PRODUCT MANUAL

Sensor

SR30

ISO Spectrally Flat Class A (Secondary Standard) Pyranometer

RELIABLE MONITORING SINCE 1974

Campbell SCIENTIFIC®

Please read first

About this manual

Please note that this manual was produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this. In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users. Differences include the U.S. standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. Please note, however, *that when a power supply adapter is ordered from Campbell Scientific it will be suitable for use in your country*.

Reference to some radio transmitters, digital cell phones and aerials (antennas) may also not be applicable according to your locality. Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered.

Recycling information for countries subject to WEEE regulations 2012/19/EU

At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility, per The Waste Electrical and Electronic Equipment (WEEE) Regulations 2012/19/EU. Campbell Scientific can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories. For further support, please contact Campbell Scientific, or your local agent.

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1. Introduction

The SR30, an ISO 9060:2018 spectrally flat Class A (secondary standard) pyranometer manufactured by Hukseflux, features recirculating ventilation and heating (RVH™) technology. As a standalone unit, the SR30 is fully compliant with IEC 61724-1 standards, whereas other pyranometers require external ventilation/heating units to be compliant. The SR30 is an ideal instrument for solar resource and photovoltaic (PV) performance monitoring.

2. Precautions

- READ AND UNDERSTAND the Safety section at the back of this manual.

- Although the SR30 is rugged, it should be handled as a precision scientific instrument.

3. Initial inspection

- Upon receipt of the SR30, inspect the packaging and contents for damage. File damage claims with the shipping company.

- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the correct product and cable length are received.

4. 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**, or **PC400**.

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

1. Open **Short Cut** and click **Create New Program**.

2. Double-click the data logger model.

3. In the **Available Sensors and Devices** box, type SR30. You can also locate the sensor in the **Sensors** > **Meterological** > **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 the Modbus map (p. 10).
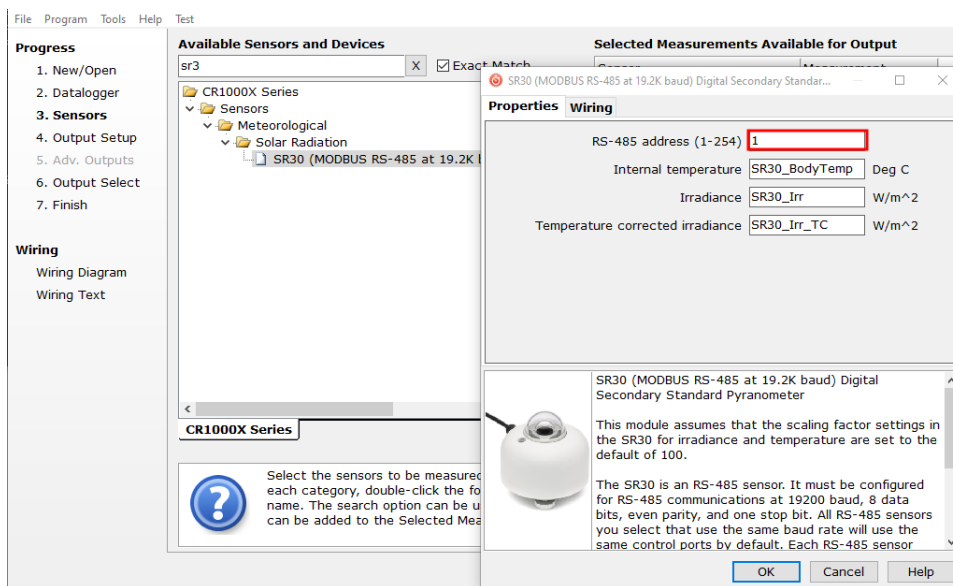
4. Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.
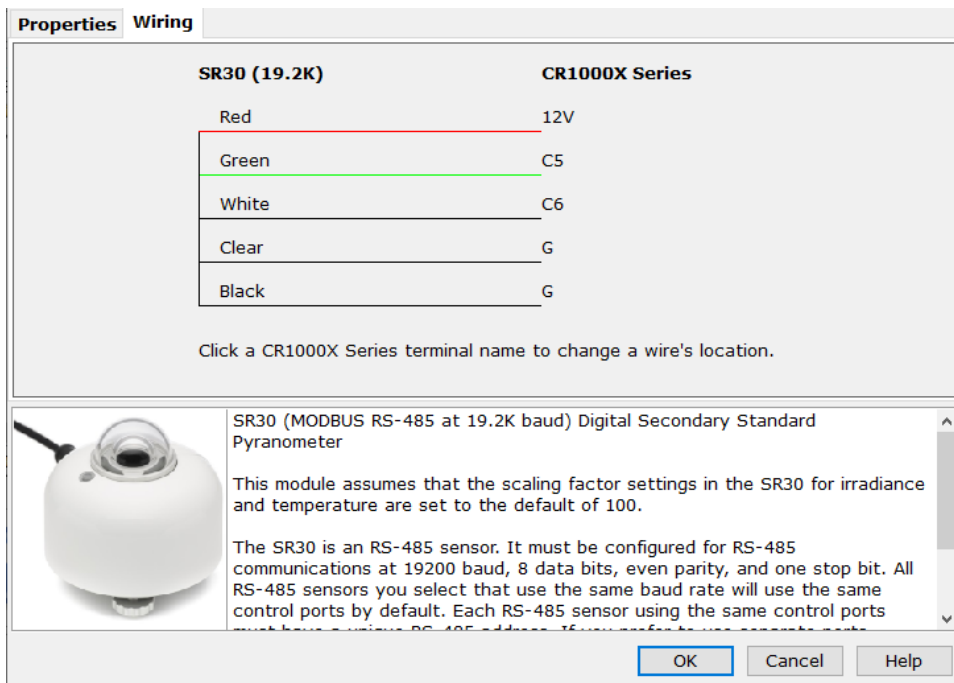
5. Repeat steps three and four for other sensors you want to measure. Click **Next**.

