Operations and Maintenance Manual

System

SunSentry

Solar Operational Meteorological Monitoring Station

02/2025

RELIABLE MONITORING SINCE 1974

Campbell SCIENTIFIC®

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1. Introduction

This document describes the operations and maintenance (O&M) requirements and procedures for the SunSentry Operational Monitoring station. This document does not cover the initial unboxing and installation procedures and steps for the SunSentry. For detailed installation information please refer to the SunSentry Installation Guide.

This manual will provide information on each component of the SunSentry Station from enclosures to sensors. It will also discuss and explain scheduled and unscheduled maintenance procedures. Additional information on the SunSentry can be found at www.campbellsci.com/sunsentry.

2. What is the SunSentry?

The SunSentry Operational Monitoring station is a purpose built, wholly inclusive station for use in operational solar monitoring requirements in compliance with IEC 61724-1:2017 & 2021. The SunSentry offers flexible measurement options yet reduces complexity by using a unique station interface that simplifies configuration, installation, and operations. Designed to be the core of every operational solar monitoring requirement set forth by IEC 61724-1, the SunSentry can be configured to meet either Class A or Class B requirements.

The SunSentry user interface (UI) introduces users to a simplistic flexibility that is unique to Campbell Scientific. Providing a user experience that allows easy setup of the station as well as long term ease of use throughout the life of solar project.

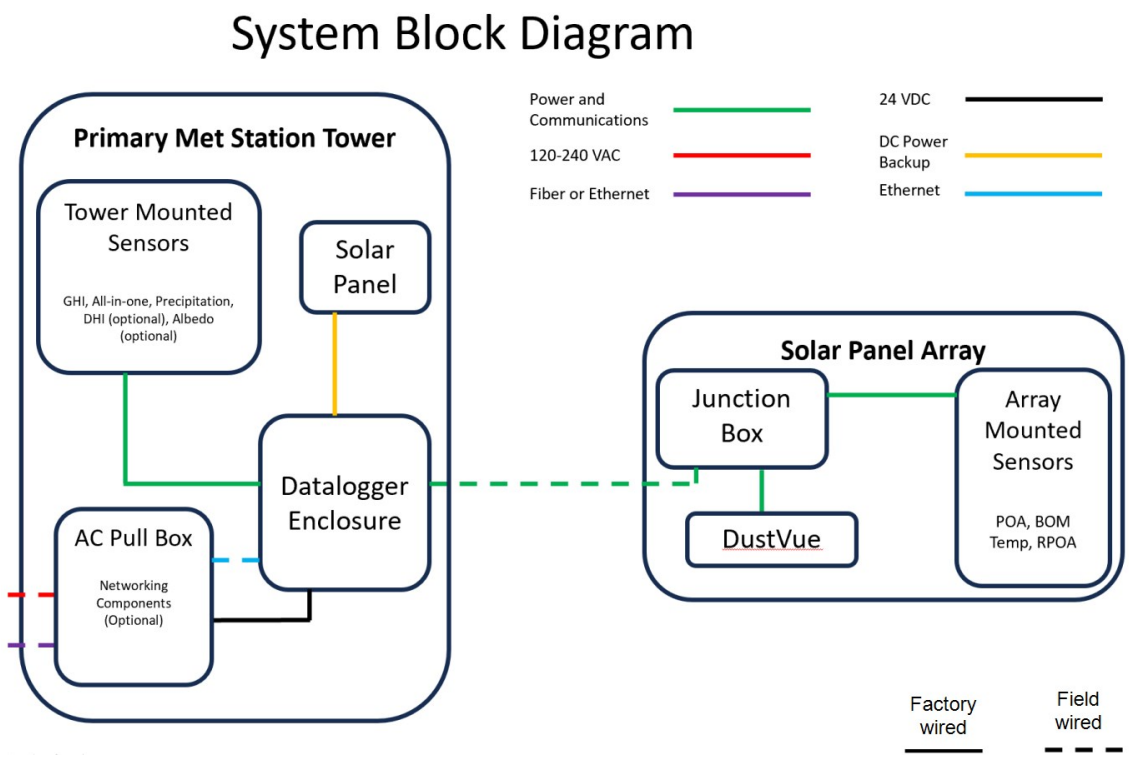


Figure 2-1. Diagram of major station components

2.1 Main Met enclosure

The SunSentry Main Met enclosure includes the CR1000Xe as its core data logger. This station component also includes sensor connections, power connections, and optional battery backup (UPS option) all within a single environmental enclosure.

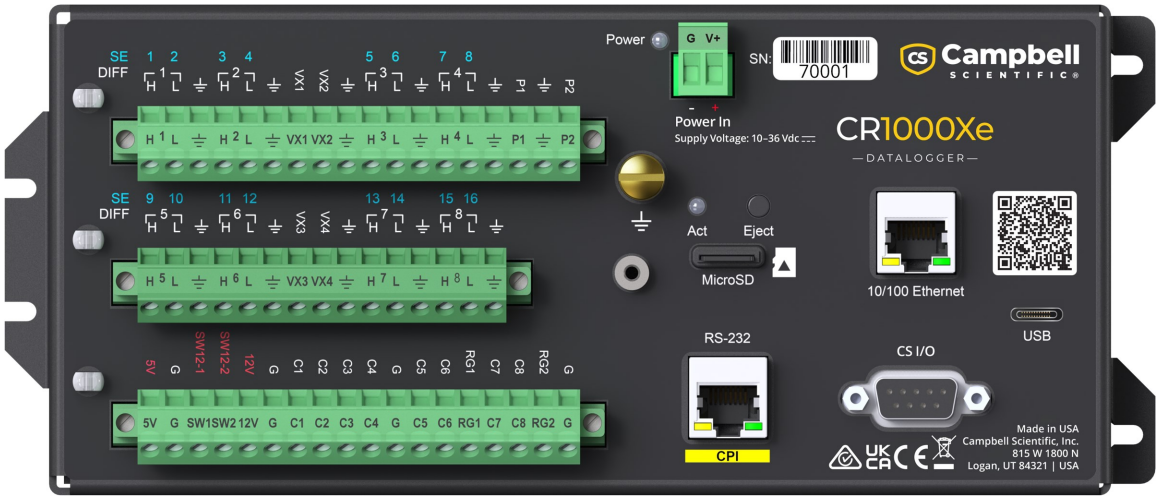
> CAUTION:
> Do not modify the enclosure wiring. Each SunSentry is engineered and built to the application requirements. For questions about any specific SunSentry station, contact Campbell Scientific.

2.1.1 Data logger

The CR1000Xe provides measurement and control for a wide variety of applications. Its reliability and ruggedness make it an excellent choice for solar meteorological stations that are installed in environmentally demanding environments and are critical to power plant operation.

The CR1000Xe is a low-powered device that measures analog and digital sensors, processes and stores measurements. The SunSentry uses the Modbus TCP and DNP3 protocol to communicate with a power plant SCADA system and stores data in non-volatile flash memory. The data logger

is configured using an internal, web-hosted, user interface that allows for simple sensor selection and station configuration while still allowing users a wide range of flexibility in choosing sensors.



2.2 AC pull box

Alternating current (AC) poses additional safety concerns over low direct current (DC) voltages. In some locations, only licensed electricians are allowed to work in enclosures with AC power present. This is why the AC power box is separate from the main met enclosure. AC power will need to be brought into the pull box, then DC power (24 V) can be ran to the main met enclosure. If the AC box is not used, 24 VDC power must be provided to the main met enclosure.

2.3 Driven piles

The SunSentry makes use of available driven piles to mount the enclosures and sensors. The size of compatible piles was chosen to correspond with those commonly used in the construction of solar power plants. The main sensor suite mounts to a driven pile using the CM400 Tower Mount and a crossarm. A separate driven pile is used to mount the optional albedo sensor using the CM410 mount. The following shows the layout of these driven piles.

Campbell Scientific recommends the use of W6x12 piles.

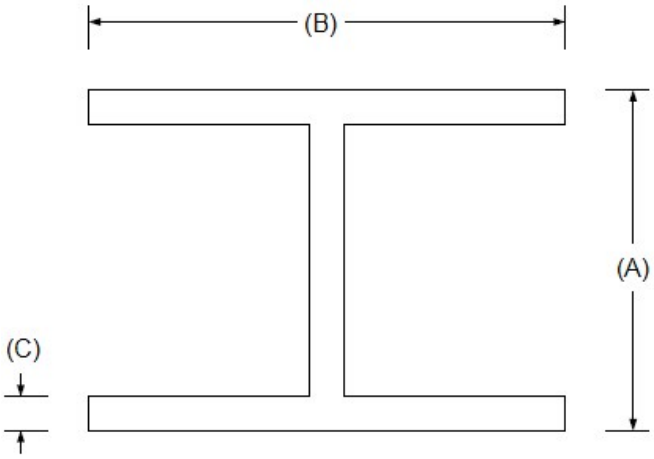


Figure 2-2. H pile dimensions

The CM400 tower mounts to all W6 H-piles or other H-piles with dimensions of:

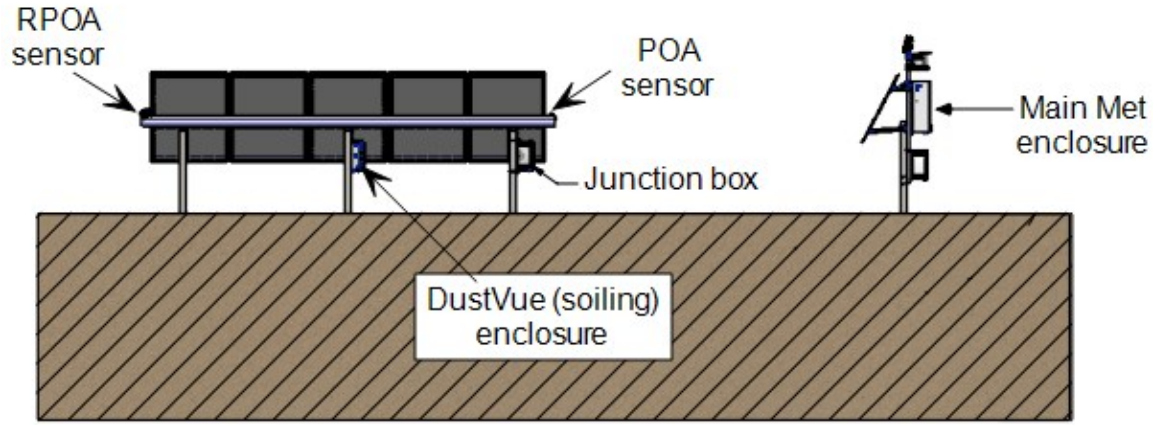
Section Depth (A in Figure 2-2 [p. 4]): 14 to 19 cm (5.5 to 7.5 in)

Flange Width (B in Figure 2-2 [p. 4]): 7.6 to 12.7 cm (3 to 5 in)

Flange Thickness (C in Figure 2-2 [p. 4]): < 1.3 cm (0.5 in)

2.4 Junction boxes

The optional junction boxes are used to consolidate multiple sensors to a single communications and power cable connected to the main met enclosure.

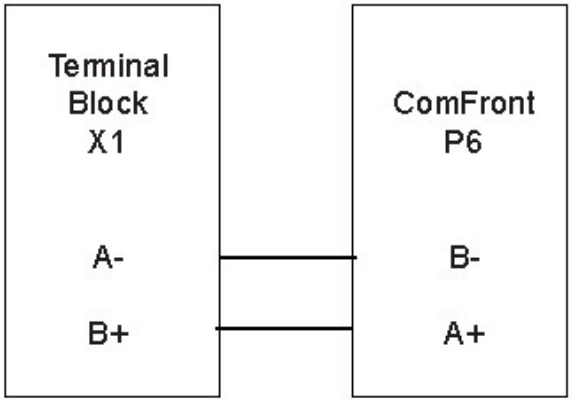


NOTE:
While surge protection and isolation are standard features of the SunSentry, some projects may require options to enhance these features.

