

Reflectance sensor

CODE 06140298 (NDVI) | 06140299 (PRI)



Radiation reflected from surfaces (e.g. plant canopies, soil) provides information about the condition of the surface. Reflectance is the ratio of the radiation reflected by the surface to the radiation at the surface.

Two common indices calculated from reflectance measurements are the normalised difference vegetation index (NDVI) and the photochemical reflectance index (PRI).

The NDVI provides a measure of the greenness of the surface and is calculated from red and near-infrared (NIR) reflectance.

The PRI provides an indication of the canopy's photosynthetic activity and is calculated from the green and yellow reflectance.

The typical application of NDVI and PRI sensors is to monitor the plant canopies. NDVI is related to plant canopy leaf area and canopy chlorophyll content and is often used to control spring greening and autumn senescence. The PRI is related to the plant canopy's light use efficiency and is often used in studies of canopy photosynthesis and responses to stress.

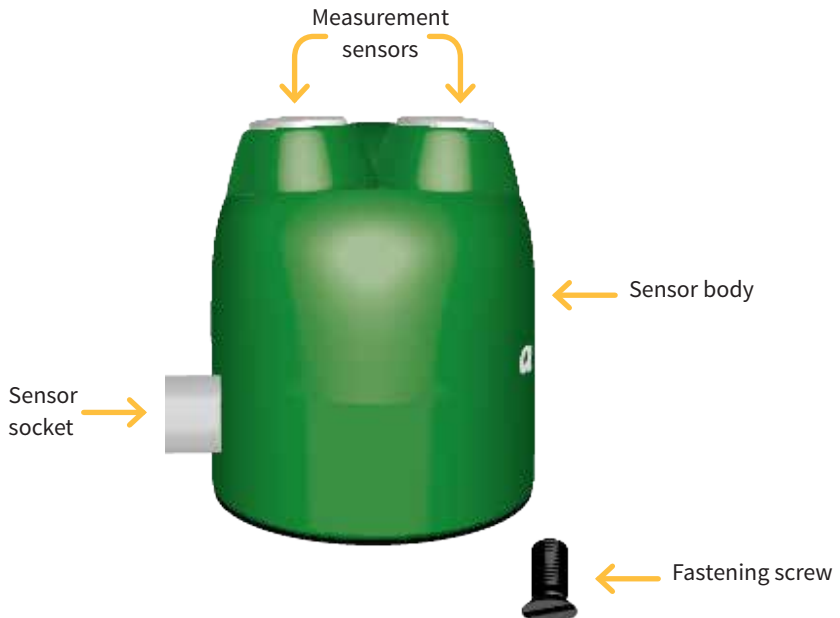
Apogee S2-series dual-band sensors consist of a cast acrylic diffuser (sensor facing up) or an acrylic window (sensor facing down), a pair of photodiodes that measure specific wavelength ranges, signal processing circuitry mounted in an anodised aluminium housing and a cable to connect to the AgroBee-L SDI-12. The S2 series sensors are designed for continuous irradiance measurements in interior and exterior environments. The reflectance derived from sensors paired up and down can be used to calculate NDVI and PRI.

Technical specifications

	Sensor details			
	NDVI		PRI	
Models	S2-411-SS	S2-412-SS	S2-421-SS	S2-422-SS
Output type	SDI-12 communication bus			
Wave length	Red detector = 650 nm with 10 nm FWHM NIR detector = 810 nm with 10 nm FWHM		Green detector = 532 nm with 10 nm FWHM Yellow detector = 570 nm with 10 nm FWHM	
Field of vision	180°	40°	180°	40°
IP	IP68			
Cable	Five metres of shielded braided cable with stainless steel connector. M8			
Dimensions	30.5 mm diameter 36.6 mm height	23.5 mm diameter 40 mm height	30.5 mm diameter 36.6 mm height	23.5 mm diameter 40 mm height
Weight	51 grams	110 g (with 5 m cable)	51 grams	110 g (with 5 m cable)

