User's Guide

RC22M

Irradiance, Temperature, and Wind Measurement System

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1 System Overview

The RC22M PV Reference Cell (part number 830323-01), shown in **Figure 1-1**, is an enhanced version of the RC22 PV Reference Cell, providing additional inputs for measuring wind speed, ambient temperature, and/or back of module temperature.

Key features include:

- Irradiance, wind speed, back-of-module temperature, and/or ambient temperature measurements, all in one small package with simplified mounting features
- Accurate irradiance measurements from 0 to 15000 W/m^2, thanks to high and low irradiance scales with auto-ranging and calibrations at both 1000 W/m^2 (STC) and 135 W/m^2 (BSTC)
- Unique glass-to-edge feature which allows water roll-off and eliminates excess soiling vs. conventional cells, increasing accuracy
- Inputs for one wind speed sensor and two Pt1000 RTD external temperature sensors, which can include ambient temperature and/or back-of-module temperature
- Digital output via Modbus RTU protocol over RS485
- Overmolded cables available in multiple lengths
- IP67-rated for outdoor use

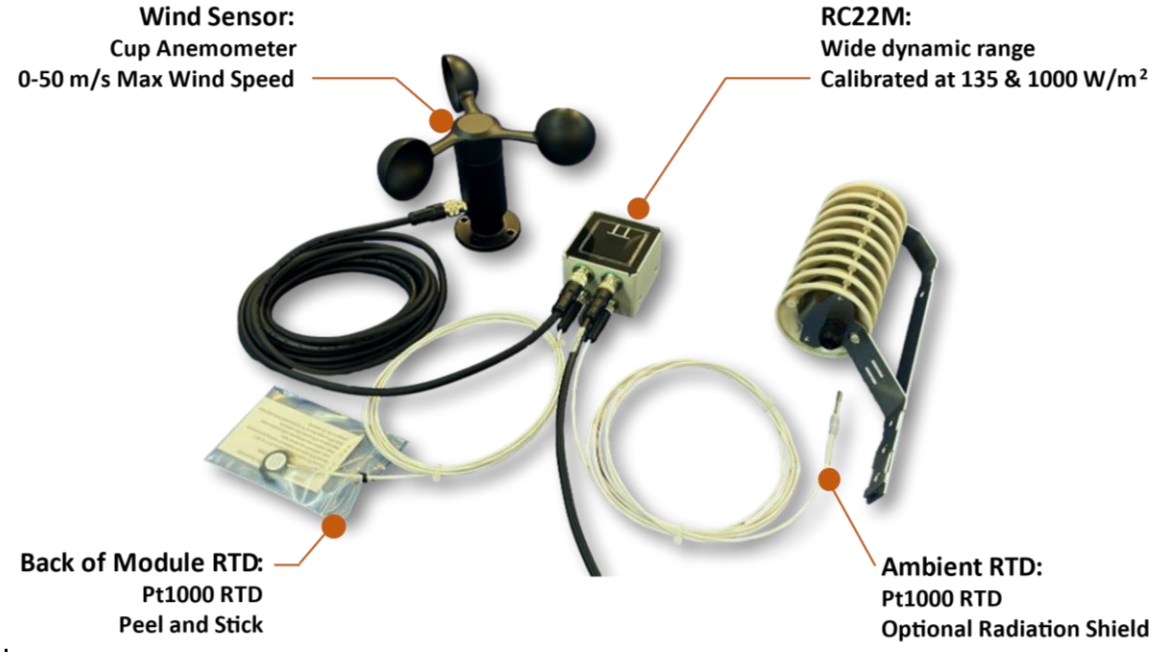


Figure 1-1: RC22M PV reference cell (830323-01) with wind and temperature options

2 Quick Start

Mount and Wire:

- Mount the RC22M in its installation location. Ensure the RC22M is parallel to the plane-of-array of your PV system. Refer to **Section 3.2** for different RC22M mounting solutions.
- Mount the optional Pt1000 RTDs and/or the optional Wind Sensor, if equipped. Refer to **Sections 4.2, 5.2, and 6.2** for mounting instructions for these accessories. Connect the accessories to the RC22M.
- Cover any unused ports on RC22M with the included port caps.

Configure:

- Obtain the RC-MT Configuration Manager software from support.atonometrics.com
- Connect to RC22M with an Atonometrics Configuration Kit (810276). Refer to **Section 7.2** for more details on the Configuration Kit and how to connect to your device.
- Set your desired RC22M communication parameters (Modbus Address, Baud Rate, and Data Format) in the Settings tab of RC-MT Configuration Manager. Refer to **Section 7.5** for more details.
- If you have the optional wind sensor, configure the wind sensor part number in your RC22M using the drop-down box in the Settings tab of the configuration manager software. Refer to **Section 7.6** for more details.
- Verify that measurements in the Outputs tab of the configuration manager are updating.
- Disconnect the configuration kit from your RC22M.

Connect to Data Logging System

- Connect your RC22M to power and to your data logging system.
- Refer to **Section 3.3** for more information on RC22M power requirements and 830303 power and communication cables and wiring.

System setup is now complete.

3 RC22M

3.1 Unpacking

Figure 3-1 shows an RC22M unit with its shipping box and contents.

Each unit includes a Standard Mounting Plate pre-attached in the bottom-mount configuration, a Calibration Certificate and Calibration Report, and caps to cover unused ports.

See **Section 3.2** for alternate mounting configurations.

Optional mounts, configuration tools, Pt1000 RTDs, and Wind Sensors are sold separately from RC22M. See separate sections in this user guide for more information.

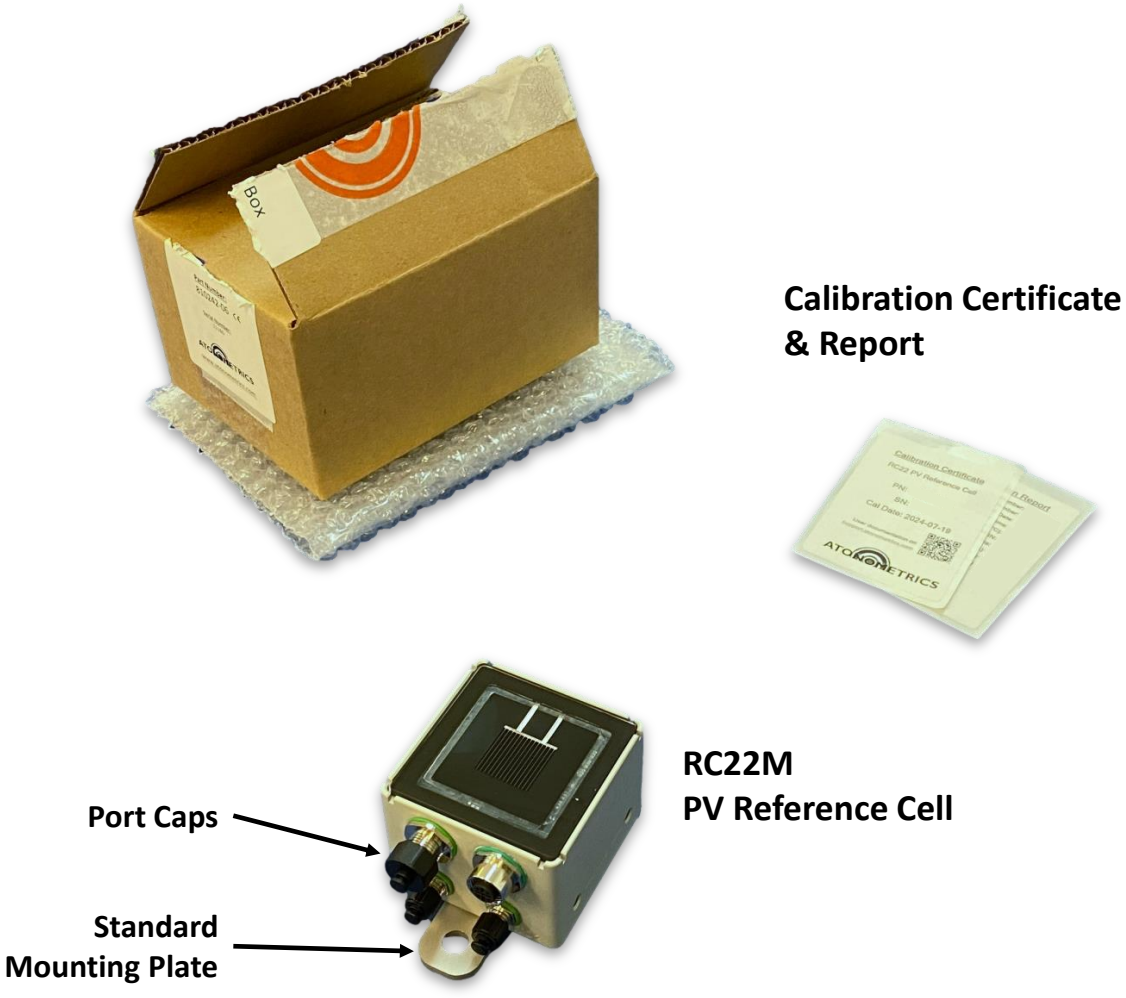


Figure 3-1 : Unpacking your RC22M unit

3.2 Mounting

3.2.1 Orientation

To minimize the potential for water entry via the connectors, please mount the RC22M unit with its cable facing down or to the side, as shown in **Figure 3-2**. Avoid mounting with the cable facing up, unless mounted on the rear side of the PV plane of array.

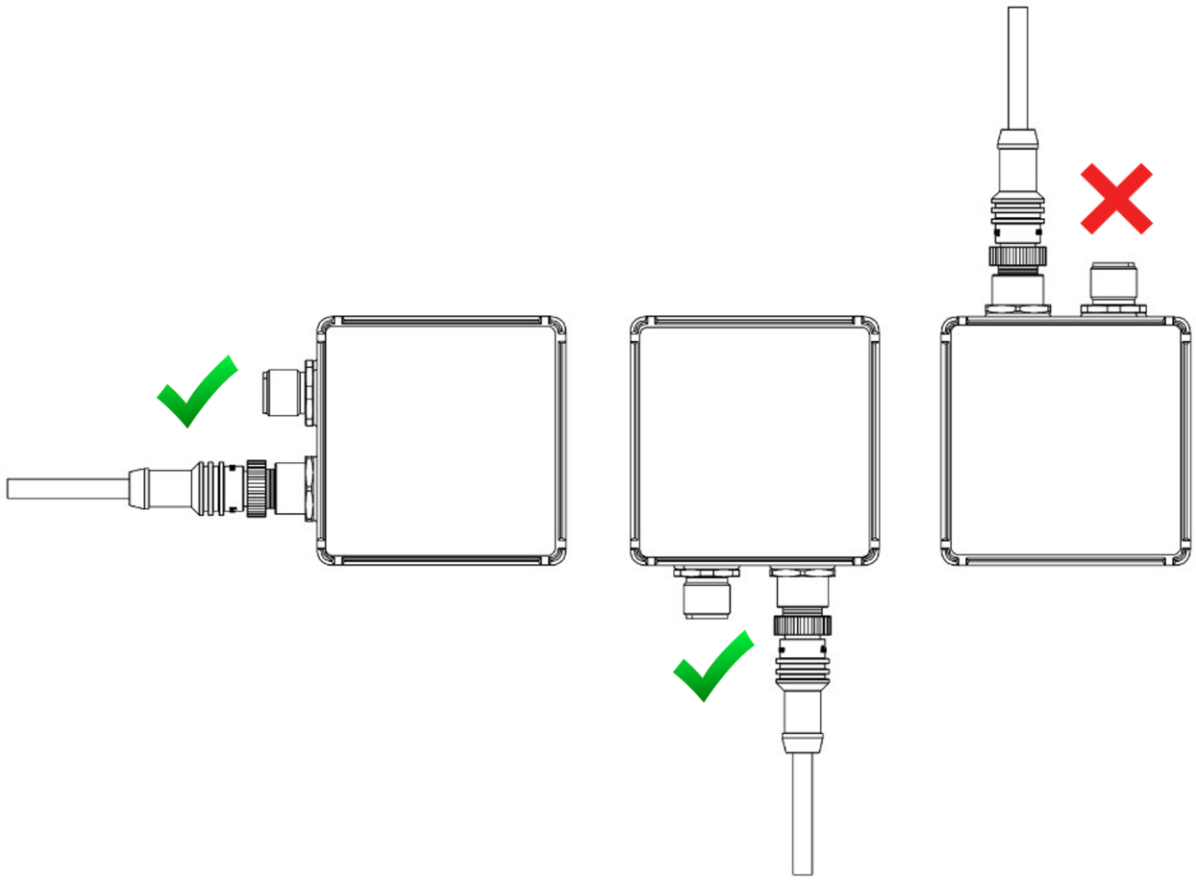


Figure 3-2 : Mount with cables down or to the side if possible

3.2.2 Standard Mounting Plate

The RC22M Standard Mounting Plate (610494) is shipped with every RC22M unit and will be pre-mounted as shown in **Figure 3-3**. The plate can be mounted in two orientations on the bottom, as shown in **Figure 3-3**, and two orientations on either side of the housing, as shown in **Figure 3-4**. Remove and reposition the plate as desired.