6. In **Output Setup**, type the scan rate, a meaningful table name, and the **Data Output Storage Interval**.
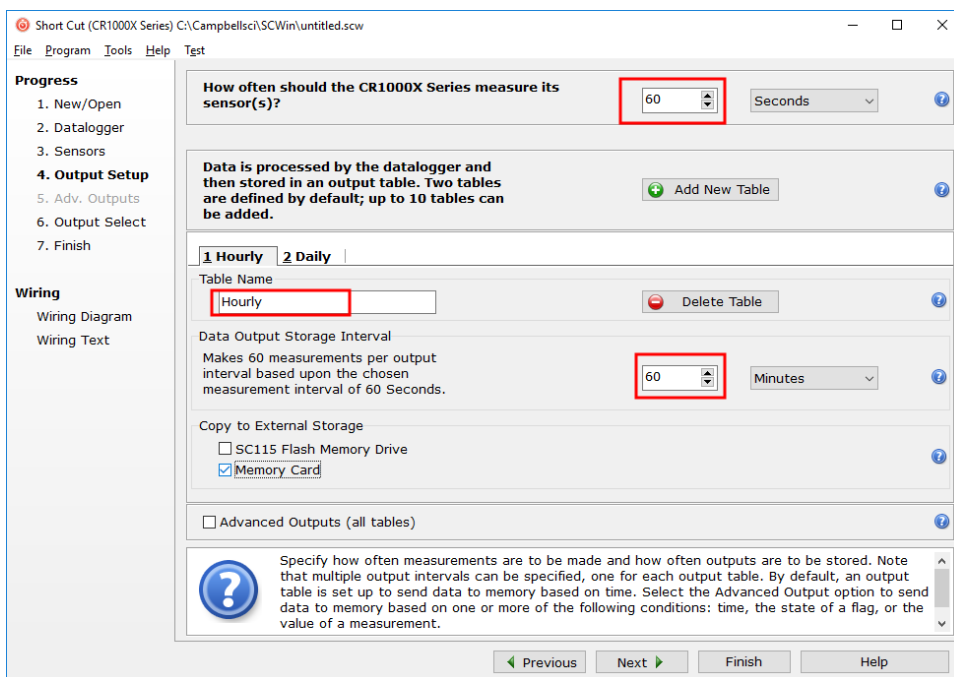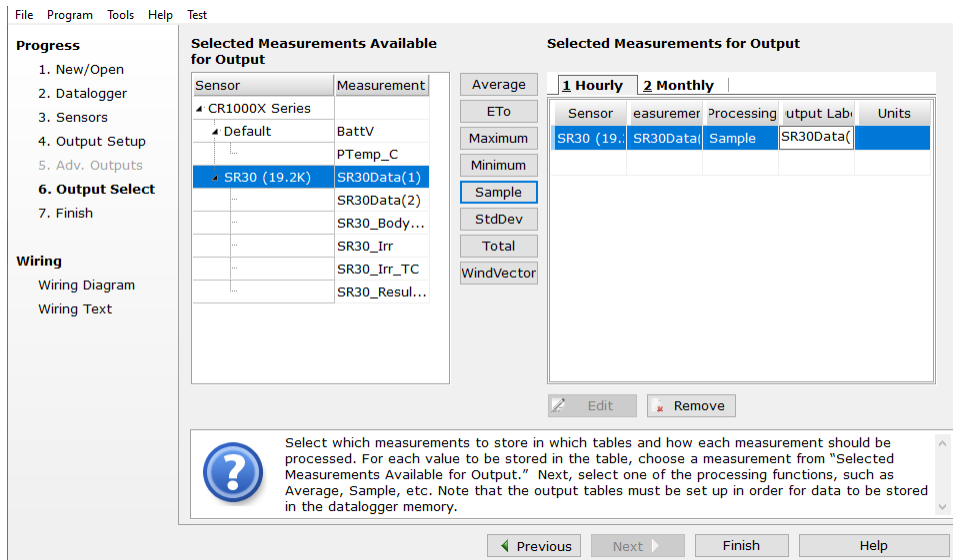
7. Select the measurement and its associated output option.