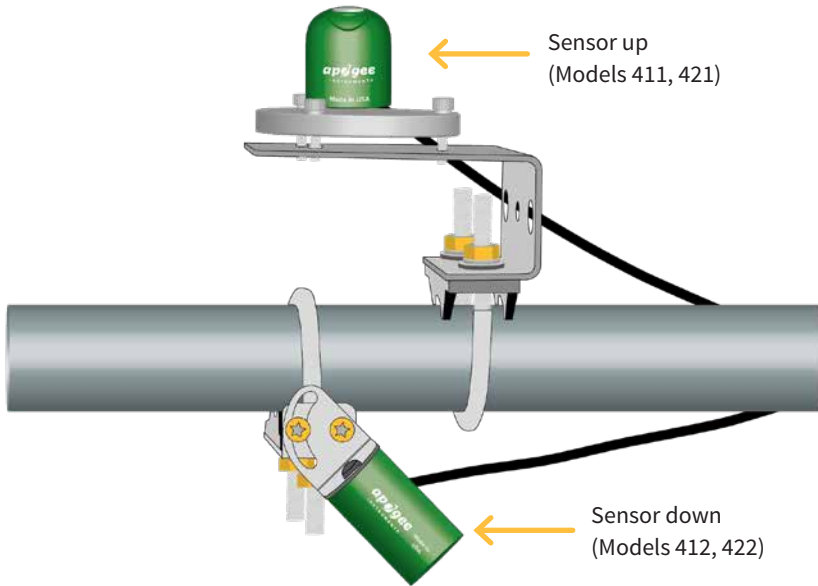
Sensor parts

The following image shows the parts of the sensor.



Installation

ASSEMBLING THE SENSORS UP AND DOWN



ASSEMBLING THE SENSOR UP

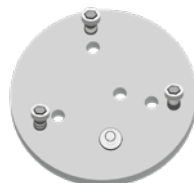
Assemble the sensor upright to a solid surface with the supplied nylon mounting screw to prevent galvanic corrosion.

To accurately measure incident irradiance on a horizontal surface, the sensor must be level. An Apogee Instruments model AL-100 levelling plate (see illustration) is recommended for levelling the sensor when used on a flat surface or assembled on surfaces such as wood.

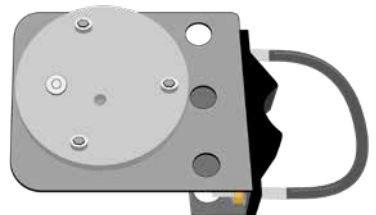
For easy assembly on a mast or pipe, the Apogee Instruments Model AL-120 solar mounting bracket with levelling plate is recommended.



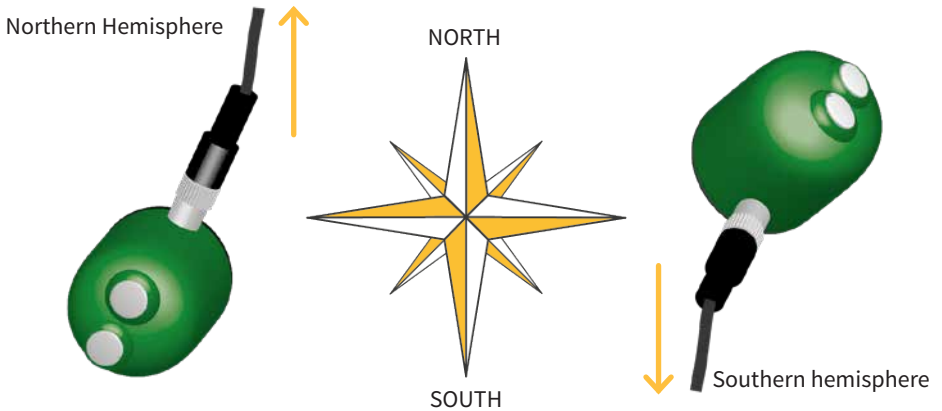
MODEL AL-100



MODEL AL-120



To minimise azimuth error, the sensor should be assembled with the cable pointed to true north in the northern hemisphere or true south in the southern hemisphere. Azimuth error is typically less than 1%, but is easily minimised by correct cable orientation.

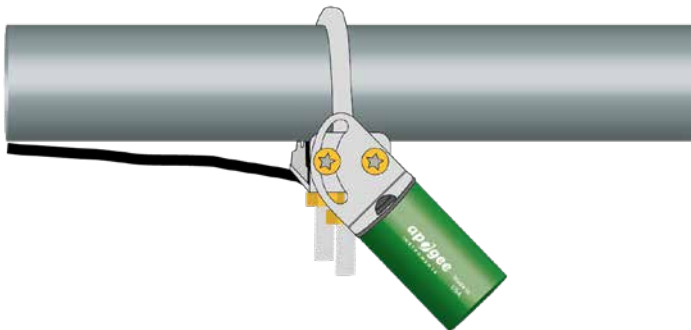


In addition to orienting the cable to point toward the nearest pole, the sensor should also be assembled so that obstructions (e.g. tripod/weather station mast or other instrumentation) do not shade the sensor. Once assembled, the green cap must be removed from the sensor. This cap can be used as a protective cover for the sensor when not in use.

