

SR30

ISO Spectrally Flat Class A (Secondary Standard) Pyranometer




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1. SR30 introduction

The SR30, manufactured by Hukseflux Thermal Sensors, is an ISO 9060 digital spectrally flat Class A (secondary standard) pyranometer that measures solar short-wave radiation in a full hemisphere of the sky. It has a built-in case-temperature sensor and embedded heater for removing dew and light rain. It connects directly to Campbell Scientific data loggers and is designed for applications that require high measurement accuracy in demanding applications such as scientific meteorological observation networks and utility scale solar-energy-power production sites.

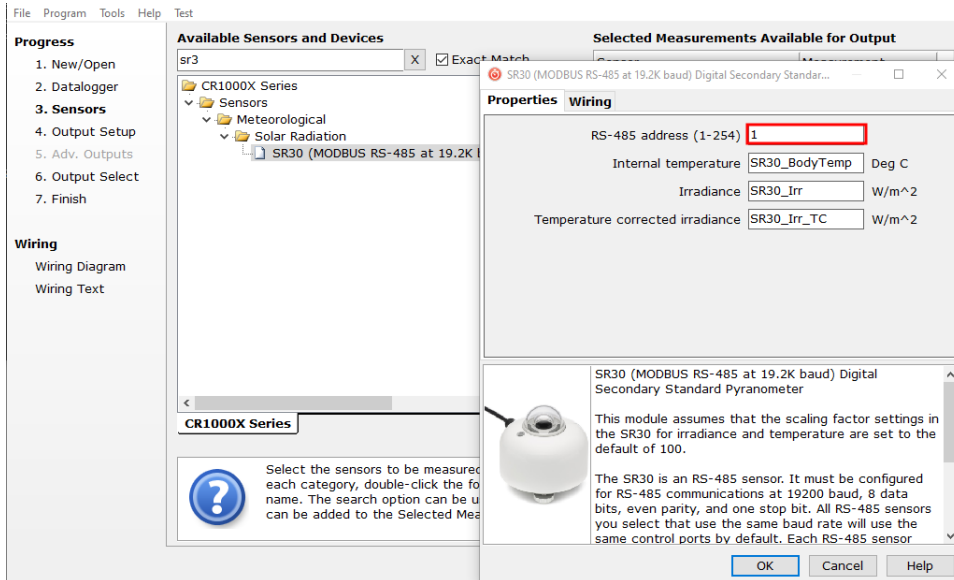
2. QuickStart

A video that describes data logger programming using *Short Cut* is available at: www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3 . *Short Cut* is an easy way to program your data logger to measure the sensor and assign data logger wiring terminals. *Short Cut* is available as a download on www.campbellsci.com. It is included in installations of *LoggerNet*, *RTDAQ*, *PC400*, or *PC200W*.

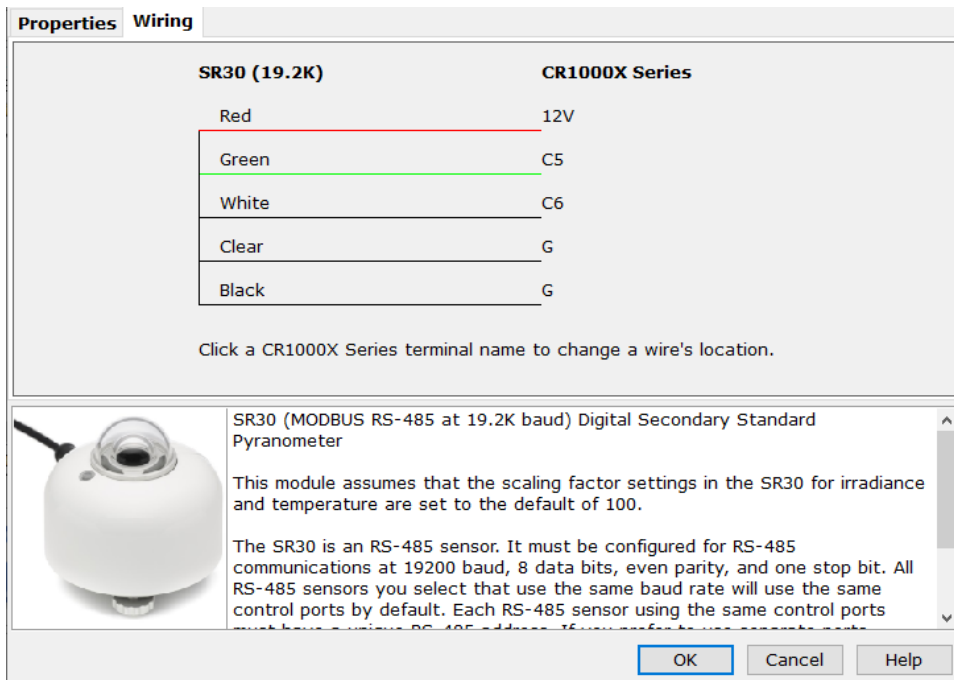
The following procedure also shows using *Short Cut* to program the SR30.