2.4.1 RS-485 termination

The RS-485 standard recommends terminating the RS-485 bus on both ends of the bus by using a resistor value matching the characteristic impedance of the cable. Campbell Scientific cables used in the SunSentry have a characteristic impedance of 100 ohm. Campbell Scientific recommends placing a 100-ohm resistor between the A and B data lines at each end of cable lengths greater than 10 m (30 ft) for best results. See Replacement parts (p. 55) for more termination resistor information.

RS-485 nomenclature varies from manufacturer to manufacturer. The key to successful wiring is to follow the polarity of the signal (–) to (–) and (+) to (+). For example, the CommFront isolation device (P6) labels are A+ and B-; all other connections in the Junction Box are labeled A- and B+. The correct connection to and from the CommFront device are A- to B- and B+ to A+. Ignore the letter and use the polarity provided by the manufacturer.



2.5 Sensors

The following sections highlight recommended sensors for a SunSentry deployment, along with high-level details that are important to consider. Refer to the sensor manuals for more information about the sensors.

NOTE:
The sensor suite selected for each SunSentry system is flexible to suit the needs of each project. A full list of sensors currently supported by the SunSentry can be found at www.campbellsci.com/sunsentry.

NOTE:
The sensors should have been configured for this SunSentry system prior to installation. The Modbus address and communications protocol settings must match the configuration settings in the user interface.

2.5.1 Irradiance sensors

Irradiance sensors are ISO 9060:2018 Class A pyranometers used for IEC 61724-1:2021 Class A monitoring of global hoizontal irradiance (GHI). Class A, C, or reference cells can be used for the other irradiance parameters.

- Global Horizontal Irradiance (GHI)—These sensors are typically installed on the main met tower. Redundant sensors may be used but are not required.
- Plane of Array (POA)—These sensors are commonly installed on the array to ensure orientation matches that of the PV array, including trackers. Campbell Scientific has many mounting options.
- Rear side Plane of Array (RPOA)—Used in bifacial module applications, these measurements, like the POA measurements can be mounted in a variety of ways.
- Albedo—Albedo is the ratio of horizontal upwelling irradiance to total downwelling irradiance. For best performance, Class A sensors with lowest thermal offsets are ideal for this measurement. The CM275 Albedometer Mounting Stand co-locates both sensors on a single bracket that is mounted to the CM410 Pile Mount Crossarm for Albedo are or to another horizontal crossarm such as the CM206.
- Diffuse Horizontal Irradiance (DHI)—Best DHI measurements are performed with shaded and tracking pyranometers. However, many other options are common including the SPN1 from Delta-T.

2.5.2 All-in-one weather sensor

The SunSentry typically uses the ClimaVue™40 Compact Digital Weather Sensor. This multi-parameter meteorological sensor is designed for solar plant operational monitoring and solar resource assessment with IEC 61724-1 compliance. At Campbell Scientific, we recognize the importance of, and are well known for, our instrumentation accuracy and reliability. We also recognize that ease of operation and overall cost of operation are critical. With the ClimaVue 40, you will get this and more. In adherence to IEC 61724-1 (2021), the ClimaVue 40 provides ambient air temperature, precipitation, relative humidity, wind speed, and wind direction measurements. The sensor also offers vapor pressure, tilt, lightning strike, and lightning average distance measurements.

The SunSentry may also use other multi-parameter meteorological sensors, such as the MetSens500 and the Lufft WX_XXX-series, to measure:

- Wind Speed and Wind Direction
- Ambient Temperature
- Relative humidity (Water stuck in the air)
- Barometric pressure
- Precipitation (water falling)
    - Rain
    - Hail
    - Snow

2.5.3 Soiling sensors

The SunSentry typically uses the DustVue solar-module soiling sensor to measure and calculate the soiling-loss index to provide solar energy professionals with the information needed to evaluate and manage the impact of soiling on their photovoltaic (PV) power plant performance.

The DustVue has been designed with ease of use in mind and can be used on any PV installation.

The sensor includes the following:

- Measurements provided by the CS241 Back-of-Module Temperature Sensor, which has been optimized for bifacial panels

- Prewired connectors for module temperature measurements and solar panels used for the soiling measurement
- Modbus RTU communications with a standard Modbus register map
- Data filtering to maximize accuracy
- Backup battery and storage of historic data
- Wide range of options for mounting the enclosure to site specific structures
- Purpose-built sensors for silicon-cell or thin-film solar panels

This sensor joins our extensive line of high-quality, turn-key measurement solutions for solar and other renewable energy applications. Campbell Scientific measurement solutions provide PV performance engineers with the data needed to validate performance models and determine energy yield.

Other soiling sensors may also be used.

2.5.4 Back-of-module (BOM) temperature sensor

The SunSentry uses the CS241DM surface-mountable, back-of-module temperature sensor. It is designed for bifacial photovoltaic (PV) module performance assessment and soiling. The sensor head has been redesigned for easier installation. The measurement performance has been improved with a smaller footprint that is optimized to reduce back-of-module shading and eliminate surface cooling. Other improvements include greater sensor-to-module bonding/adhesion and a thinner Teflon cable with a higher temperature rating. To meet the

requirements of performance validation, every CS241DM is supplied with a NIST-traceable, serialized calibration certificate.

3. Required tools and software

Required tools:

- Open end wrenches: 3/8 in, 7/16 in, 1/2 in, (2) 9/16 in
- Socket wrench set
- Magnetic compass
- Tape measure
- Nut driver (3/8 in)
- Level
- Pliers
- Flat-bladed screwdrivers
- Phillips screwdrivers

Additional tools required for concrete anchor installation (see Installation Guide):

- Hammer drill
- 3/4-inch masonry drill bit
- Eye protection
- Filter mask
- Wire brush (or compressed air)

Required software, drivers, and licenses:

- Laptop computer or mobile device with Web browser
- Sensor configuration software depending on the sensors used (refer to sensor manuals)

4. Safety

- Select a safe site to install the tower.
- The distance between any power lines and the installation site should be at least one and one-half times the height of the tower. Make the distance even greater, if possible. Since all overhead lines look somewhat alike, consider them all dangerous and stay well away from them.
- If there are power lines or buried utilities in the area, call the local utility providers for assistance.
- NEVER work alone; always have someone near who can summon help.
- Certain clothing may provide a degree of safety, but do not depend on it alone to preserve life (for example, rubber boots or shoes, industrial rubber gloves, or a long shirt or jacket).
- Check local weather conditions. Be sure it has not rained recently, and the ground is not wet or muddy. Make sure rain or thunderstorms are not predicted for the day the tower is to be installed.
- To avoid having the tower being blown into nearby power lines, do not install or remove towers in moderate or heavy winds.
- If it is necessary to use a ladder, choose a ladder made of non-conductive, non-metallic materials.
- Have someone present who has been trained in electric shock first aid, if possible.

5. Web UI

The ***Web UI*** is a program running on the SunSentry data logger that simplifies the configuration of the meteorological station system layout. It automatically builds a data logger program that controls data logger communications between the sensors and customer network programs

such as the SCADA system. Knowledge of CRBasic programming is not needed because the program is automatically created.

The *Web UI* has the following main menus:

- **Dashboard** provides real time data information collected from the sensors.
- **Configuration** enables quick and easy configuration of the system layout. After the configuration is complete, click **Apply to Station** to automatically create the data logger program. You can click **Config Report** to display and print the configuration, wiring, and Modbus information for the sensors. The configuration can also be saved and used to automatically configure the station if station recovery is needed or to configure other stations with identical configurations. Communications information is included in the saved file and needs to be changed if used for other stations in the same network.
- **Monitor Data** displays the data tables and contents. The data can be collected and downloaded, displayed, and graphed.
- **Diagnostics** accesses the data logger status table, which contains valuable troubleshooting and system performance information. Updates to the data logger operating system, programs and web pages are made using the **Updates** tab. The **Watch** tab provides a terminal window with limited communications monitoring capabilities.
- **Modbus Map** shows the Modbus map that the SCADA system uses to collect the real time data from the sensors.

You can get up and running with your SunSentry in no time. Once you are connected to the SunSentry with a web browser, navigate to the **Configuration** page. You can configure a **Station Name**, **Location field**, and add **Station Notes**, if desired, then follow these instructions to **Add Sensors**, and set up **Network Options**.

5.1 Connect to the SunSentry

Connecting to the SunSentry for the first time requires a direct connection using the USB port on the data logger.

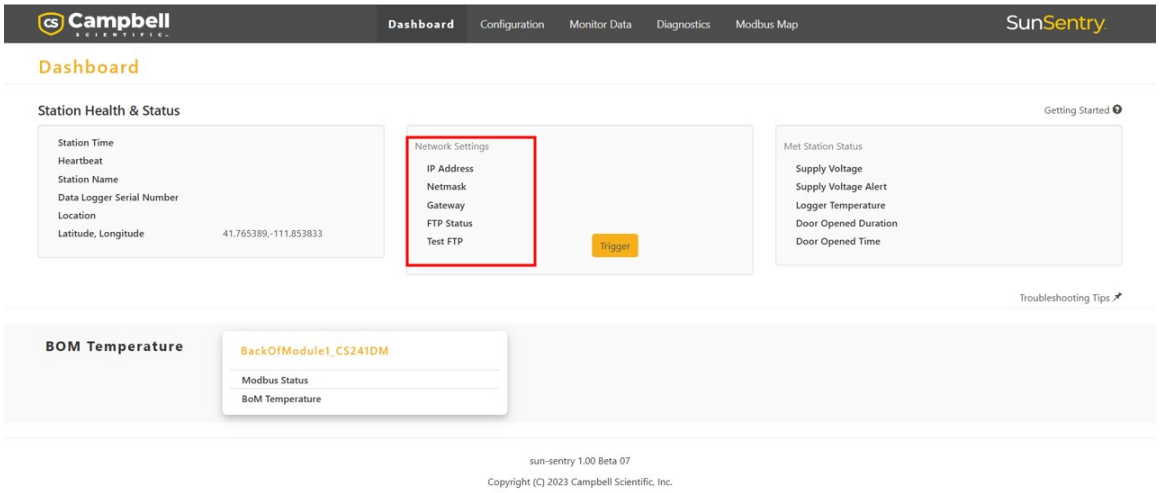
1. Use the USB cable to connect the SunSentry to the computer USB port.
2. Type www.linktodevice.com or 192.168.66.1 (default IP) in the computer browser.
3. Click **Getting Started** for instructions or go directly to the **Configuration** page.

Once you are connected to the system with a web browser, navigate to the **Configuration** page. Enter the **Station Parameters**, set up **Communications Options**, and **Add Sensors**.

If you would like to be able to configure the SunSentry system remotely, you will need to set up an account with **Administrator** privileges. See for help on setting up user accounts.

5.2 Network Settings

The Modbus TCP/IP protocol is used to communicate with the local SCADA system or other data collection platforms. Under **Network Setting**, communications settings, such as the system network **IP Address**, must be entered to allow the system to be accessible using the local network.



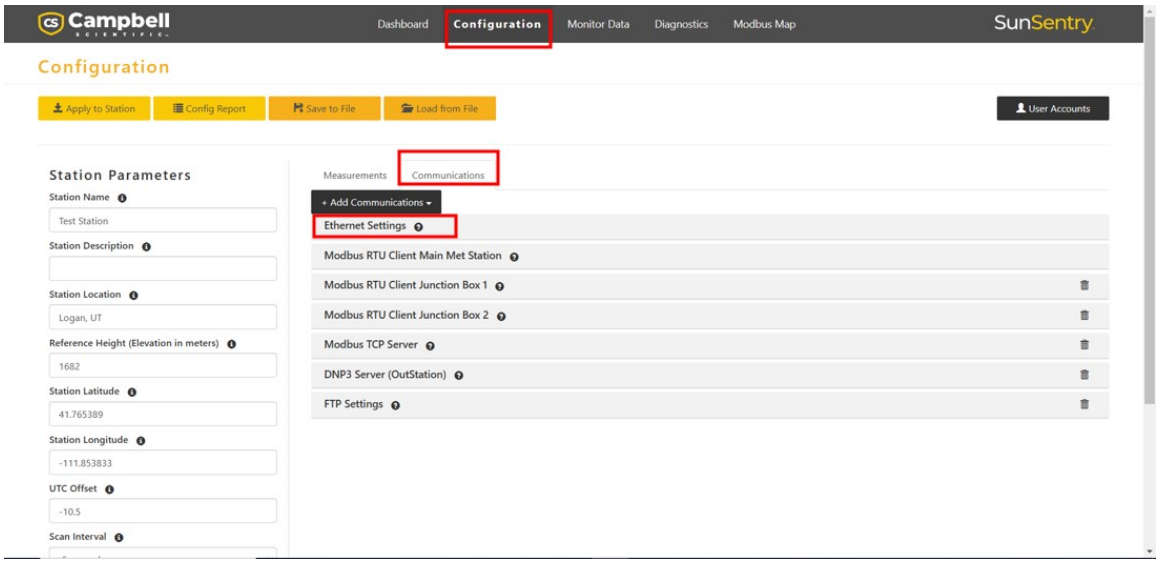
The following other communication protocols are available.

