Less than 1 ms					
SPECTRAL RANGE	CIE 1931 luminous efficiency function					
FIELD OF VIEW	180°					
DIRECTIONAL (COSINE) RESPONDE	± 2 % at 45°; ± 5 % at 75°					
TEMPERATURE RESPONSE	Less than 0.1 % per C					
OPERATING ENVIROMENT	-40 to 70 C; 0 to 100 % relative humidity					
DIMENSIONS	30.5 mm diameter, 37 mm height					
MASS (WITH 5m OF CABLE)	140 g					
CABLE	5 m of shielded, twisted-pair wire with TPR jacket and stainless steel connector					
WARRANTY	4 years against defects in materials and workmanship					



OVERVIEW

Apogee photometric sensors use a photodetector with a spectral response that closely matches the sensitivity of the human eye to light; sensors include a diffuser to properly weight light incident from any angle. Apogee photometric sensors provide highly accurate illuminance measurements (lux or footcandles) at an affordable price.

RUGGED, SELF-CLEANING HOUSING

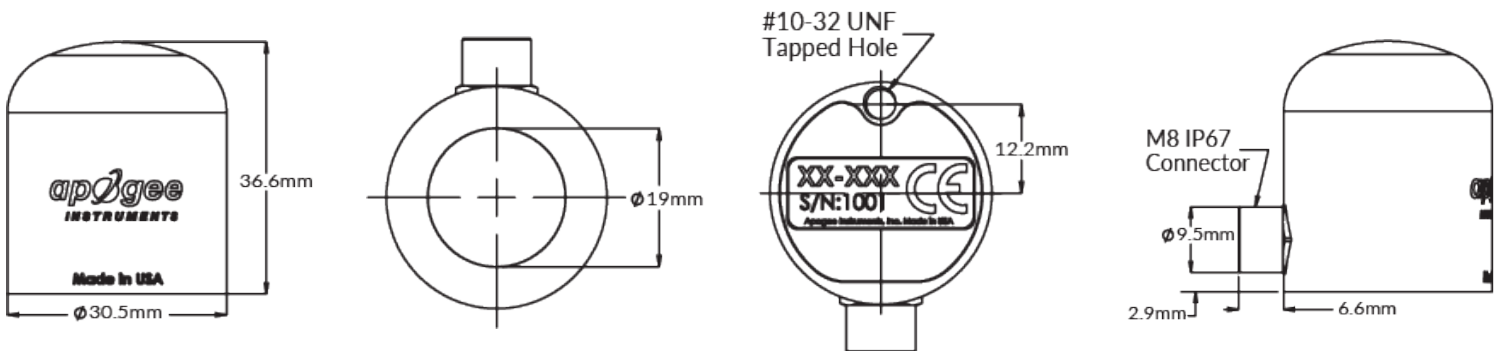
Sensor features an anodized aluminum body with fully-potted electronics. The dome-shaped sensor head minimizes errors by shedding dust and water for a self-cleaning performance.

CALIBRATION TRACEABILITY

Apogee SE photometric sensors are calibrated through side-by-side comparison to the mean of two transfer standard sensors under a reference lamp. The reference sensors are verified with a quartz halogen lamp traceable to the National Institute of Standards and Technology (NIST).



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SOLAR MOUNTING BRACKET AL-120

SIMPLE & ACCURATED MOUNTING

The AL-120 solar mounting bracket is designed to mount Apogee Instruments' solar sensors to a mast or pipe with an outer diameter of 1.3" - 2.1". The bracket has an integrated bubble-level to make leveling simple and accurate for proper sensor installation.

ACCOMMODATED SENSOR MODELS

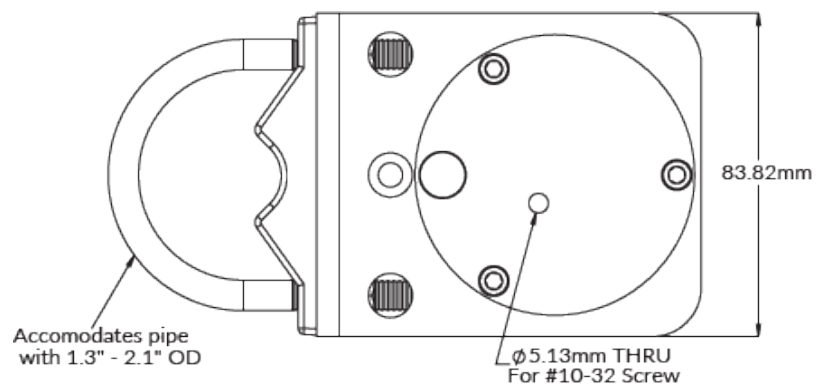
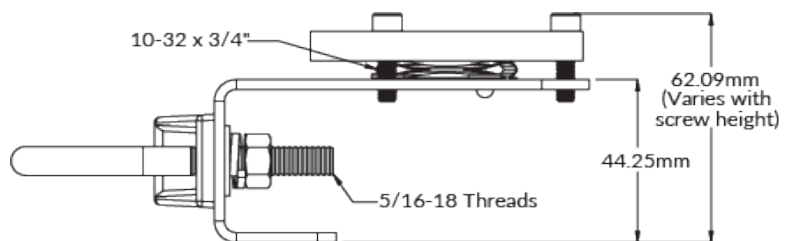
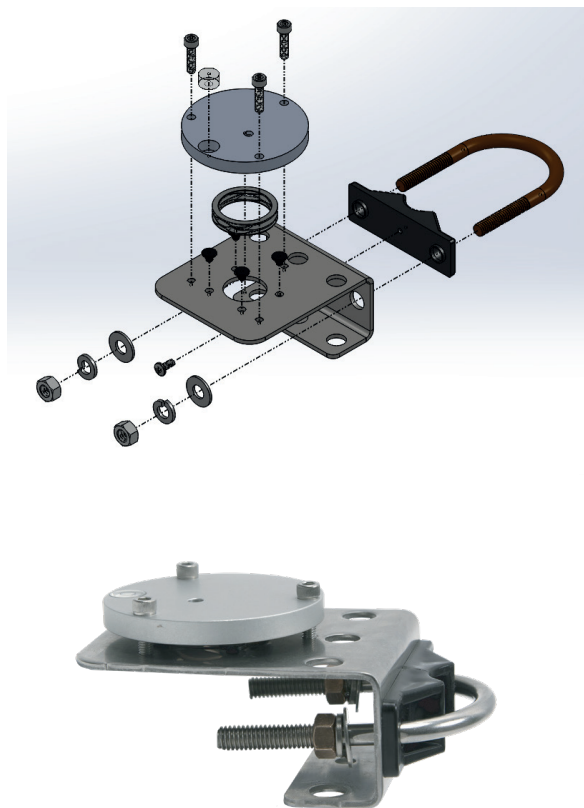
Bracket accommodates Apogee Instruments solar sensor SP, SL, SU, and SQ-100, 200, 400, and 500 series models.

TECHNICAL SPECIFICATIONS		
ITEM	DESCRIPTION	CAPACITY
1	DIMENSIONS	83.8 mm x 62.1 mm
2	MASS	420 g
3	WARRANTY	4 years against defects in materials and workmanship

AL-120



DIMENSIONS



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