

## NDVI SENSORS

S2-111-SS & S2-112-SS Analog  
S2-411-SS & S2-412-SS SDI-12

### Overview

Apogee's NDVI sensors are designed to measure reflectance in red and near infrared wavebands to calculate the normalized difference vegetation index (NDVI). NDVI is a measurement of plant greenness correlated with canopy chlorophyll content and leaf area that is used to monitor green-up in the spring and senescence in the fall.

NDVI sensors are used to ground truth NDVI measurements taken from satellite imagery and continuously monitor plant health in the field and in controlled environments.

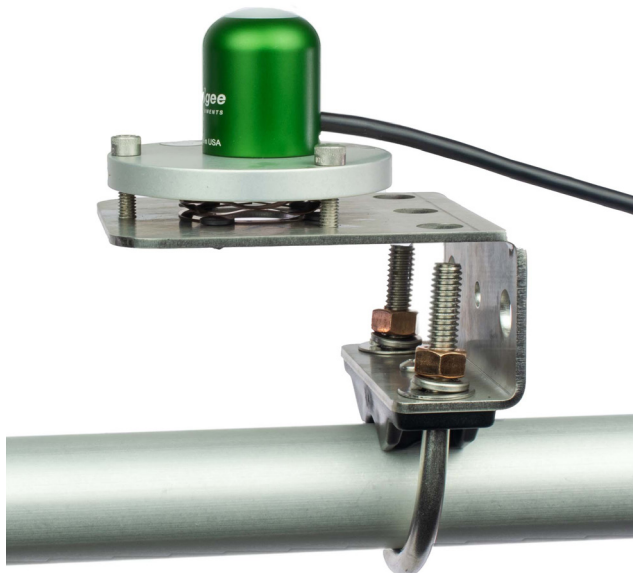
### Wavelength Ranges

#### NDVI

- Red detector = 650 nm ± 5 nm with 65 nm full-width half-maximum
- NIR detector = 810 nm ± 5 nm with 65 nm full-width half-maximum

$$NDVI = \frac{\rho_{NIR} - \rho_{Red}}{\rho_{NIR} + \rho_{Red}}$$

Where  $\rho$  = reflectance (%)



### Upward-Looking NDVI Sensor



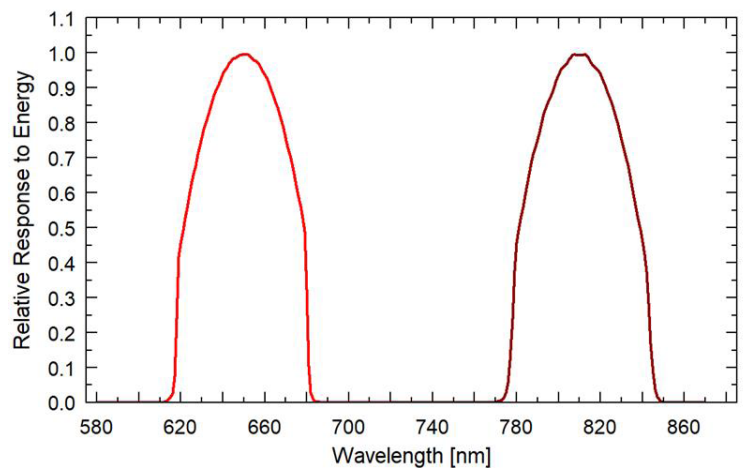
S2-111-SS &  
S2-411-SS

### Downward-Looking NDVI Sensor



S2-112-SS &  
S2-412-SS

### Spectral Response



— NDVI sensor: Red response — NDVI sensor: NIR response

NDVI sensors have peak sensitivity at 650 nm (Red) and 810 nm (NIR) ± 5 nm with 65 nm full-width half-maximum. The spectral responses can be seen in the graph above.

# Product Specifications

	Analog Output		Digital Output	
	S2-111-SS (Upward-Looking)	S2-112-SS (Downward-Looking)	S2-411-SS (Upward-Looking)	S2-412-SS (Downward-Looking)
Power Supply	Self-powered		5.5 to 24 V DC	
Output (sensitivity)	14 mV per $W\ m^{-2}\ nm^{-1}$ (Red) 20 mV per $W\ m^{-2}\ nm^{-1}$ (NIR)	12.5 mV per $W\ m^{-2}\ nm^{-1}\ sr^{-1}$ (Red) 20 mV per $W\ m^{-2}\ nm^{-1}\ sr^{-1}$ (NIR)	—	
Calibration Factor (recipricol of sensitivity)	0.07 $W\ m^{-2}\ nm^{-1}$ per mV (Red) 0.05 $W\ m^{-2}\ nm^{-1}$ per mV (NIR)	0.08 $W\ m^{-2}\ nm^{-1}\ sr^{-1}$ per mV (Red) 0.04 $W\ m^{-2}\ nm^{-1}\ sr^{-1}$ per mV (NIR)	Custom for each sensor and stored in firmware	
Calibration Uncertainty	± 5 %			
Output Range	40 mV (Red) 40 mV (NIR)	15 mV (Red) 15 mV (NIR)	SDI-12	
Wavelength Ranges	Red detector = 650 nm ± 5 nm with 65 FWHM* NIR detector = 810 nm ± 5 nm with 65 nm FWHM*			
Measurement Range	2x full sunlight			
Measurement Repeatability	Less than 1 %			
Long-term Drift	Less than 2 % per year			
Response Time	Less than 1 ms		Less than 0.6 s	
Field of View	180°	30°	180°	30°
Directional (Cosine) Response	± 2 % at 45°; ± 5 % at 75° zenith angle			
Temperature Response	Less than 0.1 % per C			
Housing	Anodized aluminum body with acrylic diffuser			
IP Rating	IP68			
Operating Environment	-40 to 70 C; 0 to 100 % relative humidity			
Dimensions	30.5 mm diameter, 37 mm height	30.5 mm diameter, 34.5 mm height	30.5 mm diameter, 37 mm height	30.5 mm diameter, 34.5 mm height
Mass (with 5 m of cable)	140 g			
Warranty	4 years against defects in materials and workmanship			

\*FWHM = full-width half-maximum

## Features

### KEY FEATURES

Digital SDI-12 output is standard with analog options available by request. Domed diffuser promotes self-cleaning to minimize errors from dust and debris.

### HIGH QUALITY CABLE

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

### FOR BEST MEASUREMENTS

For best results, we recommend pairing upward-looking sensor(s) with downward-looking sensor(s).