- Three Modbus RTU communications channels for sensor communications
  - **Mobus RTU Main Met** (default, not optional)
  - **Mobus RTU Client Junction Box 1** (default, optional)
  - **Mobus RTU Client Junction Box 2** (optional)
- **Modbus TCP Server** (optional, required for Modbus data retrieval from the SunSentry)
- **DNP3 Server (OutStation)** (optional)
- **NTP** and **FTP** services (optional)

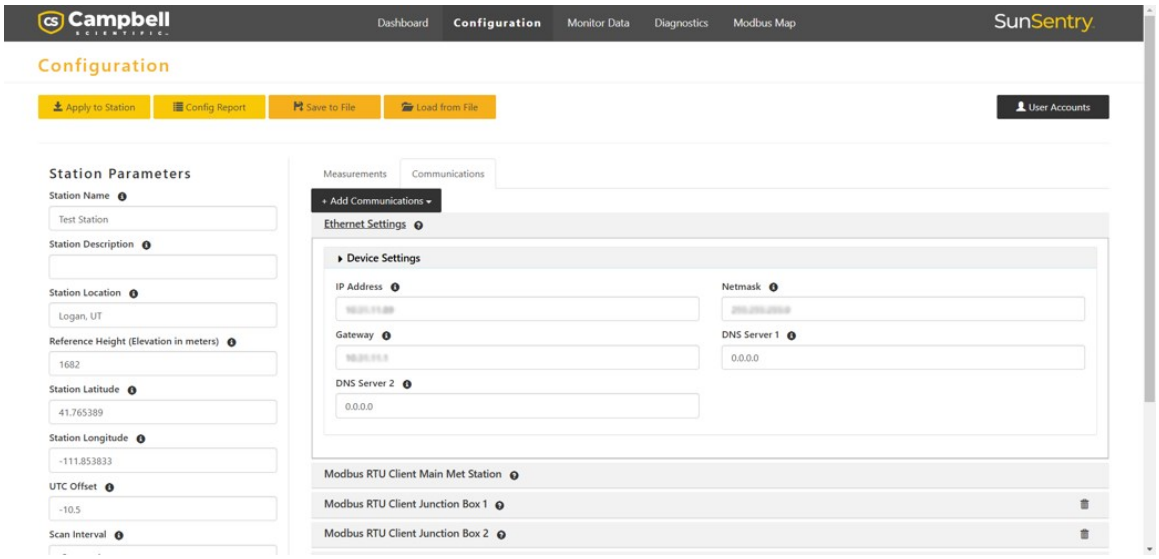
To configure those protocols, click **Configuration** then click **Communications.**

5.2.1 Ethernet settings

1. Click the **Communications** tab then click **Ethernet Settings**.

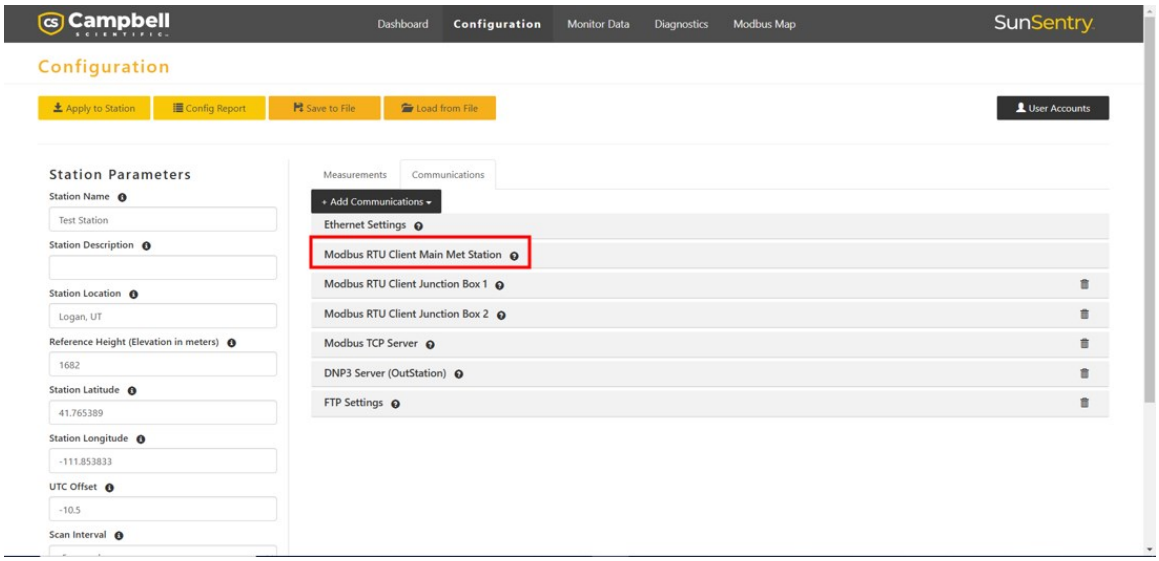


2. Configure the Ethernet Interface by entering the **IP Address**, **Netmask**, and **Gateway** that the data collection system is expecting to use to communicate with the SunSentry. Inline context help is available in the Web UI.

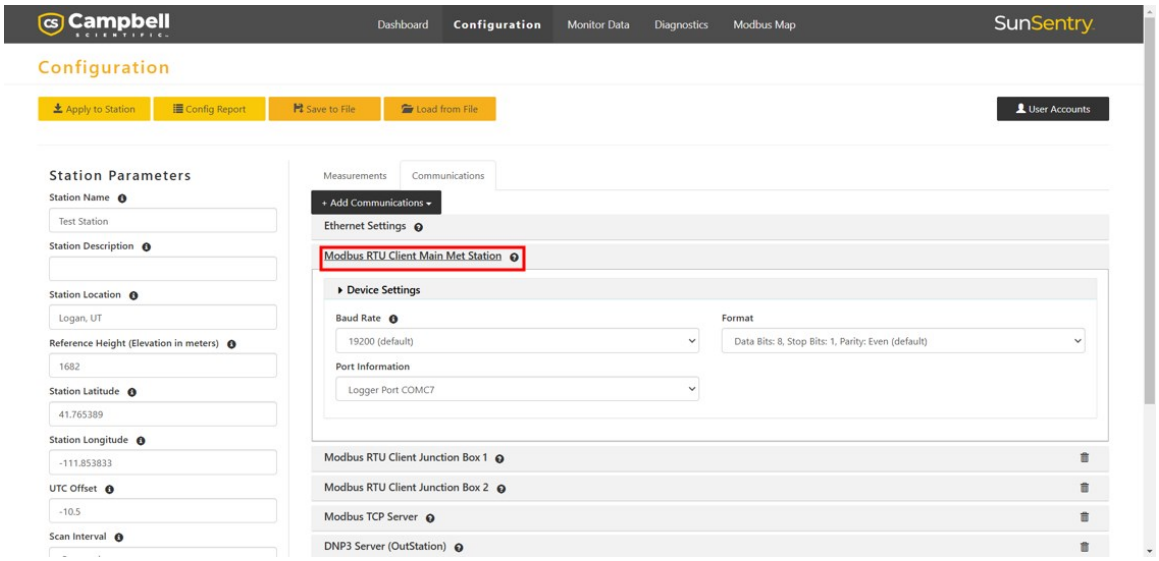


5.2.2 Modbus RTU Client Main Met Station

There are three Modbus RTU communications terminals in the SunSentry. The first communication terminal associated with the main met box is active by default and cannot be deleted. Click on the **Modbus RTU Client Main Met Station** to expand its available settings.



Click on **Modbus RTU Client Main Met Station** again to collapse the settings.

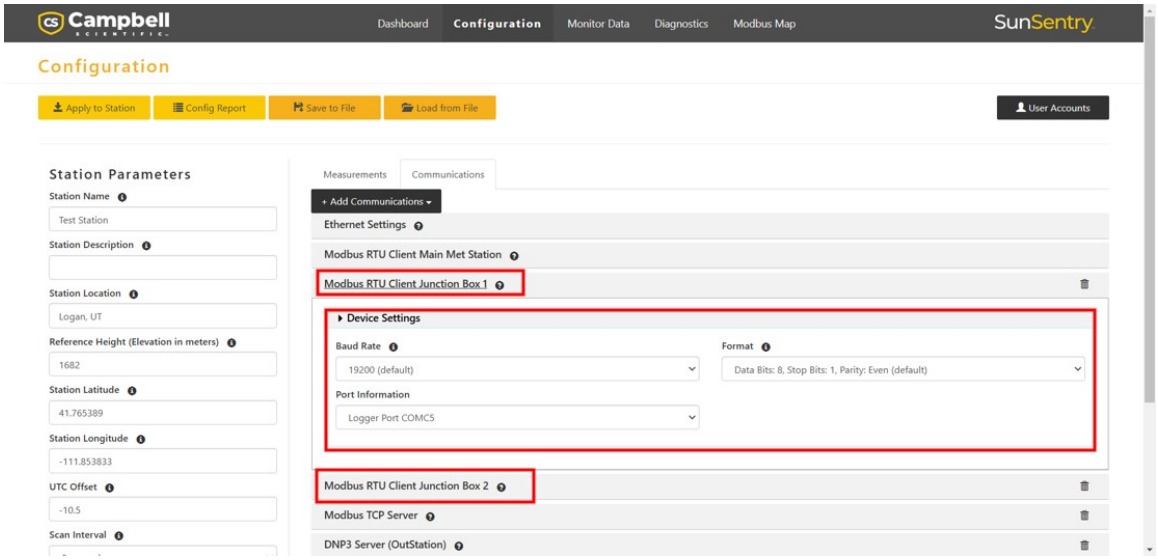


NOTE:
Ensure that each sensor is configured to match the communication terminal settings when sensors are added.

5.2.3 Modbus RTU Client Junction Box 1 and Modbus RTU Client Junction Box 2

Modbus RTU Client Junction Box 1 is the second communication port and is displayed by default and can be deleted if not used. **Modbus RTU Client Junction Box 2** is the third communication port.