1. Open *Short Cut* and click **Create New Program**.
2. Double-click the data logger model.

- In the **Available Sensors and Devices** box, type SR30. You can also locate the sensor in the **Sensors > Meteorological > Solar Radiation** folder. Double click the sensor model. Type the **RS-485 address**; default address is 1. The address must be unique and may need to be changed if another sensor on the terminal has the same address. Change the address using Modbus commands. For more information, refer to [Modbus map](#) (p. 7).

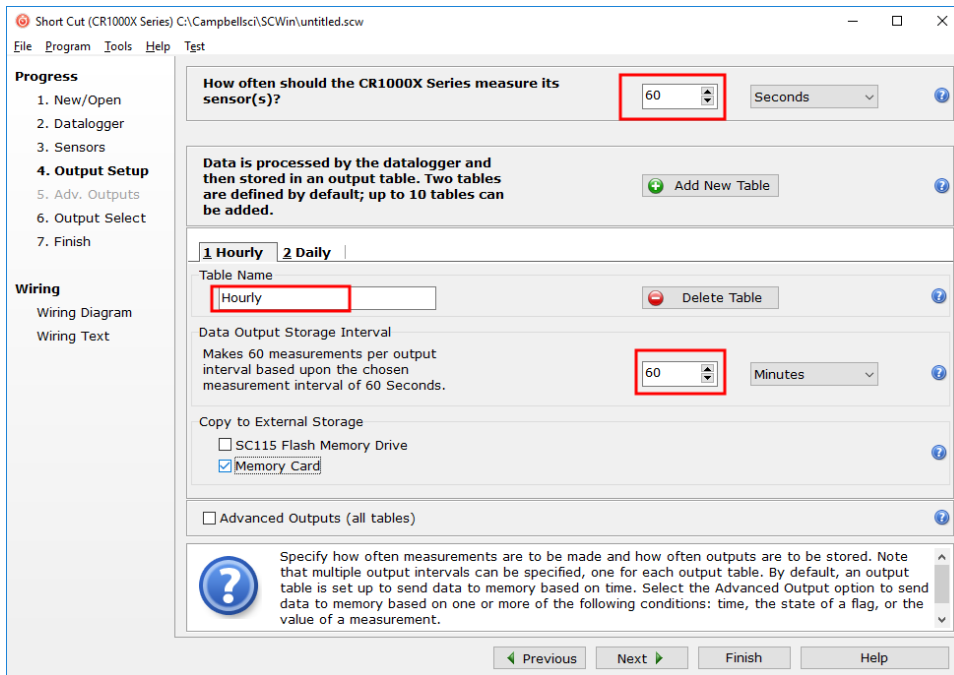


- Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

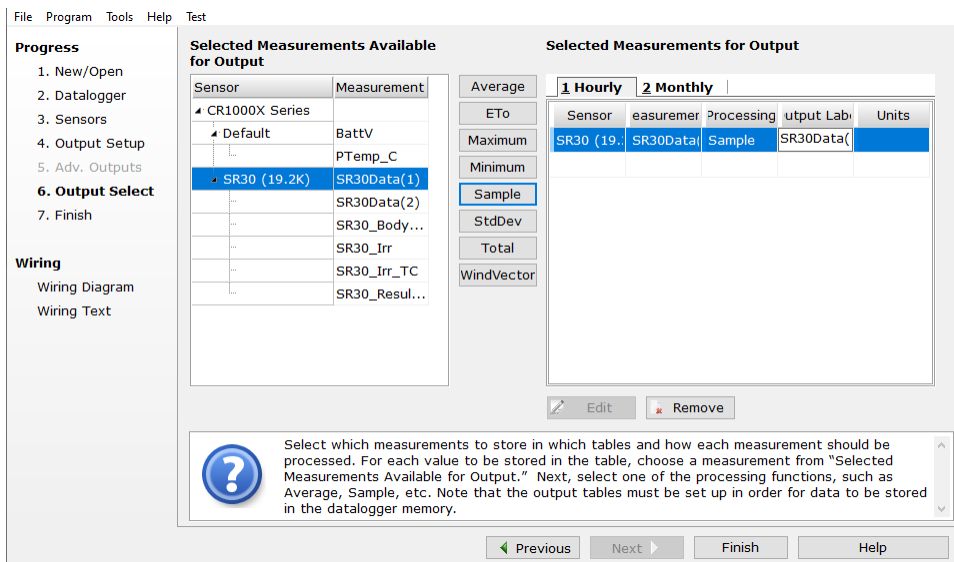


- Repeat steps three and four for other sensors you want to measure. Click **Next**.

- In **Output Setup**, type the scan rate, a meaningful table name, and the **Data Output Storage Interval**.



- Select the measurement and its associated output option.



- Click **Finish** and save the program. Send the program just created to the data logger if the data logger is connected to the computer.
- If the sensor is connected to the data logger, check the output of the sensor in the data logger support software data display in *LoggerNet*, *PC400*, *RTDAQ*, or *PC200W* to make sure it is making reasonable measurements.