8. Click **Finish** and save the program. Send the program just created to the data logger if the data logger is connected to the computer.

9. 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*, *RTDAQ*, or *PC400* to make sure it is making reasonable measurements.

4. Overview

The SR30 measures solar radiation with a high-quality blackened thermopile protected by two glass domes. It has an anodized aluminum body and a white sun shield that reduces the sensor temperature. The glass domes are heated by ventilating the area between the inner and outer dome using recirculating ventilation and heating (RVH™) technology. A bubble level and adjustable leveling screws enable leveling the sensor without using a leveling base.

Communications to on-site RTUs, SCADA systems, or other data acquisition systems are simplified with the industry-standard Modbus RTU communications protocol.

Features

- Heated for high data availability, featuring RVH™ technology
- Compliant with IEC 61724-1:2017 Class A
- Remote sensor diagnostics

5. 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/m² (unventilated, low-power mode), 2 W/m² (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:	8 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-I ↗

6. Installation

When programming with *Short Cut*, skip Wiring (p. 6) and CRBasic programming (p. 7). *Short Cut* does this work for you. See QuickStart (p. 2) for a *Short Cut* tutorial.

6.1 Wiring

Table 6-1: Pin-out, wire color, function, and data logger connection					
Wire color		Pin out		Function	Data logger connection[1]
Campbell Scientific	Huskeflux	-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	G

Table 6-1: Pin-out, wire color, function, and data logger connection					
Wire color		Pin out			
Campbell Scientific	Huskeflux	-PT	-PW	Function	Data logger connection[1]
Blue	--	--	--	RS-485 signal ground	G[2]
--	Blue	no function			
[1] Assumes the sensor directly connects to the data logger.					
[2] If the connection is RS-485 communications only, no power, then use the RG terminal; contact Campbell Scientific for more information.					

6.2 Programming

Short Cut is the best source for up-to-date programming code for Campbell Scientific data loggers. If your data acquisition requirements are simple, you can probably create and maintain a data logger program exclusively with **Short Cut**. If your data acquisition needs are more complex, the files that **Short Cut** creates are a great source for programming code to start a new program or add to an existing custom program.

> NOTE:
> **Short Cut** cannot edit programs after they are imported and edited in **CRBasic Editor**.

A **Short Cut** tutorial is available in QuickStart (p. 2). If you wish to import **Short Cut** code into **CRBasic Editor** to create or add to a customized program, follow the procedure in Importing Short Cut code into CRBasic Editor (p. 12). Programming basics for CRBasic data loggers are provided in the following section.

6.2.1 CRBasic 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). Refer to www.campbellsci.com/videos/meteopv ▶ for information about using the MeteoPV.

A CR6 or CR1000X data logger programmed as a Modbus client can retrieve the values stored in the input registers. To do this, the CRBasic program requires a `SerialOpen()` instruction followed by the `ModbusClient()` instruction.

> **NOTE:**
> `ModbusClient()` was formerly `ModbusMaster()`. Campbell Scientific, in conjunction with the Modbus Organization, is now using "client-server" to describe Modbus communications. The Modbus client(s) initiates communications and makes requests of server device(s). Server devices process requests and return an appropriate response (or error message). See https://modbus.org for more information. Existing programs that use the old Modbus terminology will still compile in the data logger.

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. 10]). `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 ↗.

6.3 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, but avoid locations with 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.

6.4 Mounting procedure

Required tools:

- Diopter
- Solar compass
- 8 mm (5/16-inch) open-end wrench or hex key 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.

2. Secure the solar radiation sensor to the mounting bracket.

3. 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.