1. Click on the **Modbus RTU Client Junction Box** name to expand its available settings.

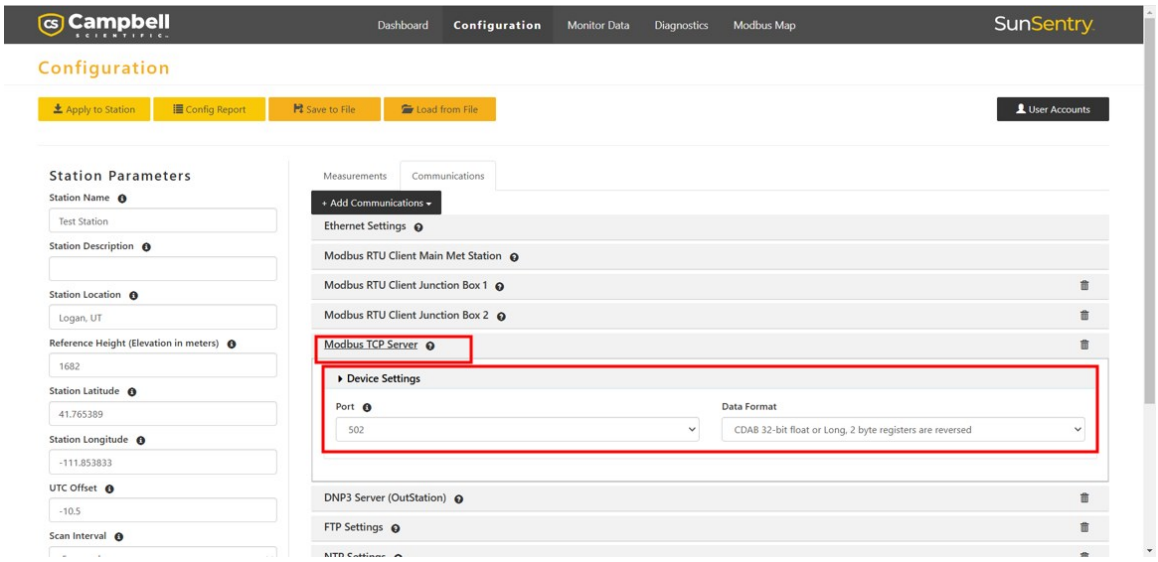


2. Configure the **Device Settings** (**Port** and **Format**) to match the configuration of the sensors using this communications port.
3. Click on **Modbus RTU Client Junction Box** name again to collapse the settings.

> **NOTE:**
> Ensure that each sensor is configured to match the communication port settings when sensors are added.

5.2.4 Modbus TCP Server

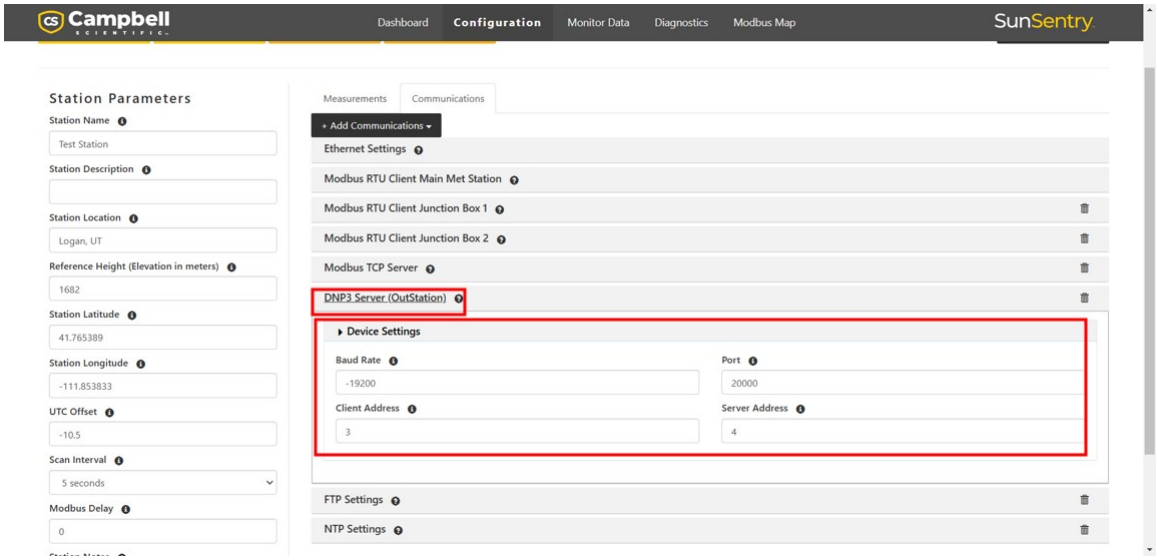
Selecting this option enables SunSentry system to act as Modbus Server, serving the Modbus data from all attached sensors.



1. Click on **Modbus TCP Server** to expand its available settings.
2. Configure the **Device Settings** (**Port** and **Data Format**) to match the desired format.
3. Click on **Modbus TCP Server** again to collapse the settings.

5.2.5 DNP3 Server (OutStation)

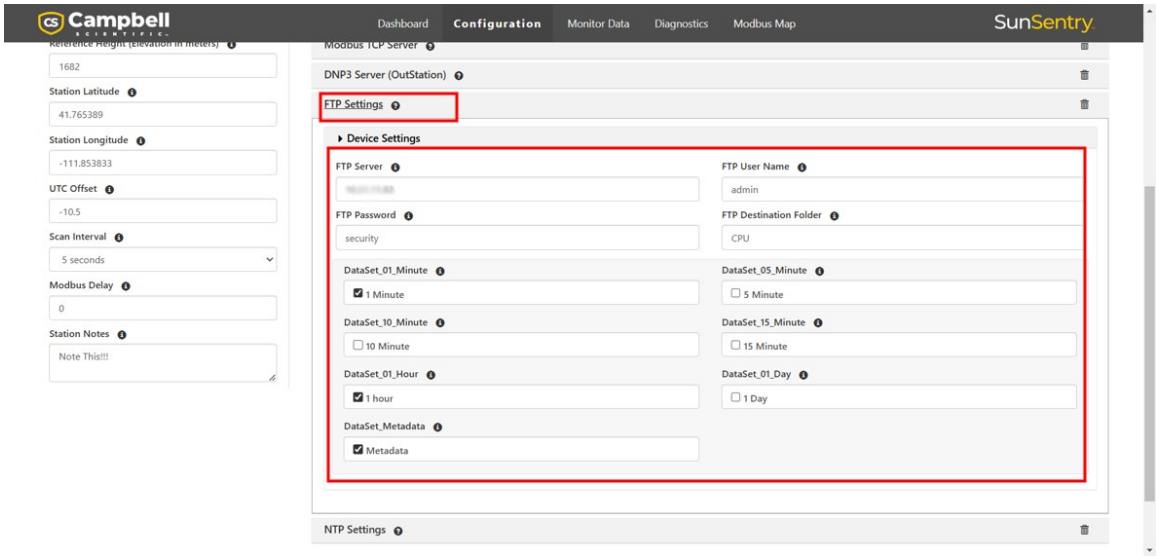
Selecting this option enablesSunSentry system to act as DNP3 Server, serving the Modbus data from all attached sensors.



1. Click on **DNP3 Server (OutStation)** to expand its available settings.
2. Configure the **Device Settings** (**Baud Rate**, **Port**, **Client Address**, and **Server Address**) to match the desired format.
3. Click on **DNP3 Server (OutStation)** again to collapse the settings.

5.2.6 FTP Settings

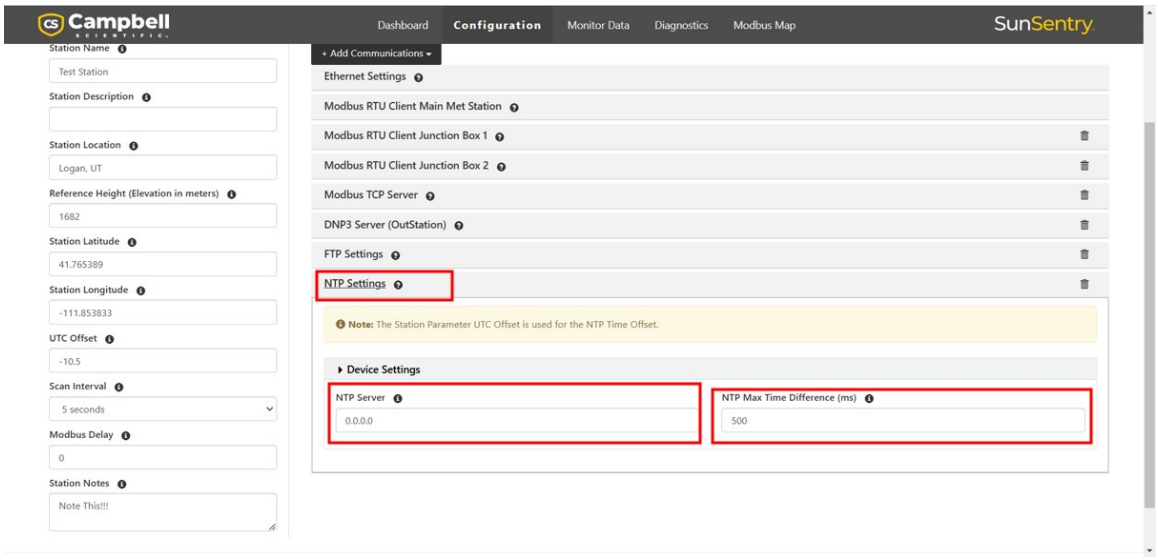
Selecting this option enables FTP streaming of the data table to an FTP server. The device will send the previous day data to the FTP server at 1:00 am.



1. Click on **FTP Settings** to expand its available settings.
2. Configure the **FTP Settings** such as the **FTP Server**, **FTP Username**, **FTP Password**, and **FTP Destination Folder** to customize the FTP behavior.
3. Click on **FTP Settings** again to collapse the settings.

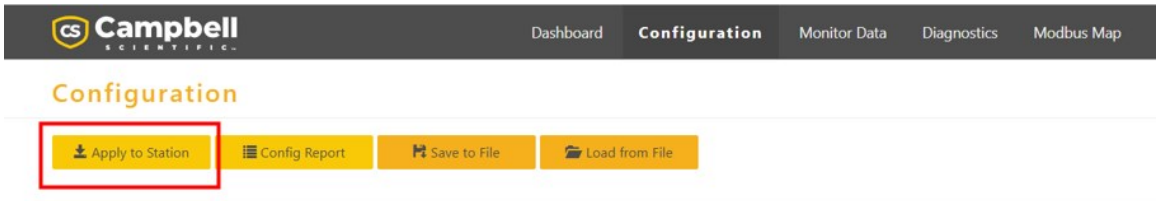
5.2.7 NTP Settings

The CR1000Xe internal clock is very reliable. However, if the application requires the clock to be synchronized by the Network Time Protocol (NTP), click on the **NTP Settings** to expand the **NTP Settings**. Configure the **NTP Server** and **Max Time Difference**) to customize the NTP behavior. Click on the communication option name again to collapse the settings.



5.2.8 Apply to Station

Click **Apply to Station** to apply the settings to the SunSentry system or add sensors.

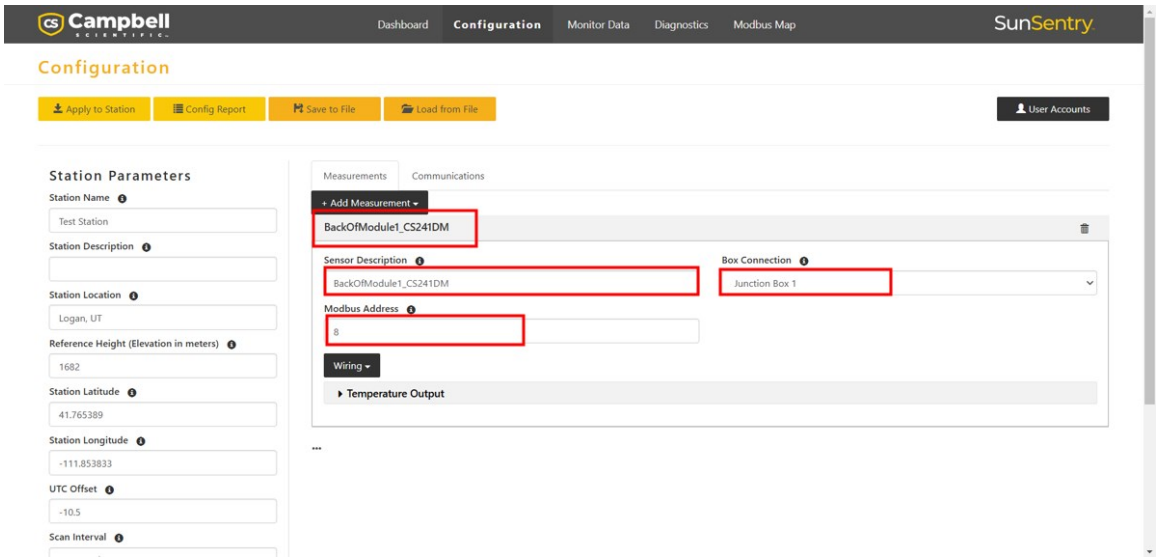


> NOTE:
> **Apply to Station** can be used at any time to apply the settings to the data logger. Single or multiple additions, changes or deletions of configuration can be applied at any time. **Apply to Station** compiles the settings into a new ***CRBasic*** program. This new program creates new data tables thus all previous data is lost. The data logger program is updating and may take a few minutes to complete before new data is displayed.