3. Specifications

Sensor:	High-quality blackened thermopile protected by two glass domes with integrated heater and ventilation
Measurement description:	Monitors solar radiation for the full solar spectrum range
ISO classification:	Spectrally flat class A (secondary standard) ISO 9060:2018
IEC 61724-1:2017 compliance:	Class A
Calibration uncertainty:	< 1.2 % (k = 2)
Heating:	Included
Ventilation:	Included
Technology employed:	Recirculating ventilation and heating (RVH™)
Operating condition	
Standard mode:	Heated and ventilated
Low-power mode:	Heater and ventilator [OFF]
Power consumption @ 12 VDC	
Standard mode:	< 2.3 W
Low power mode:	< 0.1 W
Zero offset A:	< 5 W/m ² (unventilated, low-power mode), 2 W/m ² (ventilated)
Calibration:	Traceable to WRR; calibration registers accessible to users
Spectral range:	285 to 3000 nm
Operating temperature range:	-40 to 80 °C
Temperature response:	< ±0.4 % (-30 to 50 °C)
Operating voltage range:	5 to 30 VDC
Tilt measurement uncertainty:	±1° (0 to 90 °)

Output:	Modbus RS-485 Irradiance in W/m ² Instrument body temperature in °C Tilt angle in ° Internal humidity in % Ventilator speed in RPM
Communications protocol:	Modbus over 2-wire RS-485
Compliance:	View compliance documents at: www.campbellsci.com/sr30-l