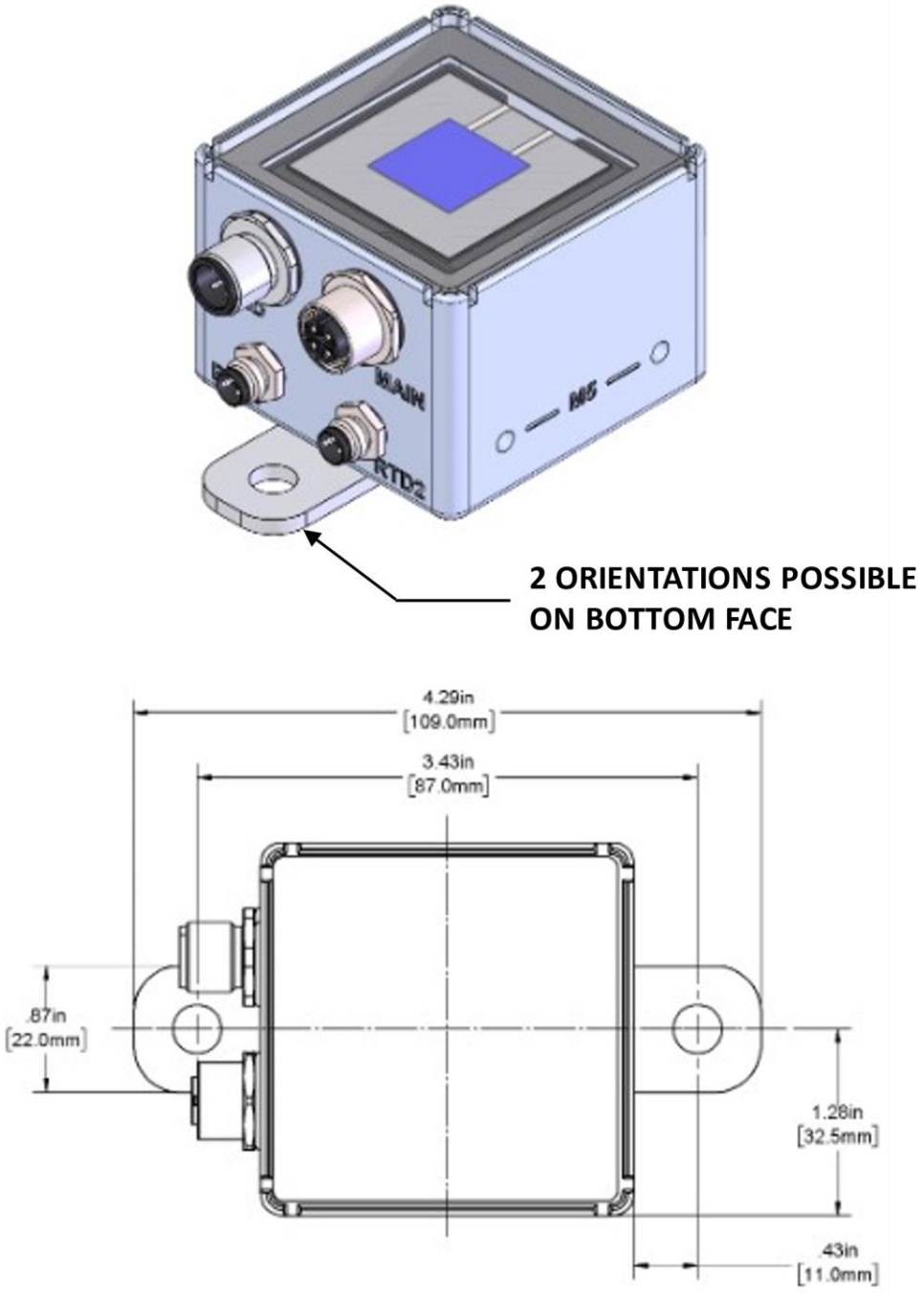
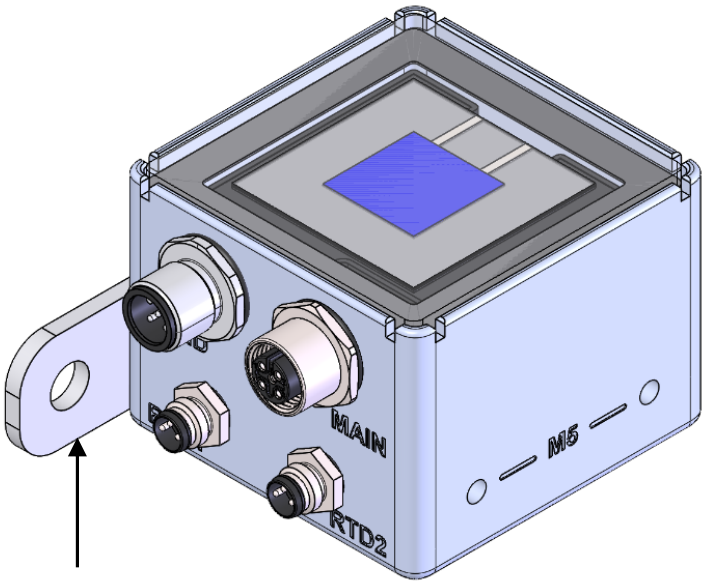


Figure 3-3 : Bottom mount configuration



MOUNT ON EITHER SIDE OF ENCLOSURE

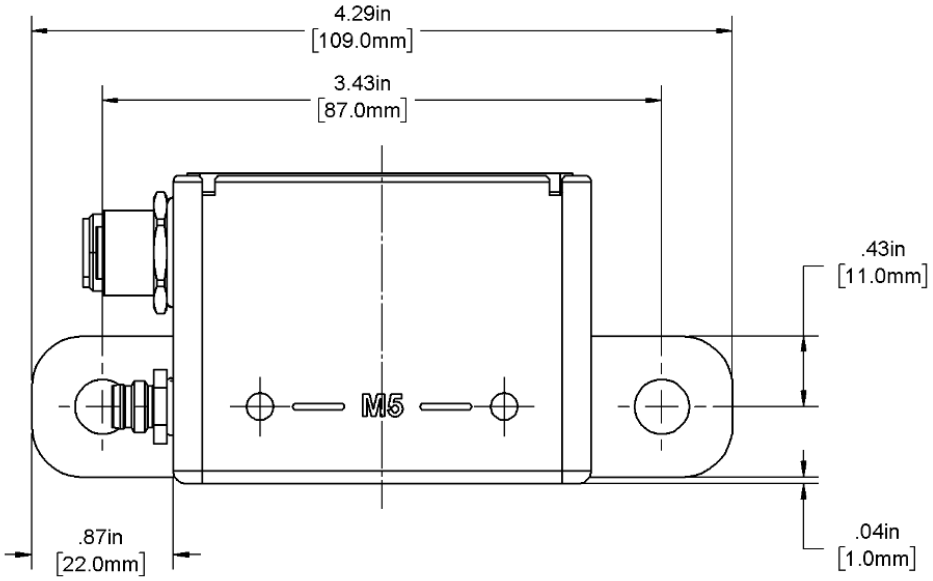


Figure 3-4: Side mount configuration

3.2.3 Mars-RC22M Mounting Bracket Kit

The Mars-RC22M Mounting Bracket (810331), sold separately, enables the user to mount RC22M to the Mars Optical Soiling Sensor, as shown in **Figure 3-5**, for convenient measurement of both irradiance and soiling.

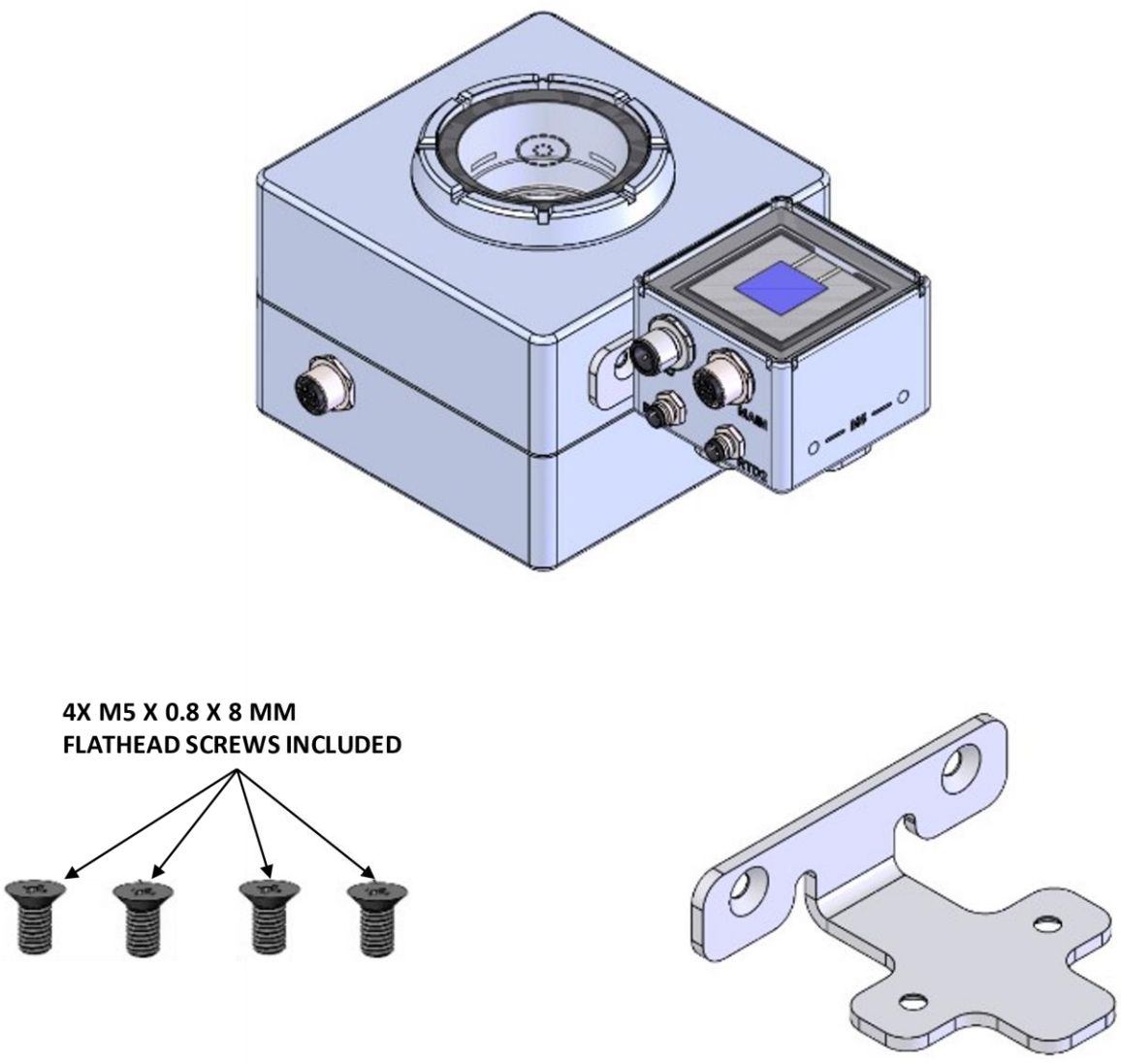


Figure 3-5: Mars-RC22M mounting bracket kit (810331)

3.2.4 Rear-Side Module Clamp

The RC22M Rear-Side Module Clamp Kit (810302)**,** sold separately, is used to mount RC22M on the rear side of a bifacial PV module to measure rear plane-of-array irradiance. See **Figure 3-6**. Mount the clamp to your RC22M unit with the two included M5 screws, then clamp it anywhere onto the rear side of a module frame overlapping the frame area between two modules.