5.3 Add sensors

Add up to two pyranometers of each functional type (GHI, POA, Albedo pairs, DHI), two compact weather sensors, six RPOA pyranometers and back-of-module temperature sensors, and two soiling sensors. The sensor menus are grouped by general output type, functional type, and manufacture model. Only one sensor can be added at a time. Click the listing to open the submenu. Click the listing again to close the submenu.

1. Click the **Measurement** tab.
2. Click **+Add Measurement** to see a list of available sensors.
3. Click the general output type desired, the functional type, and the manufacture model desired.
4. After a sensor appears in the list, type the parameters for that sensor to customize it for your application.
    a. Most sensors require the **Modbus Address** to be changed to match the Modbus address of the specific sensor being used. A default address will appear and can be used by ensuring the sensor is configured for the same address. SDI-12 sensors are also available for selection and require the SDI-12 address.
    b. **Box Connection** specifies which box the sensor is connected to. Each box is connected to a unique communications port on the data logger. Selecting the box the sensor is connected to ensures the software is configured to communicate with the sensor on the correct communication port.
    c. **Sensor Description** is used as the title of the measurements on the **Dashboard**. Although editable, Campbell Scientific suggests using the default sensor description for most circumstances.
    d. Some sensors require input from other sensor outputs to function properly. Select from the drop-down menu presented or input the required data.



5. View the wiring diagram for the sensor by clicking on **Wiring**. The wiring table is also available in the **Config Report**.

6. If you selected a sensor by mistake or no longer wish to have the SunSentry read data from it, remove it from the running configuration by clicking the red trash can icon next to the sensor heading.
7. Once you have added all the sensors, click Apply to Station (p. 18) and the SunSentry will start reading your sensors. The data logger program automatically updates, which may take a few minutes to complete before new data is displayed.

5.4 Creating accounts and passwords

Each CR1000Xe manufactured will have a unique identifier (UID). The UID can be found on a QR-code sticker on the front of the data logger. The UID also serves as a unique preprogrammed password. This password is used when connecting to the data logger using an IP connection. Direct connection using the USB port does not use this password. The first-time connection to the data logger must use the USB connection. During the first connection to the data logger, user accounts should be established allowing connection to the SunSentry data logger without knowledge of the preprogrammed password.

The SunSentry ***Web UI*** requires the use of the preprogrammed password unless additional user accounts are created. SunSentry ***Web UI*** does not change this preprogrammed password, but enables the new administrative accounts full access to the data logger.

The SunSentry ***Web UI*** adds a layer of protection and enables multiple user accounts to be created with either no access, read only or administrator privileges. Once connected by following the instructions provided in Connect to the SunSentry (p. 11), perform the following procedure to create the desired logon accounts.

5.4.1 Set up user accounts

The system is protected by password access. If you are connected using the USB connection, all access is granted. If you want to be able to control how the device is accessed remotely, you can set up user accounts. To configure the device remotely (over the Ethernet port), you need to set up a user account with **Administrator** permission level.

To manage user accounts, click **User Accounts** in the **Configuration** screen to access the **User Account Setup** dialog box. You must be connected over USB or logged in under a previously created account with administrator access.

Secure Administrator Access:

1. Select **admin** from the **Username List** (name can be changed from admin).
2. Enter a password in the **Password** field (password is not required but is highly recommended).
3. Close the page.
4. Click **Apply to Station**.

> **NOTE:**
> Web browsers may cache the password, so the password does not need entered each time the web page is accessed from the same computer.

The following table explains what permission levels are available.

Table 5-1: User account permissions

Permission level	Access
None	Disable an account without deleting it.
Read only	Permission to view the device values.
Administrator	Permission to view the device values, to edit the device configuration, and to create and edit accounts.

> **NOTE:**
> Creating an account with the user name anonymous, without a password, allows access to anyone that connects to the device without having to enter a user name. A default anonymous account exists with read only access. This allows anyone to be able to see the **Dashboard**, **Historic Data**, and **Modbus Map** without having to enter a user name.
>
> The anonymous account without password must exist to properly access the device using the Apple Safari browser.

6. Troubleshooting

Symptom: Can not connect to the station

- Verify the data logger has sufficient power by connecting to it and checking the battery voltage in the **Status** table. A healthy voltage typically reads slightly over 24 V. See video on **Measuring Data Logger Output Voltage With a Multimeter** here:

  www.campbellsci.com/videos/basic-troubleshooting-01.

Symptom: Sensor not reporting

- Check the cable for signs of damage and possible moisture intrusion.
- Check sensor connections to ensure that they are connected to the correct terminal.
- Check the voltage to the sensors with a digital voltage meter.

6.1 Web interface recovery

In the unlikely event that web interface files are lost or corrupted, a data logger-hosted recovery page can be used to restore the web interface. This page can also be used to update the web interface when new versions are available. The recovery page is accessed by navigating to: **datalogger IP Address/recovery**. For example: **111.222.333.444/recovery**. This will open a **Recovery** page in the browser.

The **Send File** button on the recovery web page allows users to upload .obj or web.obj.gz files to restore web interface files on the data logger. The upload process may take several minutes.

7. Maintenance

During site visits, check the driven pile, concrete pad with pile adapter, tower, crossarms, sensor mounts, and junction box mounts. Tighten bolts when needed. Sensor maintenance schedule and tasks are provided in the following table.

Table 7-1: Irradiance and soiling sensors maintenance schedule and tasks

Sensor type	Recommended frequency range	Maintenance task	Task details	Effect mitigated
Irradiance Sensors	Site specific, depending on site conditions. Two times per week up to two times per month	Clean outer glass dome	Spray demineralized water then wipe with a soft cloth dry to clean	The irradiance measurement will be impacted due to change in transmittance
Irradiance Sensors	Weekly to monthly	Check appearance condition	Check for cracks and scratches on the glass dome and body	May lead to shade on the detector and enhanced soiling
Irradiance Sensors	Weekly to monthly	Check setup base condition	Check if the instrument is securely and properly tightened to the mounting base/ plate	Loose instruments and/or mounting plates can lead to damages of the instruments and/or injury.
Irradiance Sensors	Weekly to monthly	Check bubble level	Verify the bubble is in the center ring of bubble level if the irradiance sensor is setup in a horizontal (GHI) position.	An additional cosine/azimuth error will be introduced

Table 7-1: Irradiance and soiling sensors maintenance schedule and tasks				
Sensor type	Recommended frequency range	Maintenance task	Task details	Effect mitigated
Irradiance Sensors	Weekly to monthly	Check the tilt angle.	Check the tilt angle and roll angle in Modbus RTU or SDI-12 output. If making a GHI measurement, check the sensor bubble level.	Any change in tilt position after the installation can affect the measurements due to the cosine response of the sensor.
Irradiance Sensors	Weekly to monthly	Check cable condition	Check if the instrument is tightened properly to the mounting base plate and the base plate and/or table is securely fastened in a proper condition.	A disconnected cable will cause sporadic reading errors or failure of operation. If the cable is damaged, it may cause noise or electric shock.
Irradiance Sensors	Weekly to monthly	Data validity	Check the daytime irradiance data and compare it to previous days or adjacent pyranometers.	Large difference occurs may indicate installation issues or sensor problems
Irradiance Sensors	Weekly to monthly	Presence of noise	Check night-time irradiance values	Used to detect night-time offsets and sensor stability issues
Irradiance Sensors	Weekly to monthly	Check the dome heating current when the dome heating function is turned on.	Check dome heating current alert register using Modbus RTU or SDI-12 output.	If the dome heating current is not energized properly, the dew and frost mitigation effect cannot be fully achieved.

Table 7-1: Irradiance and soiling sensors maintenance schedule and tasks

Sensor type	Recommended frequency range	Maintenance task	Task details	Effect mitigated
Irradiance Sensors	Weekly to Monthly	Check the temperature inside	Check the body temperature via Modbus RTU or SDI-12 output.	If the inside temperature becomes abnormally high, the life of the product will be shortened.
Irradiance Sensors	Weekly to Monthly	Check the efficacy of desiccant	Check the internal relative humidity alert status of the pyranometer in the Modbus RTU or SDI-12 output.	The condition of the drying agent can slightly change over time. If the relative humidity becomes high, the glass dome might be fogging up.
Irradiance Sensors	Weekly to Monthly, before/after severe weather events	Check sun screen	Verify if the sun screen is securely attached on the body, and the knurling screw is securely tightened.	A loose sun screen or knurling screw may damage the instrument and/or increase measurement errors due to temperature increase by sun screen coming off.
Soiling Sensors	Weekly to monthly - Site Specific	Check soiling sensor entrance optics	If a clean reference sample is used, make sure it remains clean	The soiling measurements will have erroneous measurements due to reduced transmittance on the reference clean sample
Soiling Sensors	Weekly	Clean the reference/clean panel if using that method	Use normal water and wipe clean the surface.	Maintains proper soiling measurements.

Table 7-1: Irradiance and soiling sensors maintenance schedule and tasks				
Sensor type	Recommended frequency range	Maintenance task	Task details	Effect mitigated
Soiling Sensors	Weekly to monthly	Data validity	Check the daytime values and compare to previous days or adjacent sensor. Specific to soiling, look for changes in the soiling ratio (SR)	When large differences occur, operating problems or installation issues can be detected.
All Sensors	Yearly	Physical and electrical connections	Check for wear and damage, including corrosion, stress cracks, frayed cables, nicked or cut cable housing, loose cable clamps, cable tightness, etc. and take necessary corrective actions.	Damaged sensor, poor contacts and electrical noise, etc.

Table 7-1: Irradiance and soiling sensors maintenance schedule and tasks				
Sensor type	Recommended frequency range	Maintenance task	Task details	Effect mitigated
All Sensors	Per manufacturer recommendation	Calibration	To maintain the best possible measurement accuracy, calibration of the irradiance sensors is recommended. Contact Campbell Scientific for more details and requests for a calibration and maintenance service. Traditional thermopile pyranometers with the detector at the surface require calibrations at 2 years or sooner.	Due to natural aging of materials the detector sensitivity of the pyranometer can gradually change over time.
All Sensors	Yearly	Check sensor connectors, cables, wiring, and grounding	Check full sensor cabling. Start with ensuring the connector is properly tightened on the sensor. If cables are not in conduit, verify they are not cracking or damaged. Ensure the wiring in the enclosures is proper and secure. Ensure ground and shield cables are properly connected to their respective termination points.	Lost data. Damaged connectors or wires can pull down a communication bus and cause problems with multiple sensors.