4. 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.
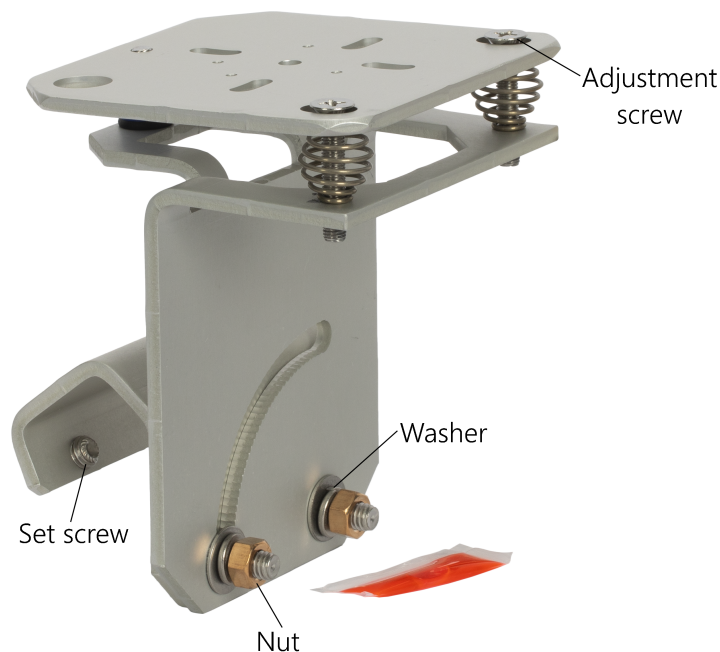
5. Verify mounting hardware is firmly tightened, and that the mounting bracket is at the desired angle.

7. Operation

7.1 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.

7.2 Modbus map

Table 7-1 (p. 10) provides the Modbus register map for the most commonly used values. A comprehensive register map is available in the Hukseflux manual.

Table 7-1: 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/m²	Irradiance (temperature compensated signal)
5	2	Signed 32 bit integer	mW/m²	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/m²	Sensor sensitivity
47	2	Signed 32 bit integer		Calibration date
99	1	Signed 16 bit integer	x 0.01 %	Humidity

8. Maintenance and troubleshooting

The SR30 has no service items that require 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 a 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 *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, then save it. Click the **Advanced** tab then the **CRBasic Editor** button. Your program file will open in CRBasic with a generic name. 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.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder. Copy the wiring information found at the beginning of the .DEF file.

3. Go into the CRBasic program and paste the wiring information at the beginning of the program.

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 ▶.

Limited warranty

Covered equipment is warranted/guaranteed against defects in materials and workmanship under normal use and service for the period listed on your sales invoice or the product order information web page. The covered period begins on the date of shipment unless otherwise specified. For a repair to be covered under warranty, the following criteria must be met:

1. There must be a defect in materials or workmanship that affects form, fit, or function of the device.

2. The defect cannot be the result of misuse.

3. The defect must have occurred within a specified period of time; and

4. The determination must be made by a qualified technician at a Campbell Scientific Service Center/ repair facility.

The following is not covered:

1. Equipment which has been modified or altered in any way without the written permission of Campbell Scientific.

2. Batteries; and

3. Any equipment which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact ⬈ to determine which Campbell Scientific office serves your country. For directions on how to return equipment, see Assistance.

Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

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Campbell Scientific will, as a default, return warranted equipment by surface carrier prepaid. However, the method of return shipment is at Campbell Scientific's sole discretion. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This warranty and the Company's obligation thereunder is in lieu of all other

warranties, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

In the event of any conflict or inconsistency between the provisions of this Warranty and the provisions of Campbell Scientific's Terms, the provisions of Campbell Scientific's Terms shall prevail. Furthermore, Campbell Scientific's Terms are hereby incorporated by reference into this Warranty. To view Terms and conditions that apply to Campbell Scientific, Logan, UT, USA, see Terms and Conditions ⬀. To view terms and conditions that apply to Campbell Scientific offices outside of the United States, contact the regional office that serves your country.

Assistance

Products may not be returned without prior authorization. Please inform us before returning equipment and obtain a **return material authorization (RMA) number** whether the repair is under warranty/guarantee or not. See Limited warranty for information on covered equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact ↗ to determine which Campbell Scientific office serves your country.

When returning equipment, a RMA number must be clearly marked on the outside of the package. Please state the faults as clearly as possible. Quotations for repairs can be given on request.

It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment. In support of this policy, when equipment is returned to Campbell Scientific, Logan, UT, USA, it is mandatory that a "Declaration of Hazardous Material and Decontamination" form be received before the return can be processed. If the form is not received within 5 working days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. For details on decontamination standards specific to your country, please reach out to your regional Campbell Scientific office.

> **NOTE:**
> All goods that cross trade boundaries may be subject to some form of fee (customs clearance, duties or import tax). Also, some regional offices require a purchase order upfront if a product is out of the warranty period. Please contact your regional Campbell Scientific office for details.

Safety

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, such as those of the FAA in the USA.
- 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.

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.

Use and disposal of batteries
- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

Avoiding unnecessary exposure to radio transmitter radiation
- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

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.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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