Note: For rear plane-of-array irradiance-only applications, we recommend using RC22 instead of RC22M due to lower profile height.

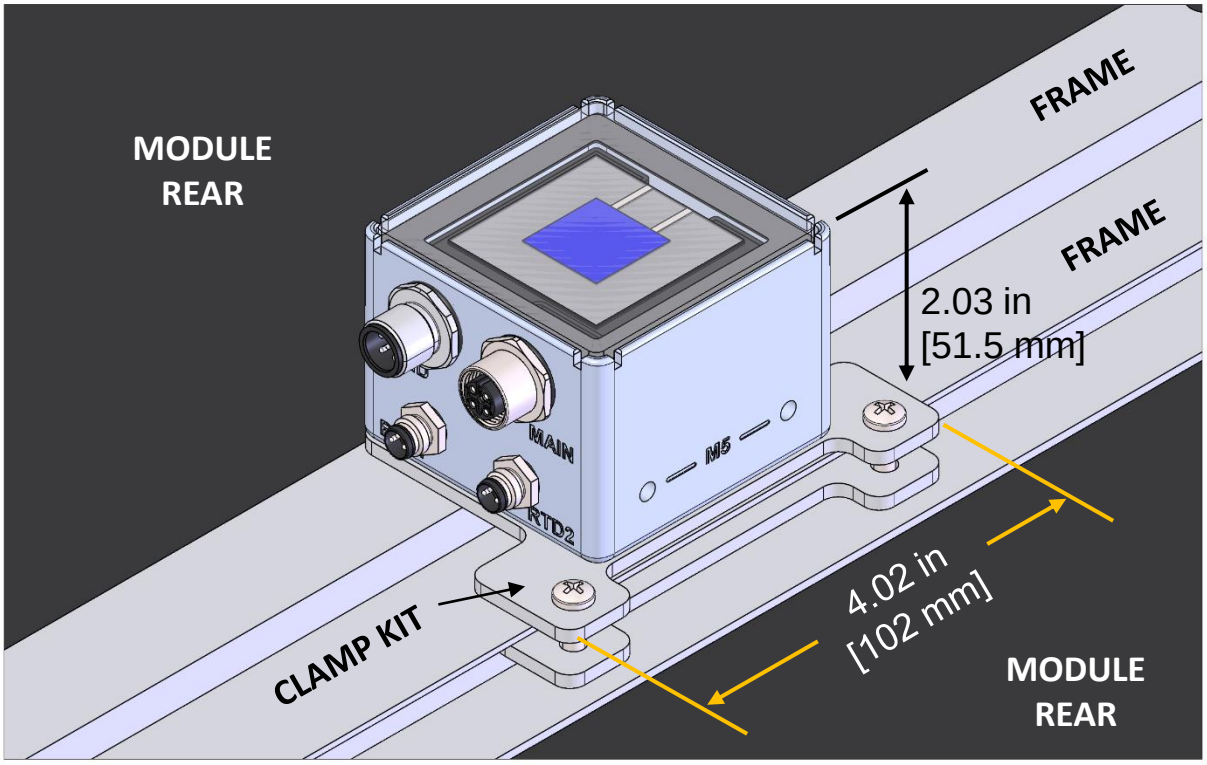


Figure 3-6: RC22M rear-side module clamp kit (810302)

3.2.5 Additional Options

The Dual Mounting Plate (610533), sold separately, can be used to mount one or two RC22M or RC22 units as shown on the left in **Figure 3-7**. This plate is ideal for mounting on customer-supplied purlins or purlin extensions such as angle extrusion or Unistrut. Mount RC22M or RC22 units to the plate using the M5 x 0.8 x 8mm flathead screws originally included with the device.

The Tube Mounting Plate (610493), sold separately, can be used to mount RC22M or RC22 to tubes such as meteorological station crossarms, as shown on the right in **Figure 3-7**. Mount RC22M or RC22 to the plate using the M5 x 0.8 x 8mm flathead screws originally included with the device.

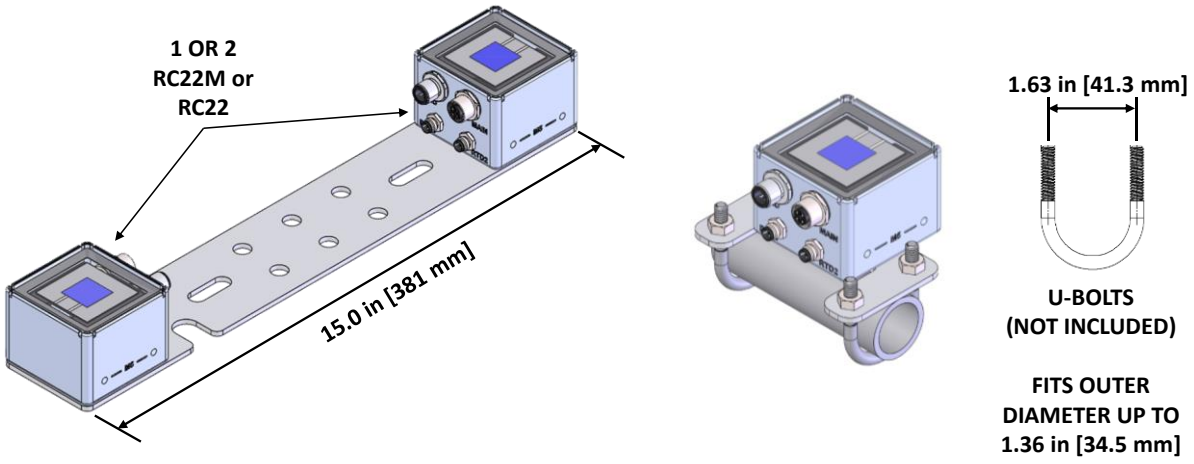


Figure 3-7: Left: dual mounting plate (610533). Right: Tube mounting plate (610493)

3.2.6 Dimensions & Mounting Holes

Figure 3-8 shows the RC22M dimensions and **Figure 3-9** illustrates its mounting hole options.

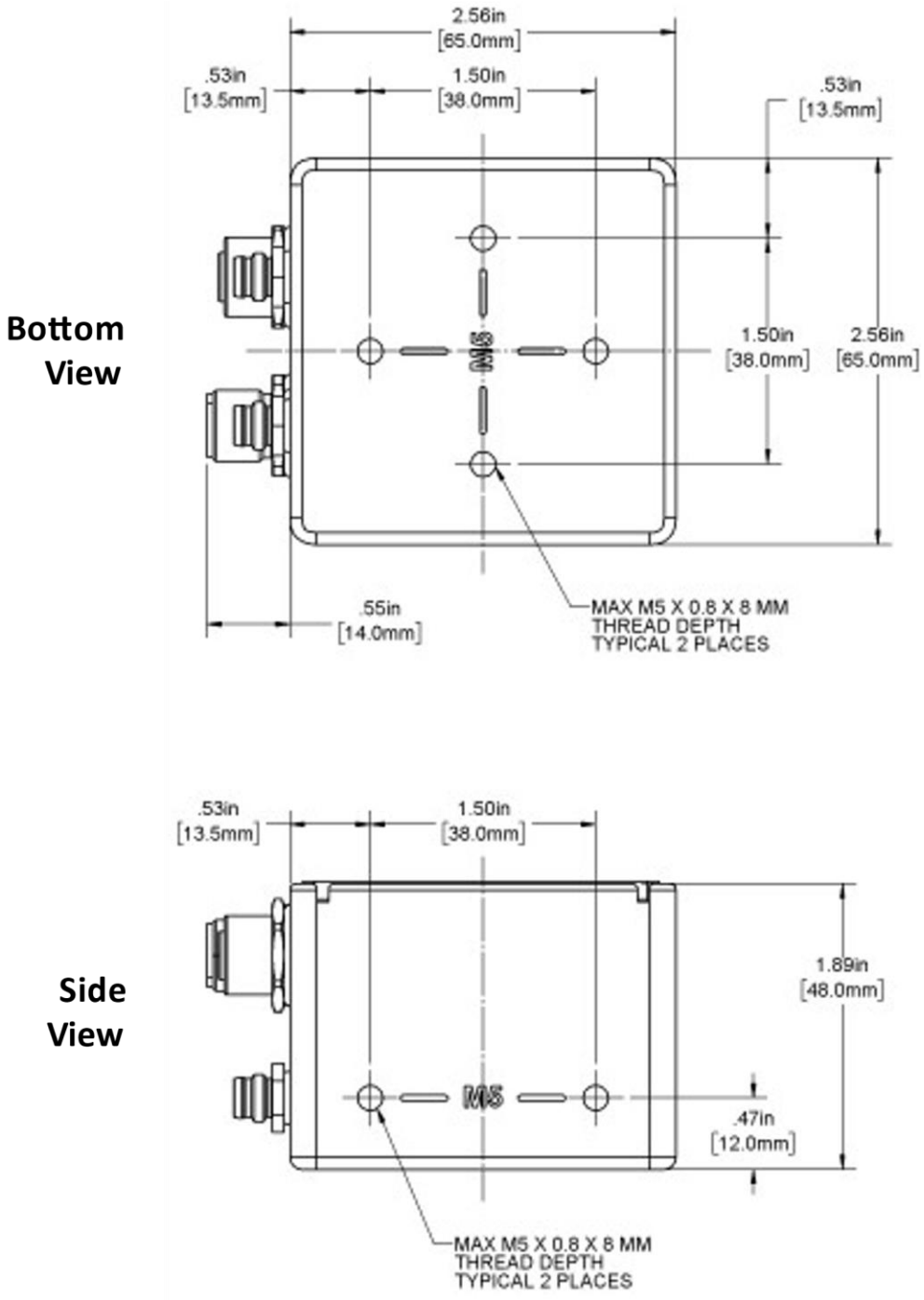


Figure 3-8 : RC22M dimensions

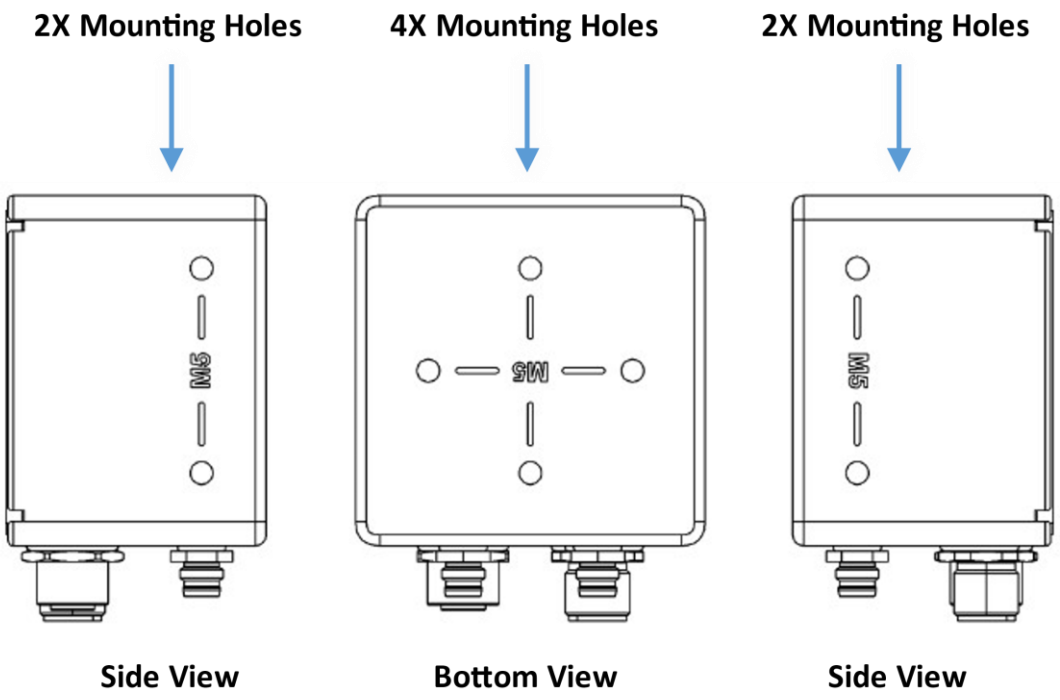


Figure 3-9 : Mounting holes for M5 screws

3.3 Wiring

3.3.1 Connectors

RC22M's connector ports, shown in **Figure 3-10**, are as follows:

- MAIN, for input power and RS485 communication
- WIND, for the optional wind sensor
- RTD1 and RTD2, each for optional ambient or back-of-module RTDs

Optional connector ports are shipped with port caps installed, as shown in **Figure 3-1**.