8. Modbus map

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40001	Heartbeat	Heartbeat	
40003	SupplyVoltage	Supply Voltage	V
40005	LoggerTemperature	Logger Temperature	°C
40007	Door_Open_Duration_ Seconds	Door Opened Duration	sec
40021	POA1	Irradiance	W/m^2
40023	POA2	Irradiance	W/m^2
40025	GHI1	Irradiance	W/m^2
40027	GHI2	Irradiance	W/m^2
40029	Albedo_1	Albedo	
40031	Albedo_2	Albedo	
40033	DHI1	GHI Irradiance	W/m^2
40035	DHI1	Diffuse Irradiance	W/m^2
40037	DHI2	GHI Irradiance	W/m^2
40039	DHI2	Diffuse Irradiance	W/m^2
40041	RPOA1	Irradiance	W/m^2
40043	RPOA2	Irradiance	W/m^2
40045	RPOA3	Irradiance	W/m^2
40047	RPOA4	Irradiance	W/m^2
40049	RPOA5	Irradiance	W/m^2
40051	RPOA6	Irradiance	W/m^2
40053	BackOfModule1	BoM Temperature	°C

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40055	BackOfModule2	BoM Temperature	°C
40057	BackOfModule3	BoM Temperature	°C
40059	BackOfModule4	BoM Temperature	°C
40061	BackOfModule5	BoM Temperature	°C
40063	BackOfModule6	BoM Temperature	°C
40079	Weather1_AirTemp	Air Temperature	°C
40081	Weather1_RH	Relative Humidity	%
40083	Weather1_BP	Barometric Pressure	hPa
40085	Weather1_WindSpeed	Wind Speed	m/s
40087	Weather1_WindDir	Wind Direction	°
40091	Weather1_Rain_Tot	Rain 1 Minute Total	mm
40093	Weather1_Rain_Tot	Rain Hourly Total	mm
40095	Weather1_Rain_Tot	Rain Daily Total	mm
40099	Weather2_AirTemp	Air Temperature	°C
40101	Weather2_RH	Relative Humidity	%
40103	Weather2_BP	Barometric Pressure	hPa
40105	Weather2_WindSpeed	Wind Speed	m/s
40107	Weather2_WindDir	Wind Direction	°
40109	Weather2_DewPoint	Dew Point	°C
40119	SnowDepth1_Depth	Snow Depth 1 Hour	m
40121	SnowDepth1_Depth	Snow Depth 1 Day	m
40123	SnowDepth2_Depth	Snow Depth 1 Hour	m
40125	SnowDepth2_Depth	Snow Depth 1 Day	m
40129	Rain1_Tot	Rain 1 Minute Total	mm
40131	Rain1_Tot	Rain Hourly Total	mm

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40133	Rain1_Tot	Rain Daily Total	mm
40139	Rain2_Tot	Rain 1 Minute Total	mm
40141	Rain2_Tot	Rain Hourly Total	mm
40143	Rain2_Tot	Rain Daily Total	mm
40149	Hail1_Hits	Number of Hail hits in last 30 seconds	hits
40159	Hail2_Hits	Number of Hail hits in last 30 seconds	hits
40179	Soiling1_SoilingRatio	Soiling Ratio	
40181	Soiling1_SLossIdx	Soiling Loss Index	%
40187	Soiling2_SoilingRatio	Soiling Ratio	
40189	Soiling2_SLossIdx	Soiling Loss Index	%
40191	Soiling2_DustIQ_ SoilingRatio2	Soiling Ratio	
40193	Soiling2_DustIQ_ TxLoss2	Soiling Loss Index	%
40199	Soiling1_RED300i_Ldr_ PI_Pmax	10 min Performance Index Pmax	
40201	Soiling1_RED300i_Ldr_ PI_Isc	10 min Performance Index Isc	
40203	Soiling1_RED300i_Ldr_ PI_PmaxAvg	24 hr Performance Index Pmax Avg	
40205	Soiling1_RED300i_Ldr_ PI_IscAvg	24 hr Performance Index Isc Avg	
40605	Supply_Voltage_Flag	0 = OK, 1 = PS Fault, Low Voltage, 2 = PS Fault, Battery Powered, 3 = Low Voltage, 4 = High Voltage, 5 = NAN	
40609	Door_Open_Duration_ Seconds	Door Opened Duration	sec
40611	DoorOpenEvent Year	Door Open Event Year	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40613	DoorOpenEvent Month	Door Open Event Month	
40615	DoorOpenEvent Day of Month	Door Open Event Day of Month	
40617	DoorOpenEvent Hour	Door Open Event Hour	
40619	DoorOpenEvent Minute	Door Open Event Minute	
40621	DoorClosedEvent Year	Door Closed Event Year	
40623	DoorClosedEvent Month	Door Closed Event Month	
40625	DoorClosedEvent Day of Month	Door Closed Event Day of Month	
40627	DoorClosedEvent Hour	Door Closed Event Hour	
40629	DoorClosedEvent Minute	Door Closed Event Minute	
40639	Weather1_ ModbusResult	0 = Success	
40641	Weather2_ ModbusResult	0 = Success	
40643	GHI1_ModbusResult	0 = Success	
40645	GHI2_ModbusResult	0 = Success	
40647	POA1_ModbusResult	0 = Success	
40649	POA2_ModbusResult	0 = Success	
40651	ALB1_Up_ ModbusResult	0 = Success	
40653	ALB1_Down_ ModbusResult	0 = Success	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40655	ALB2_Up_ ModbusResult	0 = Success	
40657	ALB2_Down_ ModbusResult	0 = Success	
40663	RPOA1_ModbusResult	0 = Success	
40665	RPOA2_ModbusResult	0 = Success	
40667	RPOA3_ModbusResult	0 = Success	
40669	RPOA4_ModbusResult	0 = Success	
40671	RPOA5_ModbusResult	0 = Success	
40673	RPOA6_ModbusResult	0 = Success	
40675	BackOfModule1_ ModbusResult	0 = Success	
40677	BackOfModule2_ ModbusResult	0 = Success	
40679	BackOfModule3_ ModbusResult	0 = Success	
40681	BackOfModule4_ ModbusResult	0 = Success	
40683	BackOfModule5_ ModbusResult	0 = Success	
40685	BackOfModule6_ ModbusResult	0 = Success	
40689	Soiling2_ ModbusResult	0 = Success	
40699	Soiling1_ ModbusResult	0 = Success	
40801	POA1_Irr_TC	Irradiance	W/m^2
40803	POA1_BodyTemp	Body Temperature	°C

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40805	POA1_SerialNumber	Serial Number	
40807	POA1_CalDate	Calibration Date	y/m/d
40809	POA1_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
40811	POA1_Humidity	Humidity	%
40821	POA1_TiltAngle	Tilt Angle	°
40827	POA1_Status	Pyranometer Status	
40861	POA2_Irr_TC	Irradiance	W/m^2
40863	POA2_BodyTemp	Body Temperature	°C
40865	POA2_SerialNumber	Serial Number	
40867	POA2_CalDate	Calibration Date	y/m/d
40869	POA2_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
40871	POA2_Humidity	Humidity	%
40881	POA2_TiltAngle	Tilt Angle	°
40887	POA2_Status	Pyranometer Status	
40921	GHI1_Irr_TC	Irradiance	W/m^2
40923	GHI1_BodyTemp	Body Temperature	°C
40925	GHI1_SerialNumber	Serial Number	
40927	GHI1_CalDate	Calibration Date	y/m/d
40929	GHI1_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
40931	GHI1_Humidity	Humidity	%
40933	GHI1_PressureAvg	Pressure Average	mbar
40935	GHI1_FanSpeed	Fan Speed	RPM
40937	GHI1_HeaterCurrent	Heater Current	mA

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
40939	GHI1_FanCurrent	Fan Current	mA
40941	GHI1_TiltAngle	Tilt Angle	°
40981	GHI2_Irr_TC	Irradiance	W/m²
40983	GHI2_BodyTemp	Body Temperature	°C
40989	GHI2_ IrrUncompensated	Irradiance No Temp Comp	W/m²
40991	GHI2_Humidity	Humidity	%
40993	GHI2_PressureAvg	Pressure Average	mbar
40995	GHI2_FanSpeed	Fan Speed	RPM
40997	GHI2_HeaterCurrent	Heater Current	mA
40999	GHI2_FanCurrent	Fan Current	mA
41001	GHI2_TiltAngle	Tilt Angle	°
41007	GHI2_Status	Pyranometer Status	
41009	GHI2_HeaterStatus	Heater ON-OFF Status	
41011	GHI2_Rotation_Z	Rotation around Z-axis	
41041	ALB1_Up_Irr_TC	Irradiance	W/m²
41043	ALB1_Up_BodyTemp	Body Temperature	°C
41045	ALB1_Up_ SerialNumber	Serial Number	
41047	ALB1_Up_CalDate	Calibration Date	y/m/d
41049	ALB1_Up_ IrrUncompensated	Irradiance No Temp Comp	W/m²
41063	ALB1_Up_TiltAngle_X	Tilt Angle X	°
41065	ALB1_Up_TiltAngle_Y	Tilt Angle Y	°
41067	ALB1_Up_Status	Pyranometer Status	
41101	ALB1_Down_Irr_TC	Irradiance	W/m²

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
41103	ALB1_Down_ BodyTemp	Body Temperature	°C
41105	ALB1_Down_ SerialNumber	Serial Number	
41107	ALB1_Down_CalDate	Calibration Date	y/m/d
41109	ALB1_Down_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
41123	ALB1_Down_TiltAngle_ X	Tilt Angle X	°
41125	ALB1_Down_TiltAngle_ Y	Tilt Angle Y	°
41127	ALB1_Down_Status	Pyranometer Status	
41133	Albedo_1	Albedo	
41161	ALB2_Up_Irr_TC	Irradiance	W/m^2
41163	ALB2_Up_BodyTemp	Body Temperature	°C
41165	ALB2_Up_ SerialNumber	Serial Number	
41167	ALB2_Up_CalDate	Calibration Date	y/m/d
41169	ALB2_Up_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
41171	ALB2_Up_Humidity	Humidity	%
41181	ALB2_Up_TiltAngle	Tilt Angle	°
41187	ALB2_Up_Status	Pyranometer Status	
41221	ALB2_Down_Irr_TC	Irradiance	W/m^2
41223	ALB2_Down_ BodyTemp	Body Temperature	°C
41225	ALB2_Down_ SerialNumber	Serial Number	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
41227	ALB2_Down_CalDate	Calibration Date	y/m/d
41229	ALB2_Down_ IrrUncompensated	Irradiance No Temp Comp	W/m^2
41231	ALB2_Down_Humidity	Humidity	%
41241	ALB2_Down_TiltAngle	Tilt Angle	°
41247	ALB2_Down_Status	Pyranometer Status	
41253	Albedo_2	Albedo	
41281	DHI1_Total_Irr	GHI Irradiance	W/m^2
41283	DHI1_Diffuse	Diffuse Irradiance	W/m^2
41285	DHI1_DNI	DNI Irradiance	W/m^2
41287	DHI1_Diffraction	Ratio DIF/GHI	
41289	DHI1_Heater_Status	Heater Power ON-OFF Status	
41341	DHI2_Total_Irr	GHI Irradiance	W/m^2
41343	DHI2_Diffuse	Diffuse Irradiance	W/m^2
41345	DHI2_DNI	DNI Irradiance	W/m^2
41347	DHI2_Diffraction	Ratio DIF/GHI	
41349	DHI2_Heater_Status	Heater Power ON-OFF Status	
41401	RPOA1_Irr_TC	Irradiance	W/m^2
41403	RPOA1_BodyTemp	Body Temperature	°C
41461	RPOA2_Irr_TC	Irradiance	W/m^2
41463	RPOA2_BodyTemp	Body Temperature	°C
41521	RPOA3_Irr_TC	Irradiance	W/m^2
41523	RPOA3_BodyTemp	Body Temperature	°C
41581	RPOA4_Irr_TC	Irradiance	W/m^2
41583	RPOA4_BodyTemp	Body Temperature	°C
41585	RPOA4_SerialNumber	Serial Number	

Table 8-1: Modbus register map			
Register	Data product/ parameter	Description	Units
41587	RPOA4_CalDate	Calibration Date	y/m/d
41641	RPOA5_Irr_TC	Irradiance	W/m^2
41643	RPOA5_BodyTemp	Body Temperature	°C
41645	RPOA5_SerialNumber	Serial Number	
41647	RPOA5_CalDate	Calibration Date	y/m/d
41701	RPOA6_Irr_TC	Irradiance	W/m^2
41703	RPOA6_BodyTemp	Body Temperature	°C
41705	RPOA6_SerialNumber	Serial Number	
41707	RPOA6_CalDate	Calibration Date	y/m/d
41761	BackOfModule1_BOM	BoM Temperature	°C
41763	BackOfModule1_ SerialNumber	Serial Number	
41765	BackOfModule1_ Counter	Counter	
41767	BackOfModule1_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41769	BackOfModule1_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
41801	BackOfModule2_BOM	BoM Temperature	°C
41803	BackOfModule2_ SerialNumber	Serial Number	
41805	BackOfModule2_ Counter	Counter	
41807	BackOfModule2_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41809	BackOfModule2_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
41841	BackOfModule3_BOM	BoM Temperature	°C