To obtain the PRI or NDVI index measurement, two sensors are needed.

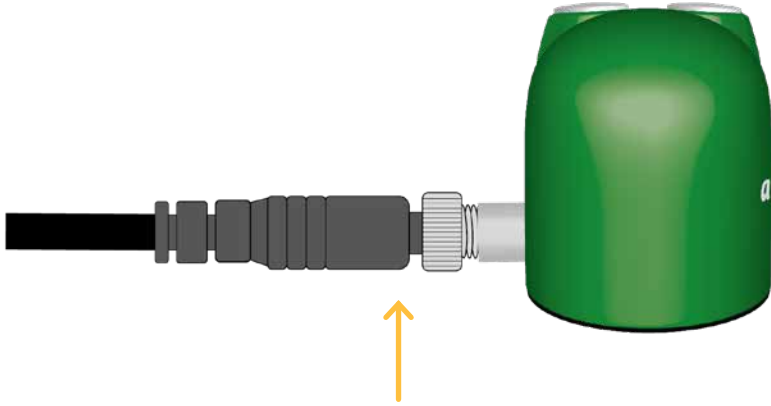
INSTALLING THE SENSOR DOWNWARDS

Install the sensor on a solid surface with the nylon screw provided to prevent galvanic corrosion. For ease of mounting on a mast or pipe, it is recommended to use the Apogee Instruments SM-400 two-band radiometer mounting bracket.



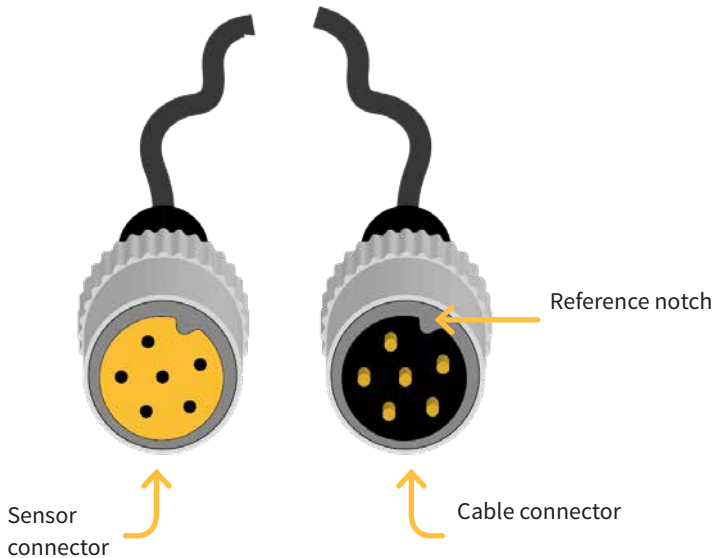
Connections

Reflectance sensors offer cable connectors to simplify wiring. The robust M8 connectors are IP68 rated, made of corrosion-resistant marine-grade stainless steel and designed for long-term use in harsh environmental conditions.

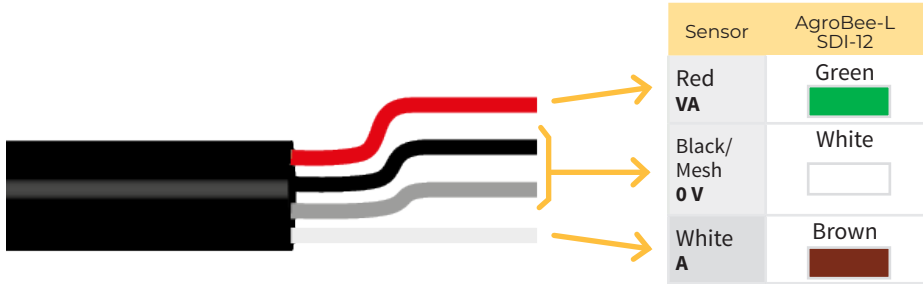


The cable connectors are attached directly to the sensor body.

All connectors have six pins, but not all pins are used and not all wires within the cable. Inside the connectors, there is a reference notch to ensure correct alignment before screwing in the connector.