Note: Leave port caps installed on all unused connector ports to prevent water entry.

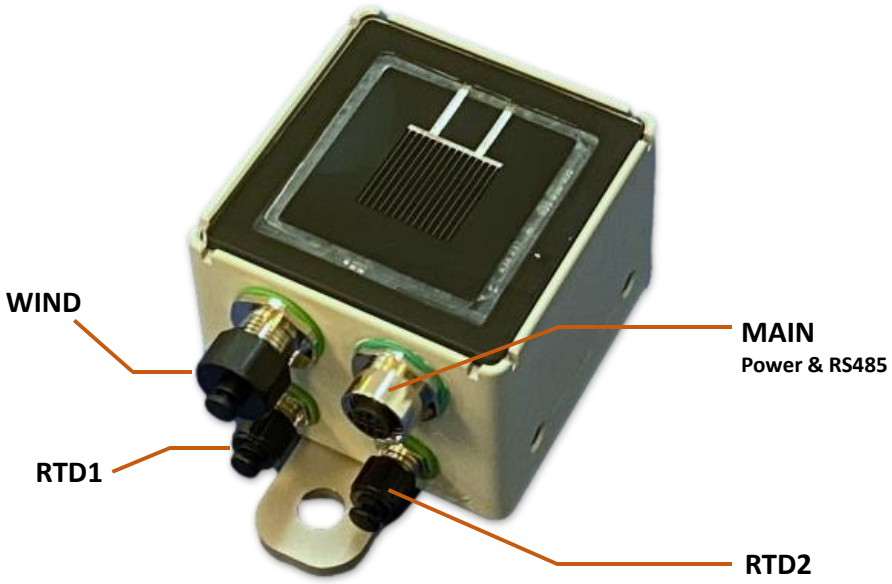


Figure 3-10: Connector inputs for RC22M

3.3.2 Power

The RC22M unit accepts 10-30 VDC and typically draws ~6 mA in operation without a wind sensor. With a wind sensor activated and connected, current draw is <60 mA.

3.3.3 Cables

Power and RS485 communication cables 830303 are listed in **Table 3-1**. Conductors are 24 AWG. Wire colors shown in **Figure 3-11**.

Note: Use only Atonometrics-supplied connectors or cables. Although other connectors may appear to fit, use of non-approved components may result in water penetration.

Note: When using long cables, power supply voltage must be high enough to account for voltage drops over the 24 AWG conductors. Consider all devices on the power bus.

Note: When using cables 50 m or longer, insert an 830331 RS485 termination cable between the 830303 cable and the RC22M to suppress RS485 signal reflections.

Note: The 830303 cables include an additional wire (blue) not used for the RC22M product.

WARNING: Check all wiring before turning on power. Incorrect wiring may damage the unit and/or your other equipment.

Table 3-1 : Power and communication cables (sold separately)

Length	830303 Power & RS485 M12 5-pin / Bare Wire	Power Supply Minimum Voltage	830331 RS485 Termination Required?
4 m	830303-004	12 VDC	No
10 m	830303-010	12 VDC	No
25 m	830303-025	12 VDC	No
50 m	830303-050	24 VDC	Yes
100 m	830303-100	24 VDC	Yes

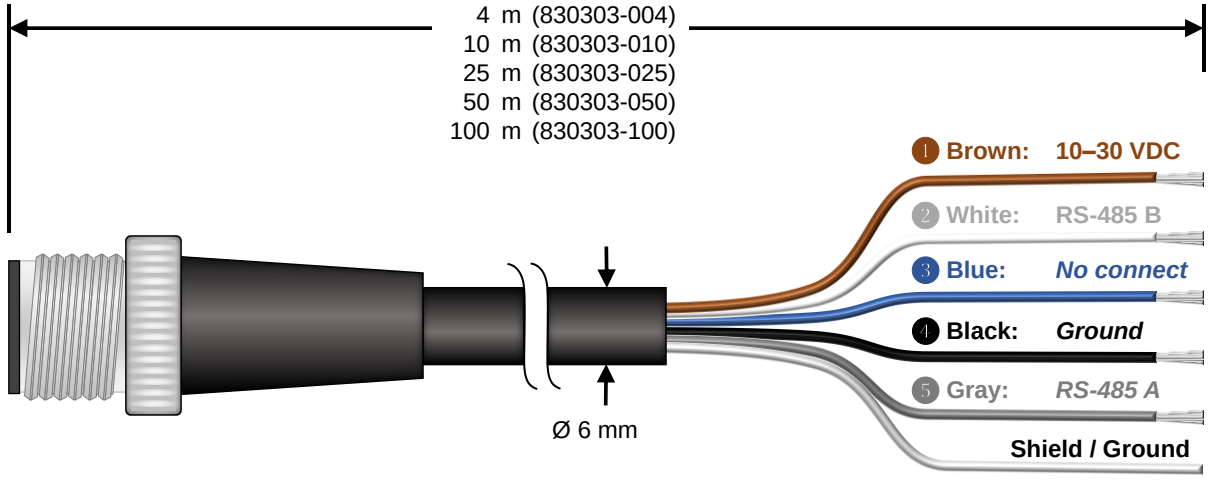


Figure 3-11: Wire colors for 830303 M12 power & RS485 cable

Protect any unused wires on the 830303 cable from accidental contact by cutting to unequal lengths, folding back, and insulating, as shown in **Figure 3-12**.

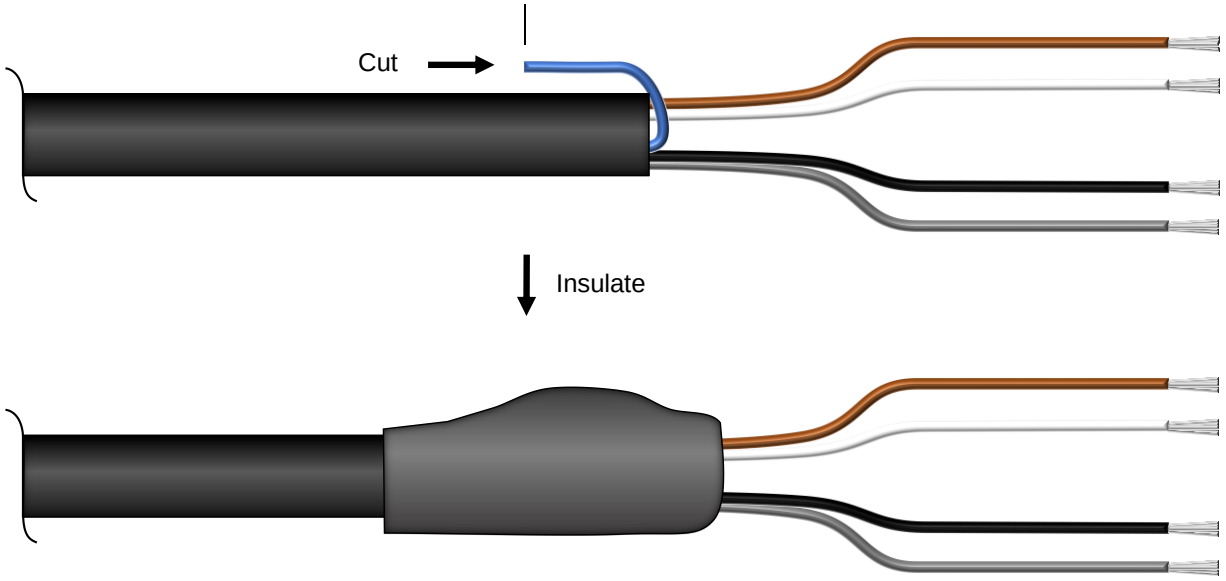


Figure 3-12: Protecting unused wires from accidental contact

4 Back-of-Module RTD

The optional back-of-module RTD, ordered separately, is a self-adhesive Pt1000 RTD for measuring a PV module temperature. The RTD has a 3-meter cable and overmolded M8 connector for easy attachment to the RC22M. For information on cable extensions contact Atonometrics.

4.1 Unpacking

As shown in **Figure 4-1**, the self-adhesive RTD probe (230056-03) is packaged together with an alcohol wipe and an installation instruction card as a kit (810297).

Figure 4-1 : Self-adhesive back-of-module Pt1000 RTD kit (810297)

4.2 Mounting

Follow the installation instructions card to adhere the RTD to the back side of your module.

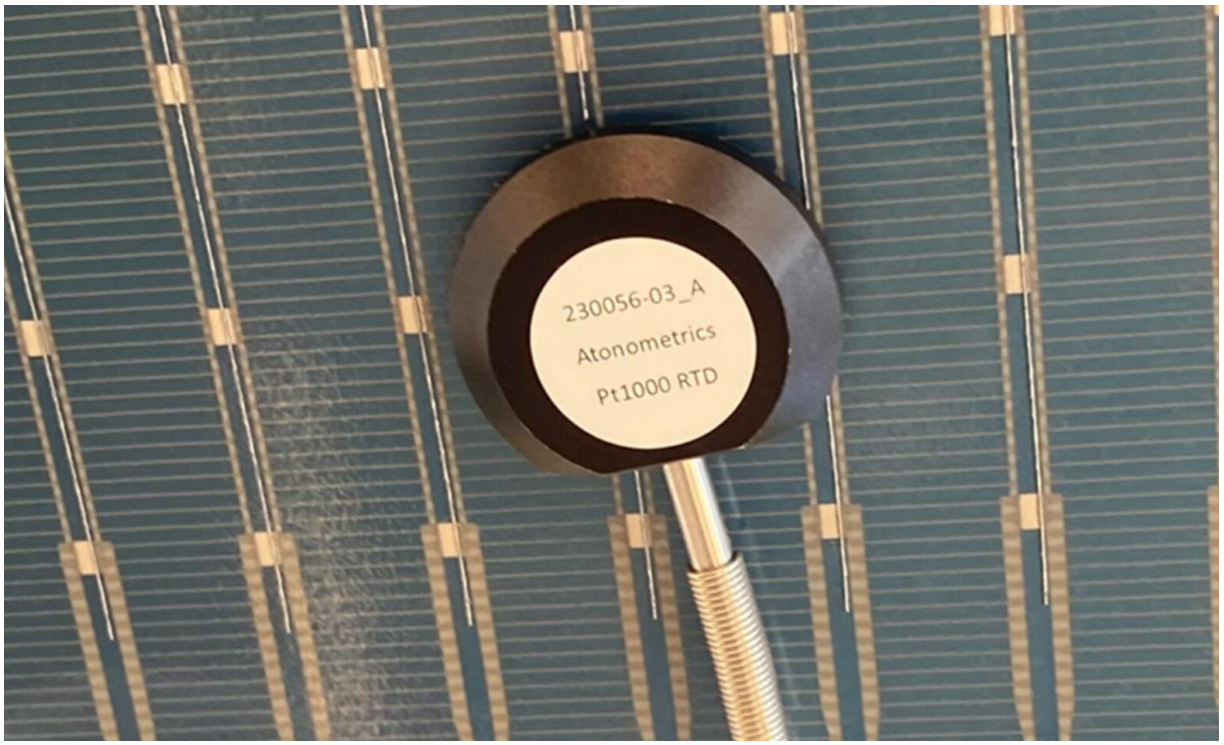


Figure 4-2 : Back-of-module RTD mounted on a module

Note:	Application of the self-adhesive RTD should be performed when the module temperature is between 21 °C and 38 °C to ensure proper adhesive bonding.

