# Red - Far-red Sensors

## Two-channel sensor for measuring the Red / Far-red ratio (RFR)


| | S2-131-SS | S2-431-SS | S2-432-SS |
|---|---|---|---|
| Power Supply | Self-powered | 5.5 to 24 V DC | |
| Current Draw | – | 1.4 mA (quiescent), 1.8 mA (active) | RS-232 37 mA; RS-485 quiescent 37 mA, active 42 mA |
| Output (sensitivity) | 0.08 mV per µmol $m^{-2}$ $s^{-1}$ | – | |
| Calibration Factor (recipricol of sensitivity) | 12 µmol $m^{-2}$ $s^{-1}$ per mV | Custom for each sensor and stored in firmware | |
| Calibration Uncertainty | ± 5 % | | |
| Output Range | 0 to 33 mV | SDI-12 | Modbus |
| Wavelength Ranges | 645 to 665 nm ± 5 nm (Red)<br>720 to 740 nm ± 5 nm (Far-red) | | |
| Measurement Range | 0 to 400 µmol $m^{-2}$ $s^{-1}$ | | |
| Measurement Repeatability | Less than 1 % | | |
| Long-term Drift | Less than 2 % per year | | |
| Response Time | Less than 1 ms | Less than 0.6 s | – |
| Non-linearity | Less than 1 % (up to 400 µmol $m^{-2}$ $s^{-1}$) | | |
| Field of View | 180° | | |
| Directional (cosine) Response | ± 2 % at 45°; ± 5 % at 75° zenith angle | | |
| Temperature Response | Less than 0.1 % per C | | |
| Operating Environment | -40 to 70 C; 0 to 100 % relative humidity | | |
| Dimensions | 30.5 mm diameter, 37 mm height | | |
| Mass (with 5 m of cable) | 140 g | | |
| Warranty | 4 years against defects in materials and workmanship | | |

## Overview

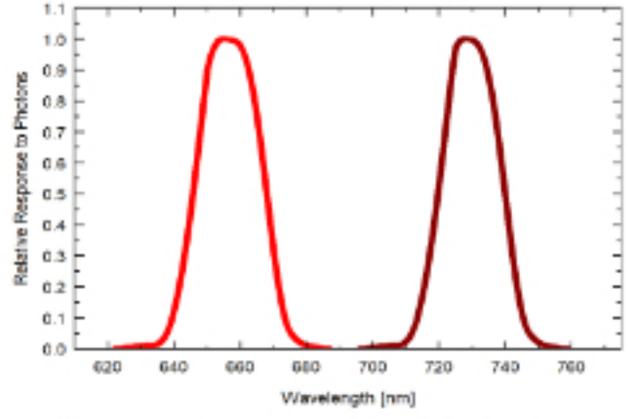
This sensor is a research-grade, cost-effective, two-channel sensor for monitoring plant light environments. It can calculate the red to far-red ratio (red photon flux density / far-red photon flux density) and far-red fraction (far-red photon flux density / sum of red and far-red photon flux densities). The FR ratio influences plant height, leaf expansion rates, and other photobiology and plant morphogenic responses.

## Typical Applications

- Investigating the effect of spectral quality on phytochrome
- Monitoring plant light environments
- Analyzing plant morphogenic activity
- Studying photobiology
- Researching ecology

## Key Features

Available in digital SDI-12 output, digital Modbus, or with an analog output. A domed diffuser promotes self-cleaning to minimize errors from dust and debris.




Spectral response of Red detector (red) and Far-red detector (maroon).

## Case Study

Apogee **Red - Far-red sensors** and **AL-120 leveling plates** are used at the **Toolik Field Station** in **Alaska.**