4. Siting

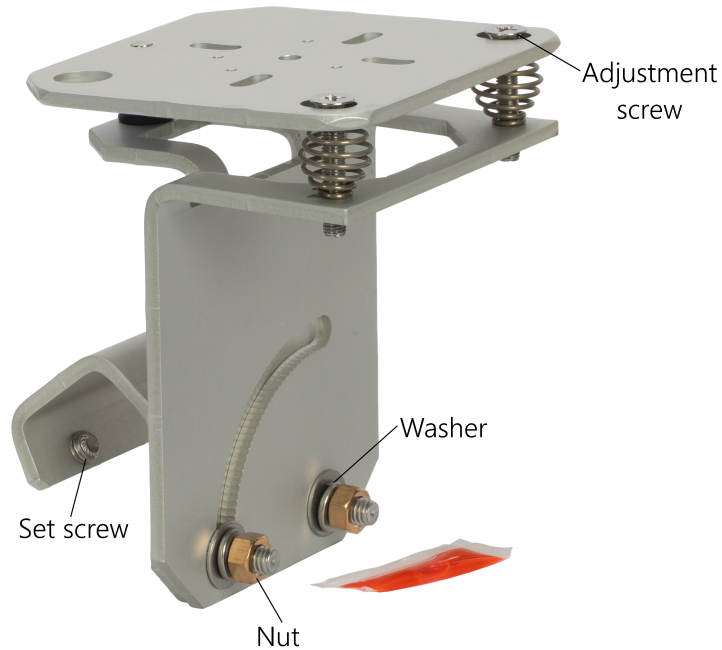
The solar radiation sensor is usually installed horizontally, but can also be installed at any angle including an inverted position. Site the sensor to allow easy access for maintenance while ideally avoiding any obstructions or reflections above the plane of the sensing element. It is important to mount the sensor such that a shadow or a reflection will not be cast on it at any time. If this is not possible, try to choose a site where any obstruction over the azimuth range between earliest sunrise and latest sunset has an elevation not exceeding 5°. Diffuse solar radiation is less influenced by obstructions near the horizon. The sensor should be mounted with the cable pointing towards the nearest magnetic pole. For example, in the northern hemisphere, point the cable toward the North Pole.

5. Mounting procedure

Required tools:

- Diopter
 - Solar compass
 - 8 mm (5/16-inch) open-end wrench for U-bolt nuts
 - CM256 mounting bracket
1. On a level surface, level the solar radiation sensor using the leveling feet on the sensor. Alternatively, remove the sensor leveling feet to allow it to be mounted directly to the mounting bracket.
 2. Secure the solar radiation sensor to the mounting bracket.

- Using a diopter in combination with a solar compass, install and orient the crossarm on the tripod or the mast. If installing the mounting bracket on a vertical pole, ensure the pole is truly vertical.
- Use the two set screws to secure the bracket to the crossarm or pole as shown in the following figure. For pyranometers mounted horizontally, ensure the mounting bracket is horizontal in two dimensions. For pyranometers mounted at an angle, set the mounting bracket angle to the desired angle prior to tightening the mounting hardware.



- Verify mounting hardware is firmly tightened, and that the mounting bracket is at the desired angle.

6. Wiring

Table 6-1: Pin-out, wire color, function, and data logger connection

Wire color		Pin out		Function	Data logger connection ¹
Campbell Scientific	Hukseflux	-PT	-PW		
Green	Gray	5	2	RS-485 (A-)	A-, C (odd)
White	White	7	4	RS-485 (B+)	B+, C (even)
Red	Brown	2	1	Power in (8 to 30 VDC)	12V
Black	Black	6	3	Power ground	G
Clear	Yellow	9	5	Shield	⊥ (analog ground)
--	Blue	no function			

¹ Assumes the sensor directly connects to the data logger.

7. RS-485 default configuration

The default RS-485 settings are: 19200 baud rate, 8 data bits, even parity, one stop bit. This configuration is used for most Modbus networks.

8. Modbus map

Table 8-1 (p. 8) provides the Modbus register map for the most commonly used values. A comprehensive register map is available in the Hukseflux manual.