5 Ambient RTD

The optional ambient RTD, ordered separately, is a tube shaped Pt1000 RTD for measuring the ambient air temperature at the PV array site. The RTD has a 3-meter cable and overmolded M8 connector for easy attachment to the RC22M. For information on cable extensions contact Atonometrics.

5.1 Unpacking

The Ambient RTD (230063-03) can be purchased by itself (**Figure 5-1**) or with an optional radiation shield which is shown in **Figure 5-3**.

Figure 5-1 : Ambient Pt1000 RTD (230063-03)

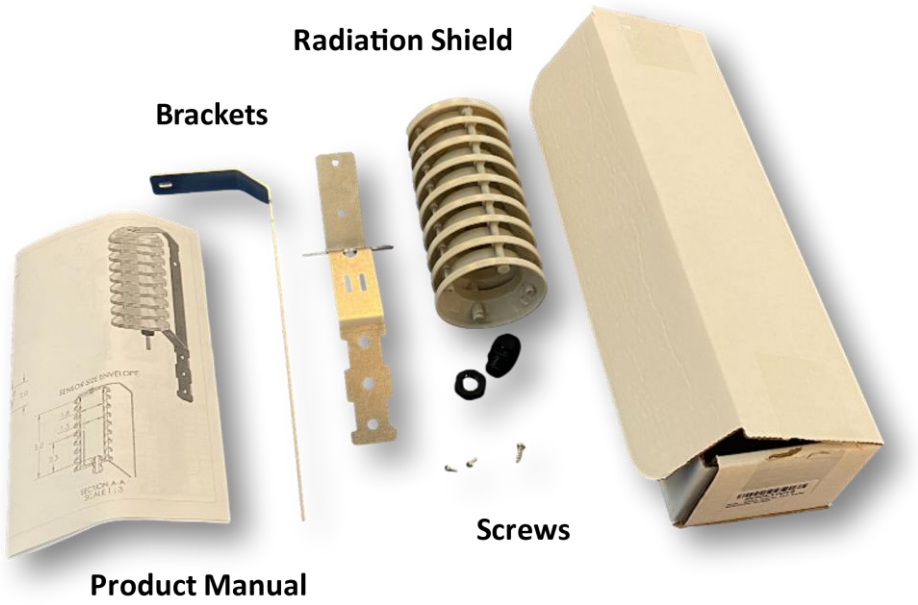


Figure 5-3 : Optional radiation shield

5.2 Mounting

If you did not purchase a radiation shield, mount the ambient RTD by tie-wrapping the cable near your preferred RTD location with the RTD probe extended into the air and shielded from sunlight.

If you purchased a radiation shield, follow the instructions on the included product manual to assemble the shield and then insert the RTD probe through the cable gland. Lock the cable gland tight around the rigid plastic portion of the ambient RTD.

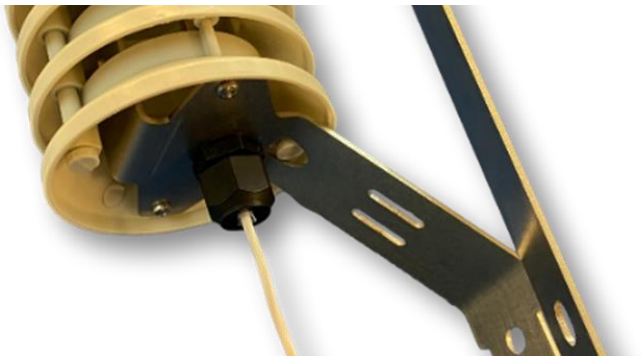


Figure 5-4 : Mounting with radiation shield

6 Wind Sensor

The optional wind speed sensor (810238), ordered separately, is used with RC22M to measure wind speeds from 0 to 50 m/s. Refer to **Section 7.6** for information on setting up your RC22M to collect wind speed data from your wind sensor.

6.1 Unpacking

Figure 6-1 shows the 810238 Wind Sensor with its shipping box and contents, including the sensor and the 830354-005 cable that connects the wind sensor to the RC22M.

Figure 6-1: Wind Sensor (810238) contents

6.2 Mounting

6.2.1 Dimensions

Figure 6-2 shows the 810238 wind sensor dimensions.

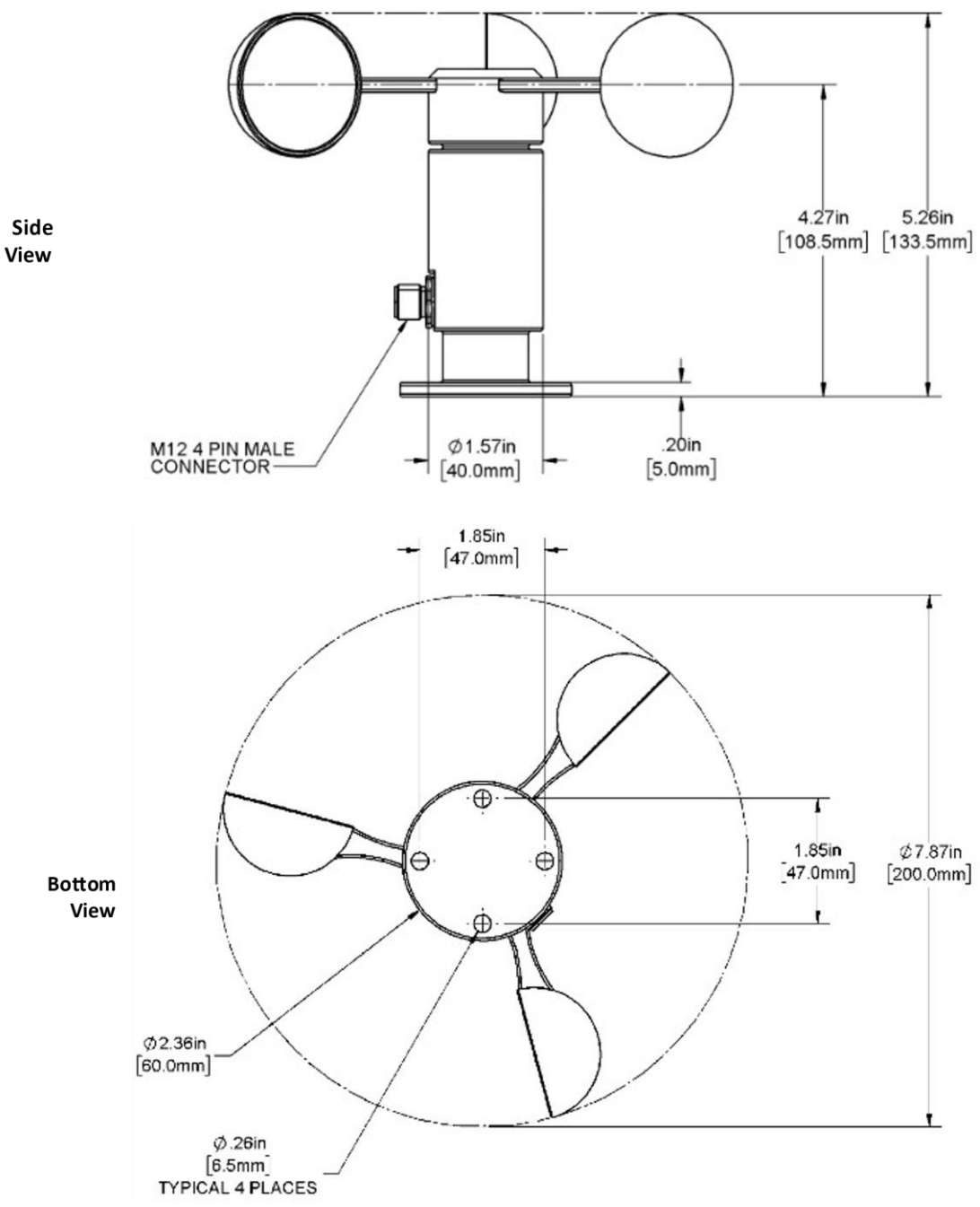


Figure 6-2: 810238 wind sensor dimensions

6.2.2 Mounting Plate

The Wind Sensor Mounting Plate (610635), sold separately, enables the user to mount a wind sensor to tubes, such as meteorological station crossarms as shown in **Figure 6-3**, or purlins or framing material on the PV array.

Mount the wind sensor to the flat plate using the two captive M5 nuts under the mounting plate (not shown in **Figure 6-3**) and two customer-supplied M5 screws.

For tube mounting, attach to the user's tube with two customer-supplied U-bolts, as specified in **Figure 6-3**.