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
41843	BackOfModule3_ SerialNumber	Serial Number	
41845	BackOfModule3_ Counter	Counter	
41847	BackOfModule3_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41849	BackOfModule3_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
41881	BackOfModule4_BOM	BoM Temperature	°C
41883	BackOfModule4_ SerialNumber	Serial Number	
41885	BackOfModule4_ Counter	Counter	
41887	BackOfModule4_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41889	BackOfModule4_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
41921	BackOfModule5_BOM	BoM Temperature	°C
41923	BackOfModule5_ SerialNumber	Serial Number	
41925	BackOfModule5_ Counter	Counter	
41927	BackOfModule5_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41929	BackOfModule5_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
41961	BackOfModule6_BOM	BoM Temperature	°C
41963	BackOfModule6_ SerialNumber	Serial Number	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
41965	BackOfModule6_ Counter	Counter	
41967	BackOfModule6_ SensorStatus	Sensor Status: 0=good; 1=open/short	
41969	BackOfModule6_ RangeCheck	Range Check: 0=good/in range; 1=out of range	
42001	Weather1_AirTemp	Air Temperature	°C
42003	Weather1_RH	Relative Humidity	%
42005	Weather1_BP	Barometric Pressure	hPa
42007	Weather1_WindSpeed	Wind Speed	m/s
42009	Weather1_WindDir	Wind Direction	°
42017	Weather1_Rain	Rain within past 3 second seconds	mm
42019	Weather1_Rain_Tot	Rain 1 Minute Total	mm
42021	Weather1_Rain_Tot	Rain Hourly Total	mm
42023	Weather1_Rain_Tot	Rain Daily Total	mm
42025	Weather1_Rain_Tot	Rain 5 Minute Total	mm
42027	Weather1_Rain_Tot	Rain 10 Minute Total	mm
42029	Weather1_Rain_Tot	Rain 15 Minute Total	mm
42031	Weather1_Strikes	Lightning Strike Count	counts
42033	Weather1_ StrikeDistance	Average Lightning Strike Distance	km
42035	Weather1_Gust_ WindSpeed	Gust Speed	m/s
42037	Weather1_ PolarOrientation	Polar Orientation	°
42039	Weather1_North_ WindSpeed	Wind Speed North	m/s

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42041	Weather1_East_ WindSpeed	Wind Speed East	m/s
42043	Weather1_ XOrientation	X Direction Orientation	°
42045	Weather1_ YOrientation	Y Direction Orientation	°
42101	Weather2_AirTemp	Air Temperature	°C
42103	Weather2_RH	Relative Humidity	%
42105	Weather2_BP	Barometric Pressure	hPa
42107	Weather2_WindSpeed	Wind Speed	m/s
42109	Weather2_WindDir	Wind Direction	°
42111	Weather2_DewPoint	Dew Point	°C
42113	Weather2_CompassH	Compass Heading of North Mark	°
42115	Weather2_WindDirCor	Wind Direction Corrected	°
42201	SnowDepth1_Depth	Snow Depth	m
42203	SnowDepth1_Depth	Snow Depth 1 Hour	m
42205	SnowDepth1_Depth	Snow Depth 1 Day	m
42207	SnowDepth1_Depth	Snow Depth 5 Minute	m
42209	SnowDepth1_ AirTempC	External temperature	°C
42211	SnowDepth1_DistTarg	Uncorrected Distance to Target	m
42213	SnowDepth1_ TempCorrDistTarg	Temperature Corrected Distance to Target	m
42215	SnowDepth1_IntTemp	IntTemp	°C
42217	SnowDepth1_IntRH	IntRH	%
42219	SnowDepth1_Pitch	Pitch	°
42221	SnowDepth1_Roll	Roll	°

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42223	SnowDepth1_SupVolt	SupVolt	V
42225	SnowDepth1_ResFreq	ResFreq	kHz
42227	SnowDepth1_Alert	Alert: 1= ResFreq is out of tolerance	
42261	SnowDepth2_Depth	Snow Depth	m
42263	SnowDepth2_Depth	Snow Depth 1 Hour	m
42265	SnowDepth2_Depth	Snow Depth 1 Day	m
42267	SnowDepth2_Depth	Snow Depth 5 Minute	m
42269	SnowDepth2_ AirTempC	External temperature	°C
42271	SnowDepth2_DistTarg	Uncorrected Distance to Target	m
42273	SnowDepth2_ TempCorrDistTarg	Temperature Corrected Distance to Target	m
42275	SnowDepth2_IntTemp	IntTemp	°C
42277	SnowDepth2_IntRH	IntRH	%
42279	SnowDepth2_Pitch	Pitch	°
42281	SnowDepth2_Roll	Roll	°
42283	SnowDepth2_SupVolt	SupVolt	V
42285	SnowDepth2_ResFreq	ResFreq	kHz
42287	SnowDepth2_Alert	Alert: 1= ResFreq is out of tolerance	
42321	Rain1_Rain	Rain	mm
42323	Rain1_Tot	Rain 1 Minute Total	mm
42325	Rain1_Tot	Rain Hourly Total	mm
42327	Rain1_Tot	Rain Daily Total	mm
42329	Rain1_Tot	Rain 5 Minute Total	mm
42331	Rain1_Tot	Rain 10 Minute Total	mm
42333	Rain1_Tot	Rain 15 Minute Total	mm

Table 8-1: Modbus register map			
Register	Data product/ parameter	Description	Units
42381	Rain2_Rain	Rain	mm
42383	Rain2_Tot	Rain 1 Minute Total	mm
42385	Rain2_Tot	Rain Hourly Total	mm
42387	Rain2_Tot	Rain Daily Total	mm
42389	Rain2_Tot	Rain 5 Minute Total	mm
42391	Rain2_Tot	Rain 10 Minute Total	mm
42393	Rain2_Tot	Rain 15 Minute Total	mm
42441	Hail1_HDI_Hits	Number of Hail hits in last 30 seconds	hits
42443	Hail1_HDI_Class_Label_10	Class_Label_10	%
42445	Hail1_HDI_Class_Label_15	Class_Label_15	%
42447	Hail1_HDI_Class_Label_20	Class_Label_20	%
42449	Hail1_HDI_Class_Label_25	Class_Label_25	%
42451	Hail1_HDI_Class_Label_30	Class_Label_30	%
42453	Hail1_HDI_Class_Label_35	Class_Label_35	%
42455	Hail1_HDI_Class_Label_40	Class_Label_40	%
42457	Hail1_HDI_Class_Label_45	Class_Label_45	%
42459	Hail1_HDI_Class_Label_50	Class_Label_50	%
42461	Hail1_HDI_Class_Label_55	Class_Label_55	%

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42463	Hail1_HDI_Class_Label_60	Class_Label_60	%
42465	Hail1_HDI_Class_Label_65	Class_Label_65	%
42467	Hail1_HDI_Class_Label_70	Class_Label_70	%
42469	Hail1_HDI_Class_Label_75	Class_Label_75	%
42471	Hail1_HDI_Class_Label_99	Class_Label_99	%
42541	Hail2_HDI_Hits	Number of Hail hits in last 30 seconds	hits
42543	Hail2_HDI_Class_Label_10	Class_Label_10	%
42545	Hail2_HDI_Class_Label_15	Class_Label_15	%
42547	Hail2_HDI_Class_Label_20	Class_Label_20	%
42549	Hail2_HDI_Class_Label_25	Class_Label_25	%
42551	Hail2_HDI_Class_Label_30	Class_Label_30	%
42553	Hail2_HDI_Class_Label_35	Class_Label_35	%
42555	Hail2_HDI_Class_Label_40	Class_Label_40	%
42557	Hail2_HDI_Class_Label_45	Class_Label_45	%
42559	Hail2_HDI_Class_Label_50	Class_Label_50	%

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42561	Hail2_HDI_Class_ Label_55	Class_Label_55	%
42563	Hail2_HDI_Class_ Label_60	Class_Label_60	%
42565	Hail2_HDI_Class_ Label_65	Class_Label_65	%
42567	Hail2_HDI_Class_ Label_70	Class_Label_70	%
42569	Hail2_HDI_Class_ Label_75	Class_Label_75	%
42571	Hail2_HDI_Class_ Label_99	Class_Label_99	%
42641	Soiling1_DustIQ_ SoilingRatio1	Soiling Ratio 1	%
42643	Soiling1_DustIQ_ TxLoss1	Transmission Loss 1	%
42645	Soiling1_DustIQ_ SoilingRatio2	Soiling Ratio 2	%
42647	Soiling1_DustIQ_ TxLoss2	Transmission Loss 2	%
42649	Soiling1_DustIQ_Data_ Model	Data Model Version	
42651	Soiling1_DustIQ_ Software_Version	Software Version	
42653	Soiling1_DustIQ_ Serial_Number	Serial Number	
42655	Soiling1_DustIQ_Cal_ Year	Cal Year	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42657	Soiling1_DustIQ_Cal_ Month	Cal Month	
42659	Soiling1_DustIQ_Cal_ Day	Cal Day	
42661	Soiling1_DustIQ_TiltX	Tilt X	°
42663	Soiling1_DustIQ_TiltY	Tilt Y	°
42665	Soiling1_DustIQ_ BackPanel_Temp	Back Panel Temperature	°C
42667	Soiling1_DustIQ_ Device_Voltage	Device Voltage	V
42669	Soiling1_DustIQ_ Status_Flags	Device Status Flags	
42671	Soiling1_DustIQ_ Calibration_readiness	Calibration Status Before	
42673	Soiling1_DustIQ_ Calibration_ completion	Calibration Status After	
42741	Soiling2_DustIQ_ SoilingRatio1	Soiling Ratio 1	%
42743	Soiling2_DustIQ_ TxLoss1	Transmission Loss 1	%
42745	Soiling2_DustIQ_ SoilingRatio2	Soiling Ratio 2	%
42747	Soiling2_DustIQ_ TxLoss2	Transmission Loss 2	%
42749	Soiling2_DustIQ_Data_ Model	Data Model Version	
42751	Soiling2_DustIQ_ Software_Version	Software Version	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42753	Soiling2_DustIQ_ Serial_Number	Serial Number	
42755	Soiling2_DustIQ_Cal_ Year	Cal Year	
42757	Soiling2_DustIQ_Cal_ Month	Cal Month	
42759	Soiling2_DustIQ_Cal_ Day	Cal Day	
42761	Soiling2_DustIQ_TiltX	Tilt X	°
42763	Soiling2_DustIQ_TiltY	Tilt Y	°
42765	Soiling2_DustIQ_ BackPanel_Temp	Back Panel Temperature	°C
42767	Soiling2_DustIQ_ Device_Voltage	Device Voltage	V
42769	Soiling2_DustIQ_ Status_Flags	Device Status Flags	
42771	Soiling2_DustIQ_ Calibration_readiness	Calibration Status Before	
42773	Soiling2_DustIQ_ Calibration_ completion	Calibration Status After	
42841	Soiling1_DustVue_ SoilingRatio	Soiling Ratio	
42843	Soiling1_DustVue_ SLossIdx	Soiling Loss Index	%
42845	Soiling1_DustVue_ SoilingLossIndexIsc	Soiling Loss Index Isc	
42847	Soiling1_DustVue_ Minutebeat	Heartbeat	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42849	Soiling1_DustVue_ IscTest	Isc Test	
42851	Soiling1_DustVue_ IscRef	Isc Ref	
42853	Soiling1_DustVue_ TempTest	Temp Test	
42855	Soiling1_DustVue_ TempRef	Temp Ref	
42857	Soiling1_DustVue_ GeffTest	Geff Test	
42859	Soiling1_DustVue_ GeffRef	Geff Ref	
42861	Soiling1_DustVue_ RefPanelWashed	Ref Panel Washed	
42863	Soiling1_DustVue_ OffsetGeff	Offset Geff	
42865	Soiling1_DustVue_ OffsetIsc	Offset Isc	
42867	Soiling1_DustVue_ UpdateOffset	Update Offset	
42869	Soiling1_DustVue_ UTC_Offset_UsrEnt	UTC Offset User Entered	
42871	Soiling1_DustVue_ Latitude_UsrEnt	Latitude User Entered	
42873	Soiling1_DustVue_ Longitude_UsrEnt	Longitude User Entered	
42875	Soiling1_DustVue_ TempCoefIscTest_ UsrEnt	Temp Coefficient Isc Test User Entered	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42877	Soiling1_DustVue_ TempCoefIscRef_ UsrEnt	Temp Coefficient Isc Ref User Entered	
42879	Soiling1_DustVue_ IscTeststc_UsrEnt	Isc Test STC User Entered	
42881	Soiling1_DustVue_ IscRefstc_UsrEnt	Isc Ref STC User Entered	
42883	Soiling1_DustVue_ SolNoonOffset_UsrEnt	Solar Noon OFfset User Entered	
42885	Soiling1_DustVue_ GeffThreshold_UsrEnt	Geff Threshold User Entered	
42887	Soiling1_DustVue_ RTU_Voltage	RTU Voltage	
42889	Soiling1_DustVue_ RTU_Internal_Temp	RTU Internal Temperature	
42891	Soiling1_DustVue_ LocalSolarNoon	Local Solar Noon	
42893	Soiling1_DustVue_ ClnPanelWashed_Yr	Clean Panel Washed Year	
42895	Soiling1_DustVue_ ClnPanelWashed_Mon	Clean Panel Washed Month	
42897	Soiling1_DustVue_ ClnPanelWashed_Day	Clean Panel Washed Day	
42899	Soiling1_DustVue_ DirtyAndClnWashed_ Yr	Dirty and Clean Washed Year	
42901	Soiling1_DustVue_ DirtyAndClnWashed_ Mon	Dirty and Clean Washed Month	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42903	Soiling1_DustVue_ DirtyAndClnWashed_ Day	Dirty and Clean Washed Day	
42941	Soiling2_DustVue_ SoilingRatio	Soiling Ratio	
42943	Soiling2_DustVue_ SLossIdx	Soiling Loss Index	%
42945	Soiling2_DustVue_ SoilingLossIndexIsc	Soiling Loss Index Isc	
42947	Soiling2_DustVue_ Minutebeat	Heartbeat	
42949	Soiling2_DustVue_ IscTest	Isc Test	
42951	Soiling2_DustVue_ IscRef	Isc Ref	
42953	Soiling2_DustVue_ TempTest	Temp Test	
42955	Soiling2_DustVue_ TempRef	Temp Ref	
42957	Soiling2_DustVue_ GeffTest	Geff Test	
42959	Soiling2_DustVue_ GeffRef	Geff Ref	
42961	Soiling2_DustVue_ RefPanelWashed	Ref Panel Washed	
42963	Soiling2_DustVue_ OffsetGeff	Offset Geff	
42965	Soiling2_DustVue_ OffsetIsc	Offset Isc	