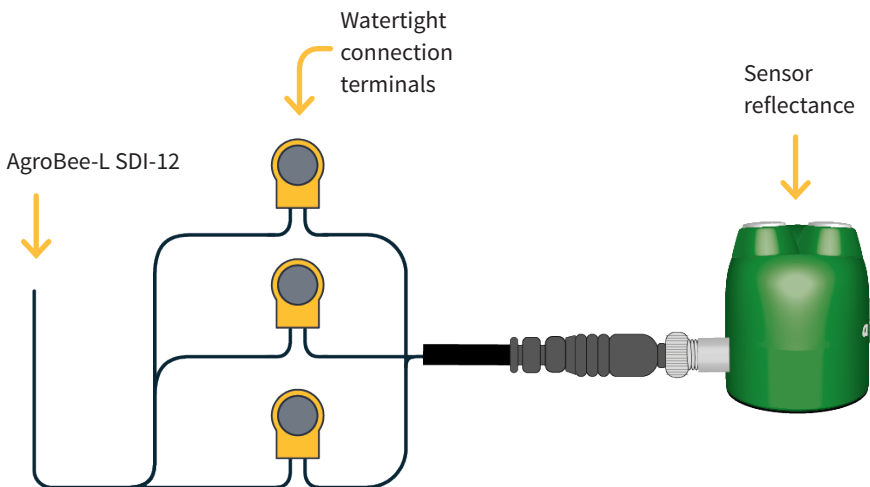
The NDVI/PRI sensor can only be connected to the AgroBee-L SDI-12 module. A cable hose is provided for each unit that enables the different connections to be made easily with no need to access the inside of the module. Each sensor must have a certain SDI-12 address (refer to the AgroBee-L SDI-12 manual for further information). All modules allow up to two pairs of sensors to be connected that use the following colour legend for the connection:




NOTE It is recommended that the cables that remain loose are also connected with a spare 3M connector to avoid possible short circuits or getting wet. These connectors are supplied together with the sensor.

To ensure the water tightness of the module's hose wire connections, it is recommended to use waterproof terminals. The connection through these terminals must be made without stripping the cable wires.

As connection elements, those of the 3M Scotchlok series (www.3m.com) can be used; ES Caps from TYCO Electronics (www.tycoelectronics.com); or the Cellpack splicing and resin diversion kits (www.cellpackiberica.com).



Compatibility table

AGRÓNIC 2500	AGRÓNIC 4000	AGRÓNIC 5500	AGRÓNIC 7000	AGRÓNIC BIT
AGROBEE-L	AGROBEE	A. MONOCABLE	AGRÓNIC RADIO	
+ AgroBee-L SDI-12				
				

Sensor configuration

The sensor acts by delivering a current or a voltage proportional to what it measures. The format indicates the sensor units and the relationship between the voltage read by the input and the sensor reading values.

A format with at least two calibration points needs to be configured for the sensor calculation and is configured from the programmer menu as follows.

Go to: **Function | Settings | Analogue Sensors | Formats** (Always validate with the Enter key)

Once in "**Formats**," check that the format 22 settings are the same as shown in the table.

- When the A-2500 and A-5500 controllers detect the AgroBee-L SDI-12 with this sensor, the formats are auto-assigned.
- By default, the programmer is configured for PRI sensors. For NDVI sensors, modify the format manually according to the table.

Apogee sensor format			
Setting	Default value in format 22		
	Value 1		Value 2
	PRI	NDVI	Raw
No. of integers	1	1	1
No. of decimals	3	3	3
Sign	Yes	Yes	Yes
Units	-	-	-
Calibration Point 1			
Real value	800 mV	800 mV	800 mV
Logical value	-1,000	+1,000	-2,000
Calibration Point 2			
Real value	4000 mV	4000 mV	4000 mV
Logical value	+1,000	-1,000	+2,000

Measurement verification

Details to take into account:

- If any of the sensors that are part of the assembly are covered, the NDVI/PRI index should be 0 or close to it.
- NDVI readings: The given range is between +1 and -1.
 - Negative values close to -1 correspond to water.
 - Values close to 0 indicate arid areas (or that the sensor is covered).
 - Positive but low values (<0.4) represent bushes or grass.
 - Values close to 1 are indicative of tropical and temperate forests.
- PRI readings: The given range is between -1 and +1.
 - Values between -0.2 and +0.2 indicate an optimal state of the plant.