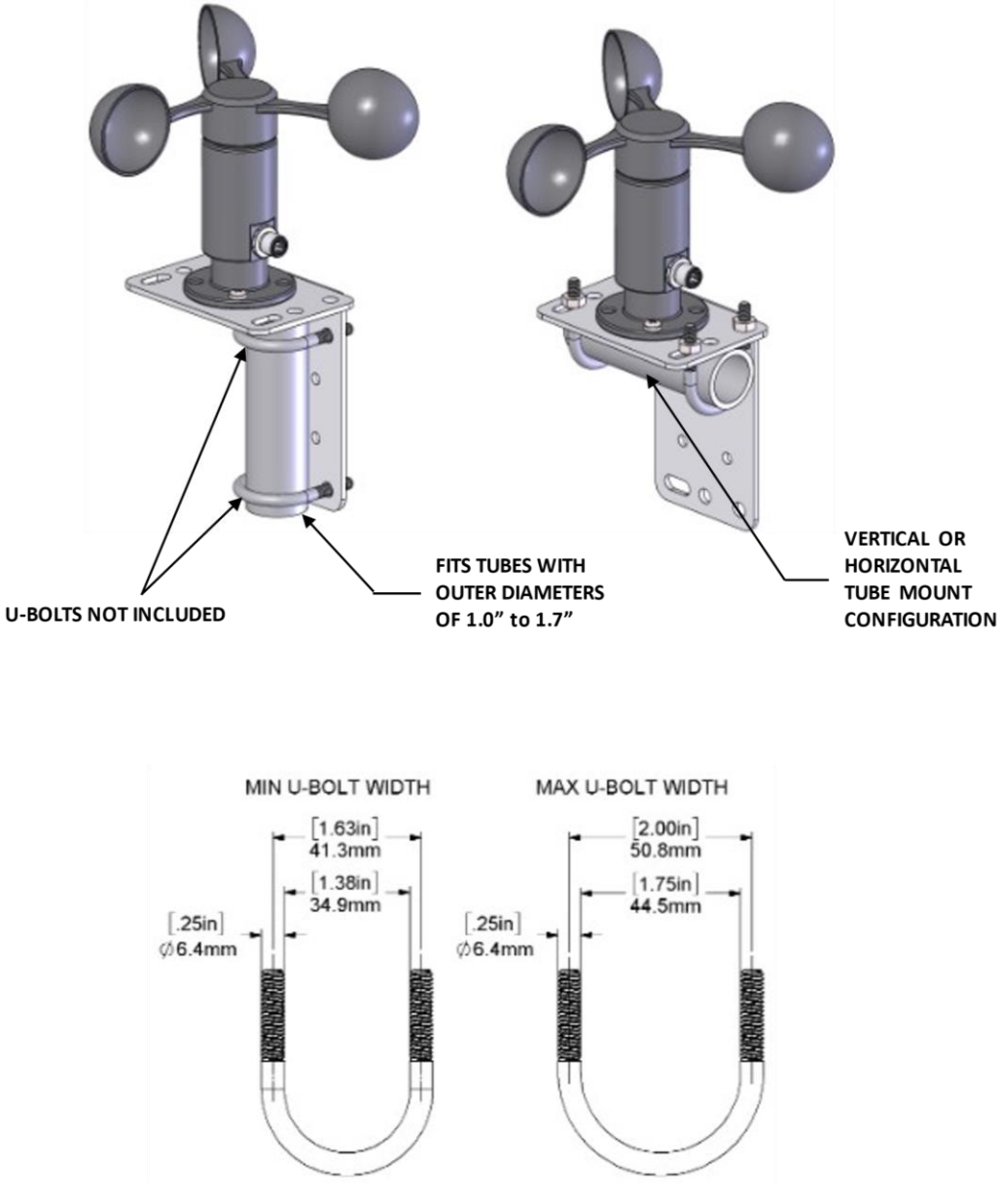


Figure 6-3: 610635 Wind Sensor mounting plate, shown on tube mounts

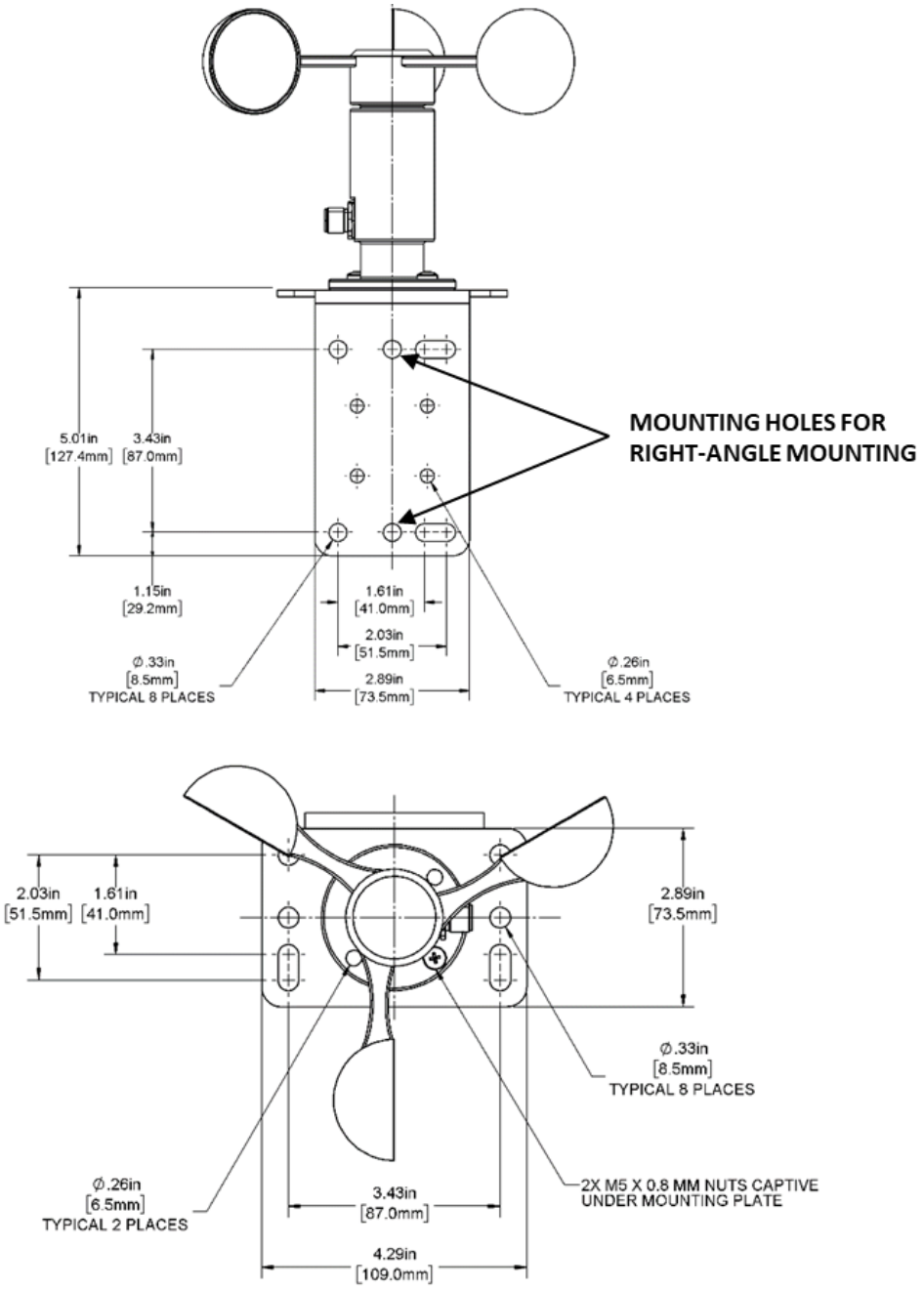


Figure 6-4: 610635 Wind Sensor mounting plate dimensions

6.2.3 Wiring

Connect the wind sensor to the RC22M using its included 830354-005 cable.

7 Configuration

7.1 Documentation

Before starting configuration or programming, visit support.atonometrics.com and get the latest copy of this document (RC22M User Guide, document 880106).

7.2 Configuration Kit

The Configuration Kit (810276), sold separately, allows you to conveniently power your RC22M unit, perform configuration, and test communication and system status. Relevant kit contents are shown in **Figure 7-1**.

Note: The 810276 Configuration Kit supports multiple products. It may include some accessories that are not required for RC22M and/or which are not shown below.

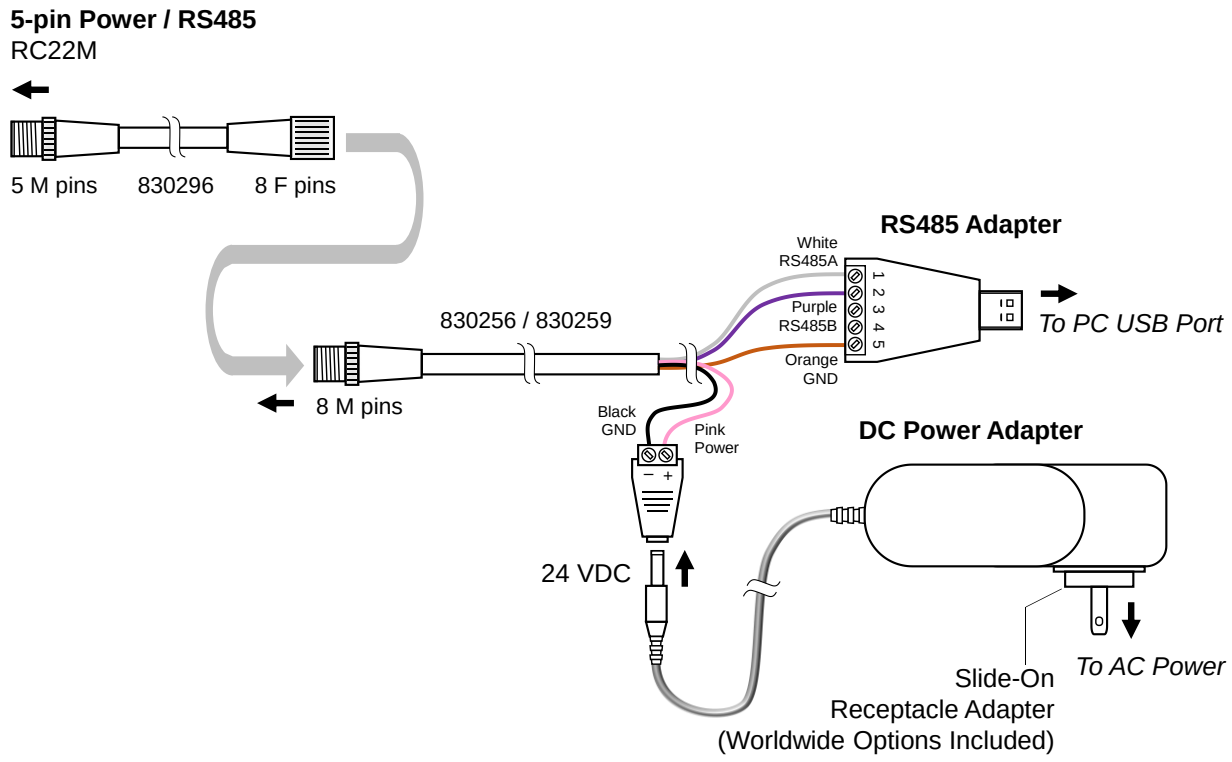


Figure 7-1: Using Configuration Kit 810276 (sold separately) with RC22M

To assemble and install the kit for use with your Windows PC:

- Select the included AC power receptacle adapter appropriate for your region and install it on the AC-DC power adapter.
- Insert the 24 VDC plug into the cable assembly as shown.
- Connect the kit's 8-pin cable to the 5-pin cable as shown.
- Connect the 5-pin cable to your RC22M unit.
- Connect the kit's USB Type A cable to your PC.
- Allow Windows to detect the USB adapter and automatically install its driver or install the driver from the provided CD. If needed, visit support.atonometrics.com for drivers for the 810276 kit.
- Connect the power adapter to AC power.

Note: For more information on the 810276 Configuration Kit, or to find software drivers, visit support.atonometrics.com.

7.3 Configuration Manager Software

RC-MT Configuration Manager Software (500116) allows you to connect to your RC22M, set communication options, and test the device. The software runs on a Windows PC. Obtain the software by visiting support.atonometrics.com and install it per instructions found there.

7.4 Connect to RC22M

Connect the Configuration Kit (or equivalent equipment) to RC22M as shown above in **Section 7.2** and ensure the kit is powered.

Launch the RC-MT Configuration Manager Software on your PC.

From RC-MT Configuration Manager, use the Connect tab shown in **Figure 7-2** to connect to your RC22M unit:

- Select your PC's COM port corresponding to the USB/RS485 adapter of the Configuration Kit. (Click Refresh to update the list of connected COM ports.)
- If you do not know the Modbus communication settings of your RC22M unit, Scan for the RC22M using the Find and Connect button.
- If you know your Modbus communication settings, you may enter these in the Connect Manually box and press the Connect button.

Note: Default Modbus settings for RC22M are address 22, baud rate 57600, data format 8N1.

Note: To determine the COM port of your RS485 adapter, check the COM ports drop down box with and without the adapter connected to your PC, using the Refresh button to update the list after connecting/disconnecting the adapter from the PC.

Figure 7-2: Connecting to RC22M

Once your RC22M unit is connected, the software will display the Connected status, as shown in **Figure 7-3**. Your unit's firmware version, serial number, and part number will also be displayed at the top of the screen.

Figure 7-3: RC22M connected

7.5 Setting Communication Parameters

Your RC22M unit's default Modbus serial communication parameters are Address = 22, Baud Rate = 57600, and Data Format = 8-N-1 (8 data bits, no parity, 1 stop bit).

To update the communication parameters, use the Settings tab of RC/MT Configuration Manager, shown in **Figure 7-4**.

Enter your new parameters in the Update Modbus Settings box and press Apply to transmit these to the unit.

Addresses from 1 to 247 are allowed.

Supported baud rates are 9600, 19200, 38400, and 57600.

Supported data formats are 8-N-1, 8-N-2, 8-E-1, and 8-O-1.

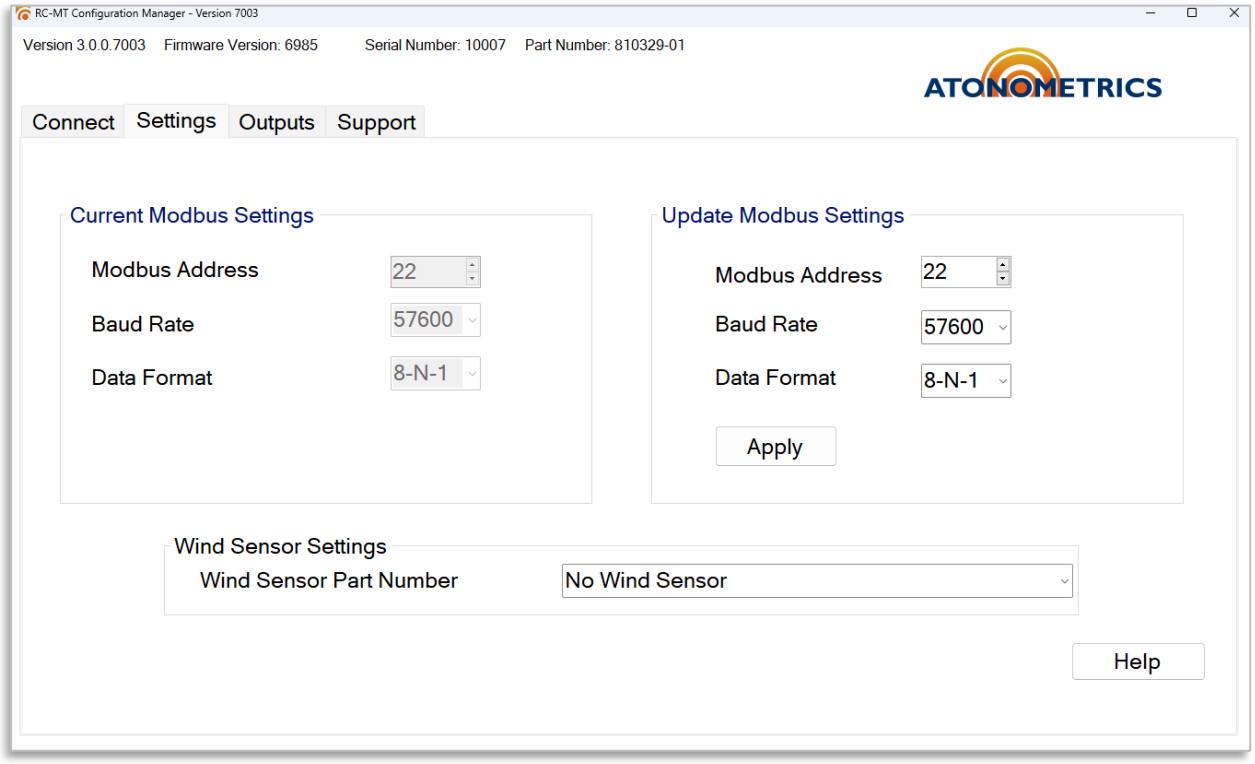


Figure 7-4: Setting communication parameters

7.6 Wind Sensor

Use the Wind Sensor Settings in the Settings tab to configure the optional wind sensor accessory by setting the wind sensor's part number, as shown in **Figure 7-5**.