Table 8-1: Modbus register map			
Register	Data product/ parameter	Description	Units
42967	Soiling2_DustVue_ UpdateOffset	Update Offset	
42969	Soiling2_DustVue_ UTC_Offset_UsrEnt	UTC Offset User Entered	
42971	Soiling2_DustVue_ Latitude_UsrEnt	Latitude User Entered	
42973	Soiling2_DustVue_ Longitude_UsrEnt	Longitude User Entered	
42975	Soiling2_DustVue_ TempCoefIscTest_ UsrEnt	Temp Coefficient Isc Test User Entered	
42977	Soiling2_DustVue_ TempCoefIscRef_ UsrEnt	Temp Coefficient Isc Ref User Entered	
42979	Soiling2_DustVue_ IscTeststc_UsrEnt	Isc Test STC User Entered	
42981	Soiling2_DustVue_ IscRefstc_UsrEnt	Isc Ref STC User Entered	
42983	Soiling2_DustVue_ SolNoonOffset_UsrEnt	Solar Noon OFfset User Entered	
42985	Soiling2_DustVue_ GeffThreshold_UsrEnt	Geff Threshold User Entered	
42987	Soiling2_DustVue_ RTU_Voltage	RTU Voltage	
42989	Soiling2_DustVue_ RTU_Internal_Temp	RTU Internal Temperature	
42991	Soiling2_DustVue_ LocalSolarNoon	Local Solar Noon	
42993	Soiling2_DustVue_ ClnPanelWashed_Yr	Clean Panel Washed Year	

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
42995	Soiling2_DustVue_ ClnPanelWashed_Mon	Clean Panel Washed Month	
42997	Soiling2_DustVue_ ClnPanelWashed_Day	Clean Panel Washed Day	
42999	Soiling2_DustVue_ DirtyAndClnWashed_ Yr	Dirty and Clean Washed Year	
43001	Soiling2_DustVue_ DirtyAndClnWashed_ Mon	Dirty and Clean Washed Month	
43003	Soiling2_DustVue_ DirtyAndClnWashed_ Day	Dirty and Clean Washed Day	
44001	Soiling1_RED300i_ RED300i_Ldr_PI_Pmax	10 min Performance Index Pmax	
44003	Soiling1_RED300i_Ldr_ PI_Isc	10 min Performance Index Isc	
44005	Soiling1_RED300i_Ldr_ PI_PmaxAvg	24 hr Performance Index Pmax Avg	
44007	Soiling1_RED300i_Ldr_ PI_IscAvg	24 hr Performance Index Isc Avg	
44009	Soiling1_RED300i_Ldr_ status	RDE300i Leader Status	
44011	Soiling1_RED300i_Ldr_ eCode	RDE300i Leader Error Code	
44013	Soiling1_RED300i_Ldr_ modI	Ldr_modI	A
44015	Soiling1_RED300i_Ldr_ modV	Ldr_modV	V

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
44017	Soiling1_RED300i_Ldr_strI	Ldr_strI	A
44019	Soiling1_RED300i_Ldr_strV	Ldr_strV	V
44021	Soiling1_RED300i_Ldr_modTemp	Ldr_modTemp	°C
44023	Soiling1_RED300i_Ldr_rtdTemp	Ldr_rtdTemp	°C
44025	Soiling1_RED300i_Ldr_modPmax	modPmax	W
44027	Soiling1_RED300i_Ldr_modImp	modImp	A
44029	Soiling1_RED300i_Ldr_modVmp	modVmp	V
44031	Soiling1_RED300i_Ldr_modIsc	modIsc	A
44033	Soiling1_RED300i_Ldr_modVoc	modVoc	V
44035	Soiling1_RED300i_Ldr_modIrradiance	modIrradiance	W/m^2
44037	Soiling1_RED300i_Ldr_frntIrrUncorr	frntIrradianceUncorr	W/m^2
44039	Soiling1_RED300i_Ldr_frntIrrCorr	frntIrradianceCorr	W/m^2
44041	Soiling1_RED300i_Ldr_rearIrrUncorr	rearIrradianceUncorr	W/m^2
44043	Soiling1_RED300i_Ldr_totalEffectIrr	totalEffectiveIrradiance	W/m^2

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
44045	Soiling1_RED300i_Ldr_sweepID	sweepID	
44201	Soiling1_RED300i_Fwr_pmaxPI	pmaxPI	
44203	Soiling1_RED300i_Fwr_iscPI	iscPI	
44205	Soiling1_RED300i_Fwr_pmaxPIavg	pmaxPIavg	
44207	Soiling1_RED300i_Fwr_iscPIavg	iscPIavg	
44209	Soiling1_RED300i_Fwr_status	Status	
44211	Soiling1_RED300i_Fwr_eCode	Error Code	
44213	Soiling1_RED300i_Fwr_modI	Fwr_modI	A
44215	Soiling1_RED300i_Fwr_modV	Fwr_modV	V
44217	Soiling1_RED300i_Fwr_strI	Fwr_strI	A
44219	Soiling1_RED300i_Fwr_strV	Fwr_strV	V
44221	Soiling1_RED300i_Fwr_modTemp	Fwr_modTemp	°C
44223	Soiling1_RED300i_Fwr_rtdTemp	Fwr_rtdTemp	°C
44225	Soiling1_RED300i_Fwr_modPmax	modPmax	W

Table 8-1: Modbus register map

Register	Data product/ parameter	Description	Units
44227	Soiling1_RED300i_Fwr_ modImp	modImp	A
44229	Soiling1_RED300i_Fwr_ modVmp	modVmp	V
44231	Soiling1_RED300i_Fwr_ modIsc	modIsc	A
44233	Soiling1_RED300i_Fwr_ modVoc	modVoc	V
44235	Soiling1_RED300i_Fwr_ modIrradiance	modIrradiance	W/m^2

Appendix A. Replacement parts

Table A-1: Replacement parts

Component	Item	Additional description/information	Frequency
CR1000XE	3768 2-Pin Screw Terminal Plug Connector .2 inch pitch Straight Wire Entry 12-24 AWG Green Marked G 12V		As needed
CR1000XE	6554 Desiccant 1/6 Unit Bag	Enclosure accessories and items	As needed
CR1000XE	6044 Grommet for #6 or #8 Screw	Enclosure accessories and items	As needed
CR1000XE	505 Screw #6-32 x .375 Pan Phillips	Enclosure accessories and items	As needed
CR1000XE	8125 Flat-bladed Screwdriver, RS PRO SL2.5X60	Tools	As needed
CR1000XE	27555 USB 2.0 Cable Type A Pin (Male) to Micro B Pin (Male), 6/6.5ft	USB Cable	As needed
CR1000XE	10645 Screw #10-32 x .312 Pan Slot Brass	Ground lug	As needed
CR1000XE	30028 3.6V 2.4Ahr Lithium Battery AA	Logger battery	2-3 Years
CR1000XE	31676 CR1000X Replacement Connectors Analog Input 1-4	Replacement connectors on wiring panel	As needed
CR1000XE	31677 CR1000X Replacement Connectors Analog Input 5-8	Replacement connectors on wiring panel	As needed
CR1000XE	31678 CR1000X Replacement Connectors Power Out & Communications		As needed
SR30	39591	Glare screen for down facing albedo	As needed
SMP-series	SB-1119	Glare screen for down facing albedo	As needed

Table A-1: Replacement parts

Component	Item	Additional description/information	Frequency
MS-series	Call for quotation	Glare screen for down facing albedo	As needed
Solar sensor mounts	27522	Threadlocker Vibra-Tite VC3 1.0 ml Pouch	As needed
TE525	CM270 TE525, TE525MM, or TE525WS Rain Gage Mounting Kit - 20621	Mounting kit for rain gage	As needed
TE525	13818 TE525 Replacement Screen - 13818		As needed
TE525	30278 TE525 Replacement Funnel / Collector w/Screen & Snap Ring - 30278		As needed
TE525	33735 Knurled-Head Thumb Screw #8-32 x .375 Low-Profile SS - 33735		As needed
TE525	30272 Replacement Reed Switch w/o Terminal Lugs for TE525, TE525MM< or TE525WS Serial# 55225-13 or Greater - 30272		As needed
Main met enclosure	39112 DIN Rail Terminal Kit Containing 1 21329 Terminal, 1 End Cover w/Black, White, & Clear Wires - 39112	Additional terminal strip items	As needed
Main met enclosure	39643 RS-485 DIN Rail Terminal Bus Kit w/o Mounting - 39643	Additional terminal strip items	As needed
Main met enclosure	39120 DIN Rail Terminal Kit Containing 2 21329 Terminals, 1 End Cover w/Black, Green, Red, White, and Clear Wires - 39120	Additional terminal strip items	As needed
CS241DM	39349 T Coupler M12 Male/M12 Female Straight - 39349	For daisy chaining CS241DM	As needed
CS241DM	35154 3M Extreme Sealing Tape 4411N Clear Flashing Tape, (-40F to 200F), 1.5 inch X 5 yard roll, 40 mil Thick - 35154	For adhering CS-241 series sensors	As needed
CS241DM	39643 RS-485 DIN Rail Terminal Bus Kit w/o Mounting - 39643	Additional terminal strip items	As needed

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.

CAMPBELL SCIENTIFIC EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF

MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell Scientific hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the products, whether express, implied, or statutory, other than those expressly provided herein.

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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