Table 8-1: Modbus register map

Starting register number	Register count	Data format	Units	Description
1	1	Signed 16 bit integer		Modbus address
3	2	Signed 32 bit integer	mW/m ²	Irradiance (temperature compensated signal)
5	2	Signed 32 bit integer	mW/m ²	Irradiance (temperature uncompensated signal)
7	1	Signed 16 bit integer	0.01 °C	Sensor body temperature
8	1	Signed 16 bit integer	x 0.1 Ω	Sensor electrical resistance
9	1	Signed 16 bit integer		Scaling factor irradiance
10	1	Signed 16 bit integer		Scaling factor temperature
11	2	Signed 32 bit integer	nV	Sensor voltage output
41	1	Signed 16 bit integer		Serial number
42	2	Float	μV/W/m ²	Sensor sensitivity
47	2	Signed 32 bit integer		Calibration date
99	1	Signed 16 bit integer	x 0.01 %	Humidity

9. RS-485 programming

The RS-485 output can be directly read by a MeteoPV, CR6-series, CR1000X, or Modbus RTU RS-485 network. Other Campbell Scientific data loggers can use an MD485 multidrop interface to read the RS-485 output (refer to the MD485 manual).

A CR6 or CR1000X data logger programmed as a Modbus Master can retrieve the values stored in the Input Registers. To do this, the CRBasic program requires a `SerialOpen()` instruction followed by the `ModbusMaster()` instruction.

The `SerialOpen` instruction has the following syntax:

```
SerialOpen (ComPort, Baud, Format, TXDelay, BufferSize, Mode)
```

The **Format** is typically set to logic 1 low; even parity, one stop bit, 8 data bits. The **Mode** parameter should configure the ComPort as RS-485 half-duplex, transparent. The **ModbusMaster()** instruction has the following syntax:

```
ModbusMaster (Result, ComPort, Baud, Addr, Function, Variable, Start, Length, Tries, Timeout, [ModbusOption])
```

The **Addr** parameter must match the sensor Modbus address. To collect all of the values, the **Start** parameter needs to be 1 and the **Length** parameter needs to correspond with the register count (see [Modbus map](#) (p. 7)). **ModbusOption** is an optional parameter described in the *CRBasic Editor* Help. A downloadable example program is available at www.campbellsci.com/downloads/sr30-example-program.

10. Maintenance and troubleshooting

The SR30 has no service items requiring scheduled replacement. There is no accessible desiccant cartridge to maintain. Use pure alcohol or distilled water and a lint-free cloth to clean the dome, removing smears and deposits. Local conditions and application dictate cleaning interval. Sophisticated research applications require daily cleaning. For typical PV applications, clean once per week, bi-monthly, or monthly. The SR30 should be recalibrated following industry standard best practices such as ASTM G167, ISO 9846, ASTM E824 or ASTM G207 by an accredited lab. The recommended recalibration interval is two years. Contact Campbell Scientific for more information.

Unexpected results typically occur because of improper wiring or programming, electromagnetic radiation, or damaged cables. Ensure that the data logger program includes the correct parameters for the measurement instructions. Check for the presence of strong sources of electromagnetic radiation. Check the cable for damage and ensure that it is properly connected to the data logger.

Appendix A. Importing *Short Cut* code into *CRBasic Editor*


Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into the *CRBasic Editor*. By default, these files reside in the C:\campbellsci\SCWin folder.

Import *Short Cut* program file and wiring information into *CRBasic Editor*:

1. Create the *Short Cut* program. After saving the *Short Cut* program, click the **Advanced** tab then the **CRBasic Editor** button. A program file with a generic name will open in CRBasic. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

NOTE:

Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the program it created.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder, and copy the wiring information, which is at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information into it.
4. In the CRBasic program, highlight the wiring information, right-click, and select **Comment Block**. This adds an apostrophe (') to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The **Comment Block** feature is demonstrated at about 5:10 in the [CRBasic | Features](#) video .

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DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.** FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com. You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 6 meters (20 feet), or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.
- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

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