You may also disable the wind sensor if desired by selecting "No Wind Sensor."

When RC22M is configured to use the wind sensor, it will automatically check for the sensor at startup and every 10 minutes. Once the wind sensor is detected, RC22M will activate it.

Note: RC22M only works with Atonometrics-supplied wind sensors.

Note: Your new RC22M unit may arrive with the wind sensor part number pre-configured, depending on your ordering options.

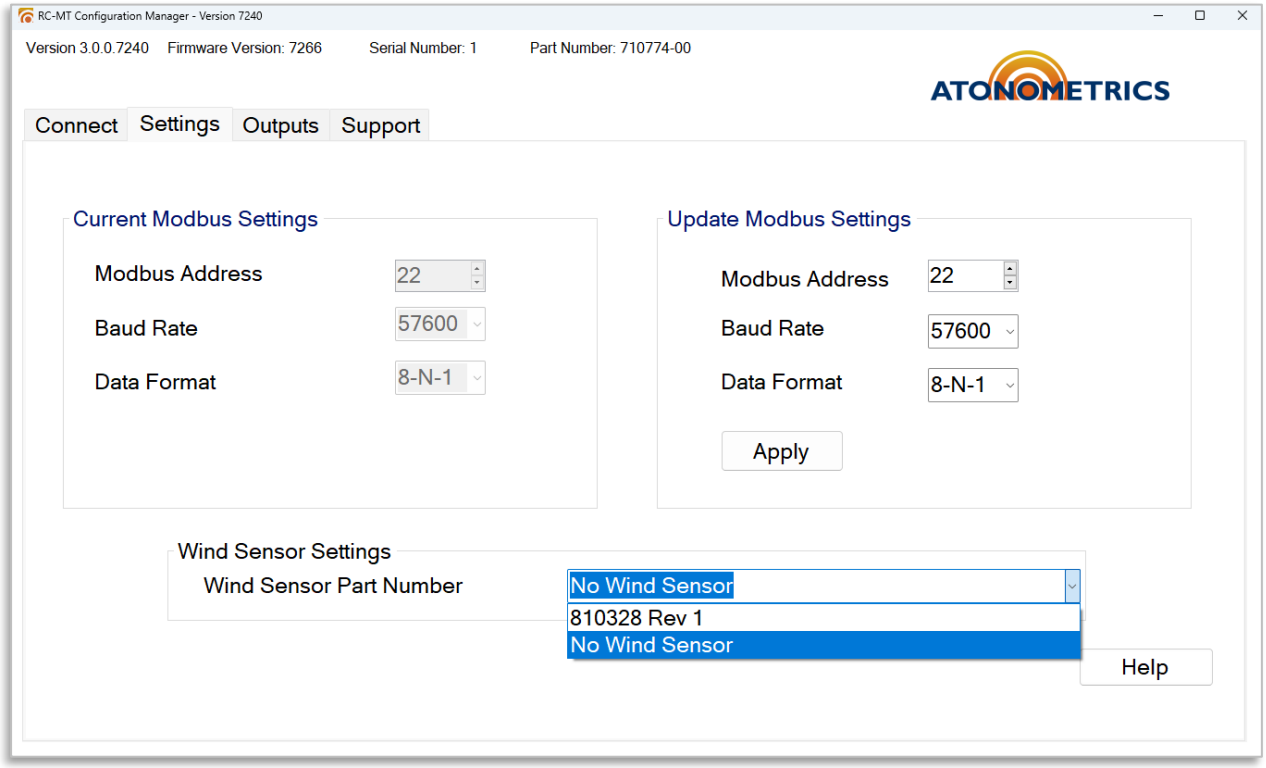


Figure 7-5: Configuring the optional wind sensor

When the wind sensor is connected and activated, wind speed readings will appear on the Outputs tab, as shown in **Figure 7-6**, and in Modbus registers.

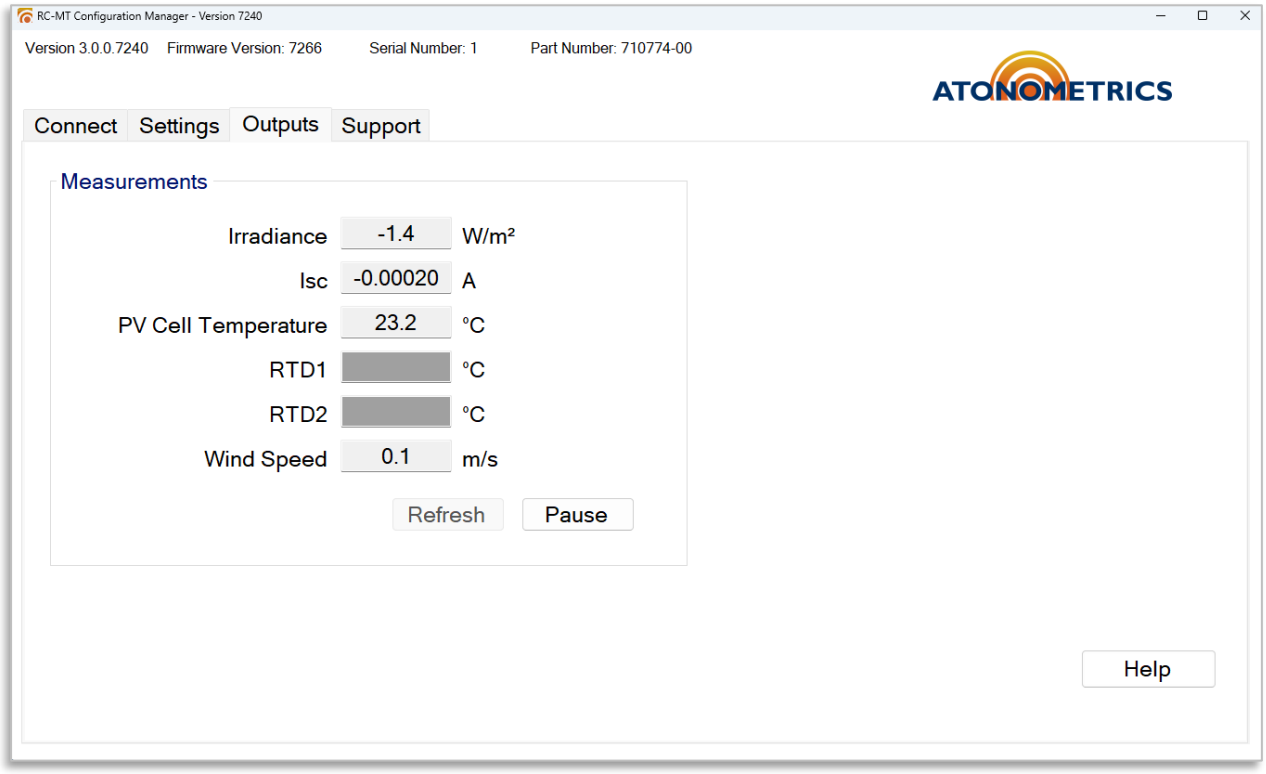


Figure 7-6: Wind speed readings on the Outputs tab

If the wind sensor is disabled in the settings (see **Figure 7-5**) or not yet activated, the Outputs tab will show wind speed readings disabled (see below, **Figure 7-7**), and wind speed readings via Modbus will be NaN.

Note: If the wind speed sensor is configured and connected but the Outputs tab shows wind speed readings disabled, wait 10 minutes for RC22M to detect and activate the wind speed sensor, or cycle power to RC22M to cause the sensor to be immediately detected.

Note: If you disconnect the wind speed sensor from an RC22M, re-install the port cap on the wind sensor port (see **Figure 3-1**) to prevent water entry, and power cycle the RC22M so that it will deactivate the wind sensor port.

Note: For RC22M installations that will not include the wind sensor, you may wish to disable the wind sensor port using the software settings shown in **Figure 7-5**.

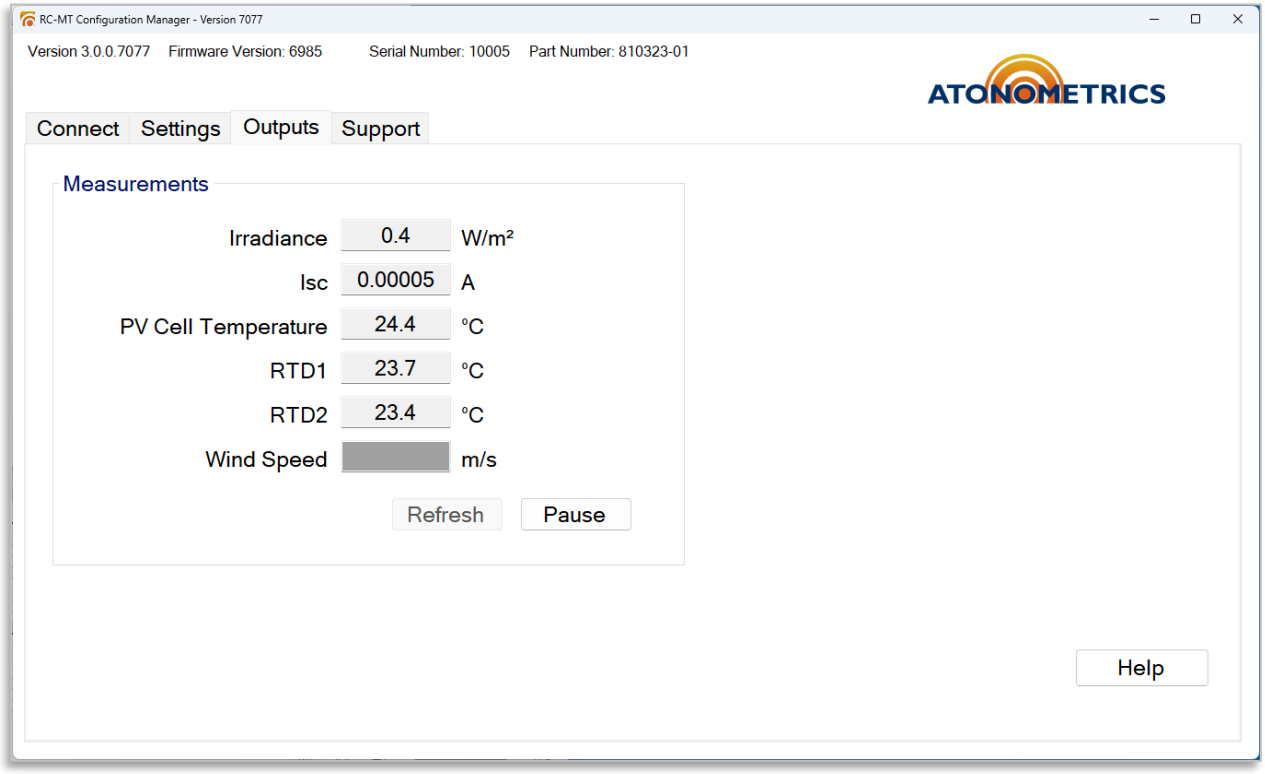


Figure 7-7 : Wind speed readings if wind sensor is disabled or missing

7.7 Checking Output Data

Use the Outputs tab to check the measurement results from your unit, as shown in **Figure 7-8**. The tab displays your RC22M's measured irradiance, Isc, cell temperature, Pt1000 external RTD temperature(s), and wind speed (if wind sensor is activated).

Note: If an RTD is not connected to one of the RTD ports, the port's corresponding output box will be greyed out.

The readings on the Outputs tab will update continuously. To pause the readings, click the Pause button. To update the readings when paused, use the Refresh button. To resume the automatic update of readings when paused, click Resume as shown in **Figure 7-9**.

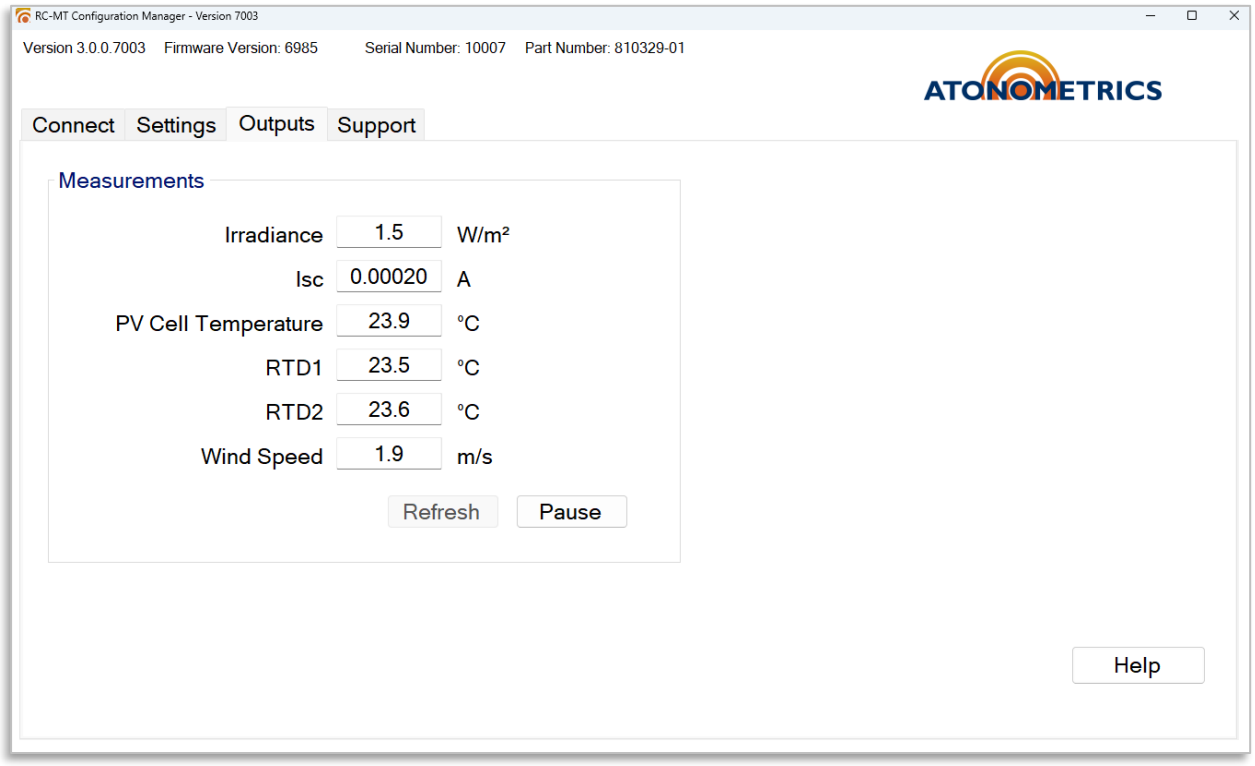


Figure 7-8: Checking output data, outputs continuously updating

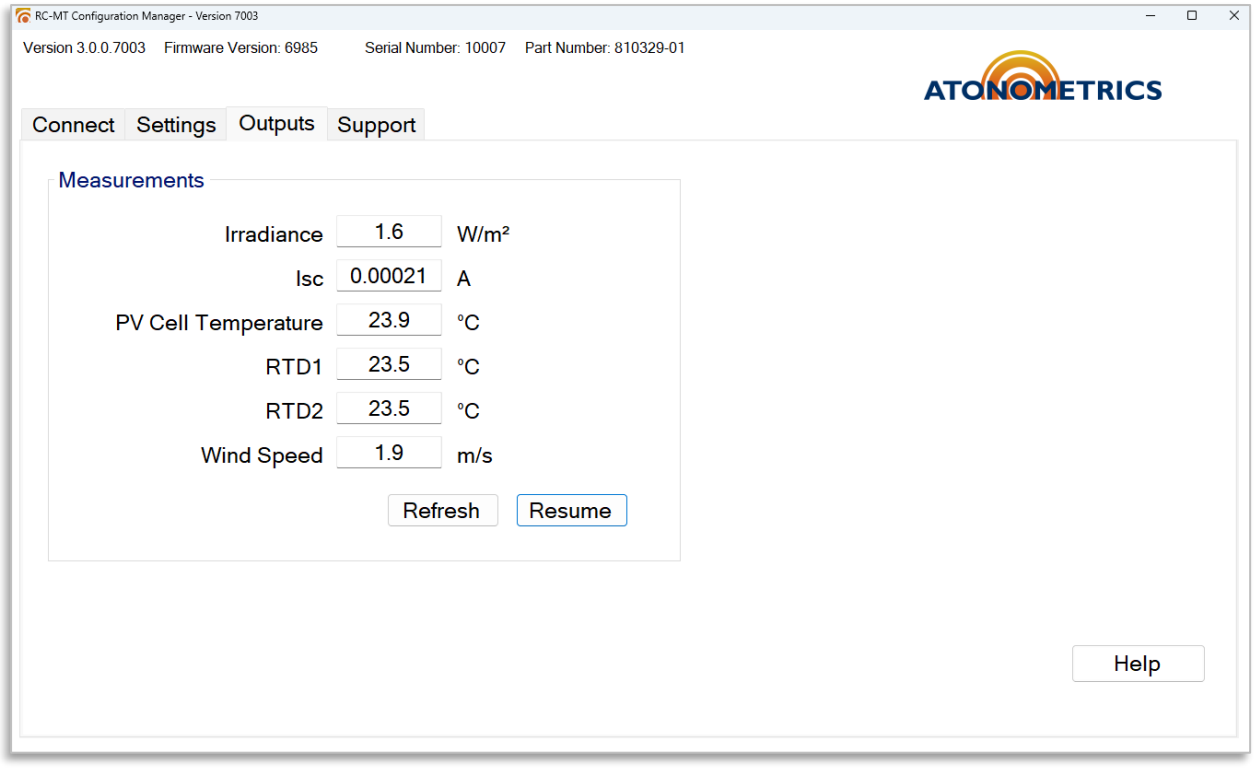


Figure 7-9: Checking output data, outputs paused

7.8 Updating Software

If your PC is connected to the internet, the “Software Updates?” Check button on the Support tab will automatically detect if there is an RC22M firmware or RC-MT Configuration Manager update.

If software updates are available, visit support.atonometrics.com to obtain them.

To install a firmware update, use the Upload button in the Support tab of RC-MT Configuration Manager software, shown in **Figure 7-10**.

Note: The Support tab also provides convenient links to the Atonometrics support website for obtaining product documentation or support.

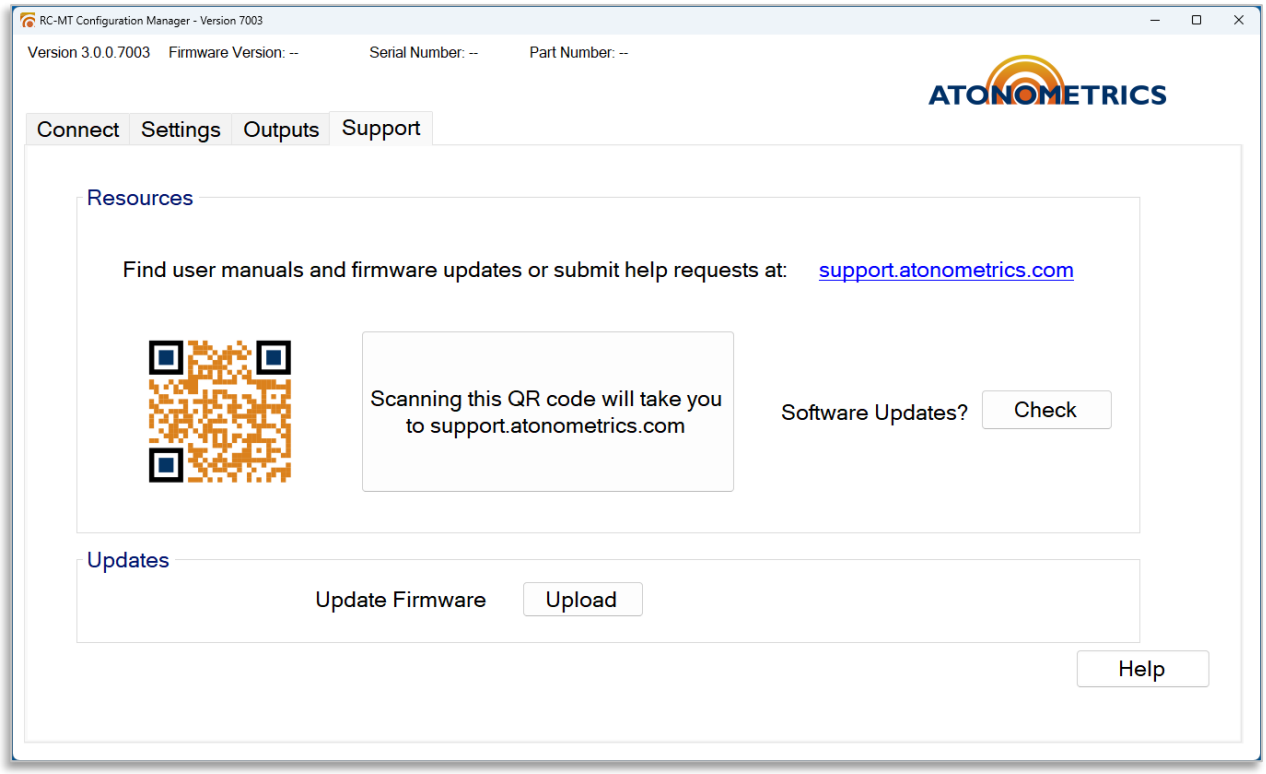


Figure 7-10: Support tab

8 Modbus

Table 8-1 lists the registers available for your client software to read data from the RC22M unit.

Each numbered register in the table is a 16-bit (2-byte) register. Parameters requiring more than two bytes must be read from sequential registers as indicated by the Register Start and Register End columns. Byte order is big-endian: for a 4-byte value with bytes in the order *ABCD*, from most to least significant, the first register reads out bytes *AB* and the second reads out bytes *CD*.

Float32 denotes single-precision 32-bit floating point per IEEE 754.

For detailed information on Modbus protocols, please reference the specifications published by Modbus.org.

Note: On some user data acquisition devices, it is necessary to add 1 to all the register values shown in Table 8-1 to determine the Modbus address.

Table 8-1: Modbus map

Register Start	Register End	Parameter Name	Units	Data Format	Bytes	Description
1	2	**Irradiance**	W/m^2	Float32	4	Irradiance
3	4	**Short-Circuit Current**	A	Float32	4	Short-circuit current of the PV cell
5	6	**PV Temperature**	°C	Float32	4	Temperature of the PV cell
11	12	**External RTD1**	°C	Float32	4	Temperature of the optional external Pt1000 RTD connected to the RTD1 port
13	14	**External RTD2**	°C	Float32	4	Temperature of the optional external Pt1000 RTD connected to the RTD2 port
15	16	**Wind Speed**	m/s	Float32	4	Wind speed measured by the optional wind speed sensor