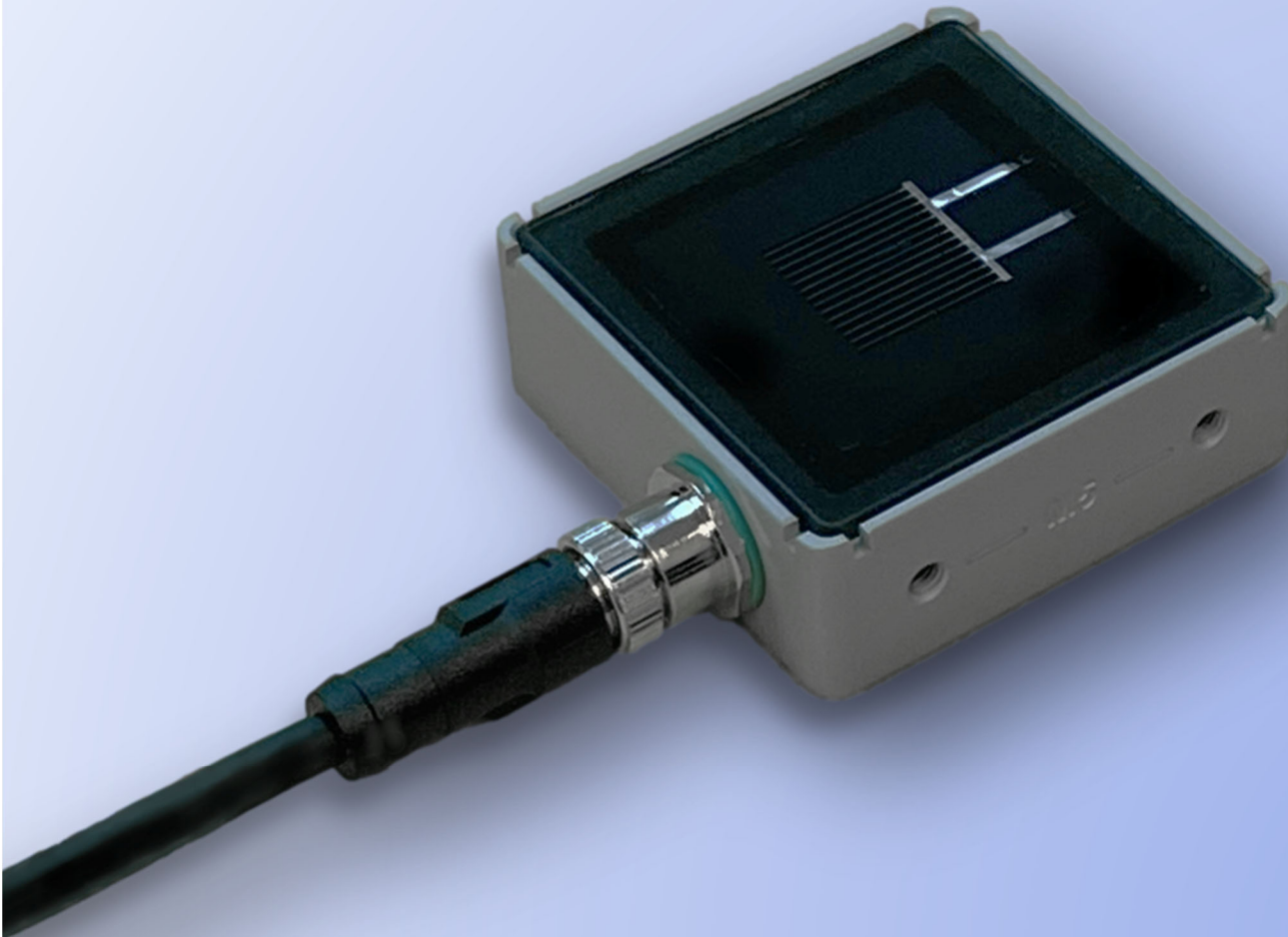


User Guide

RC22 PV Reference Cell



Document Number 880095 Rev. A1, October 2023



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1 Product Overview

RC22, shown in **Figure 1-1**, is the first PV reference cell specifically optimized for irradiance measurement in both monofacial and bifacial PV systems. Key features include:

- Compact size & integrated mounting features
- Simplified mounting on front or rear of array
- Calibrated at both 1000 W/m² (STC) and 135 W/m² (BSTC)
- High and low scales with auto-ranging, for measurements at front or rear irradiance levels
- Unique glass-to-edge feature allowing water roll-off, eliminating excess soiling vs. conventional cells
- M12 connection port with industry-standard five-pin pinout for power and communication
- Digital output via Modbus RTU protocol over RS485
- Overmolded connectors available in multiple lengths
- IP67-rated for outdoor use

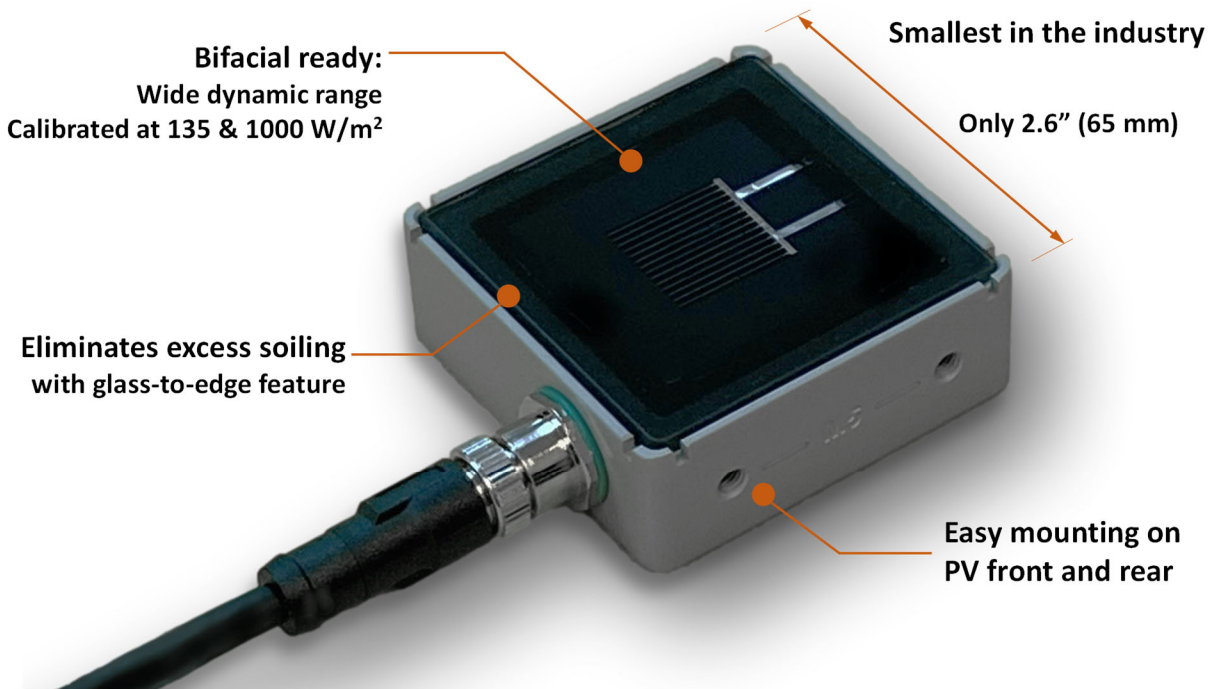


Figure 1-1: RC22 PV reference cell (810290)

2 Unpacking

Figure 2-1 shows an RC22 unit with its shipping box and contents.

Each unit includes a Standard Mounting Plate pre-attached in the bottom-mount configuration. See Section 3 for alternate configurations.

Each unit includes a Calibration Certificate and Calibration Report.

Optional mounts (Section 3), cables (Section 4), and configuration tools (Section 5) must be ordered separately.



Figure 2-1: Unpacking your RC22 unit

3 Mounting

3.1 Dimensions & Mounting Holes

Figure 3-1 shows the RC22 dimensions and Figure 3-2 illustrates its mounting hole options.

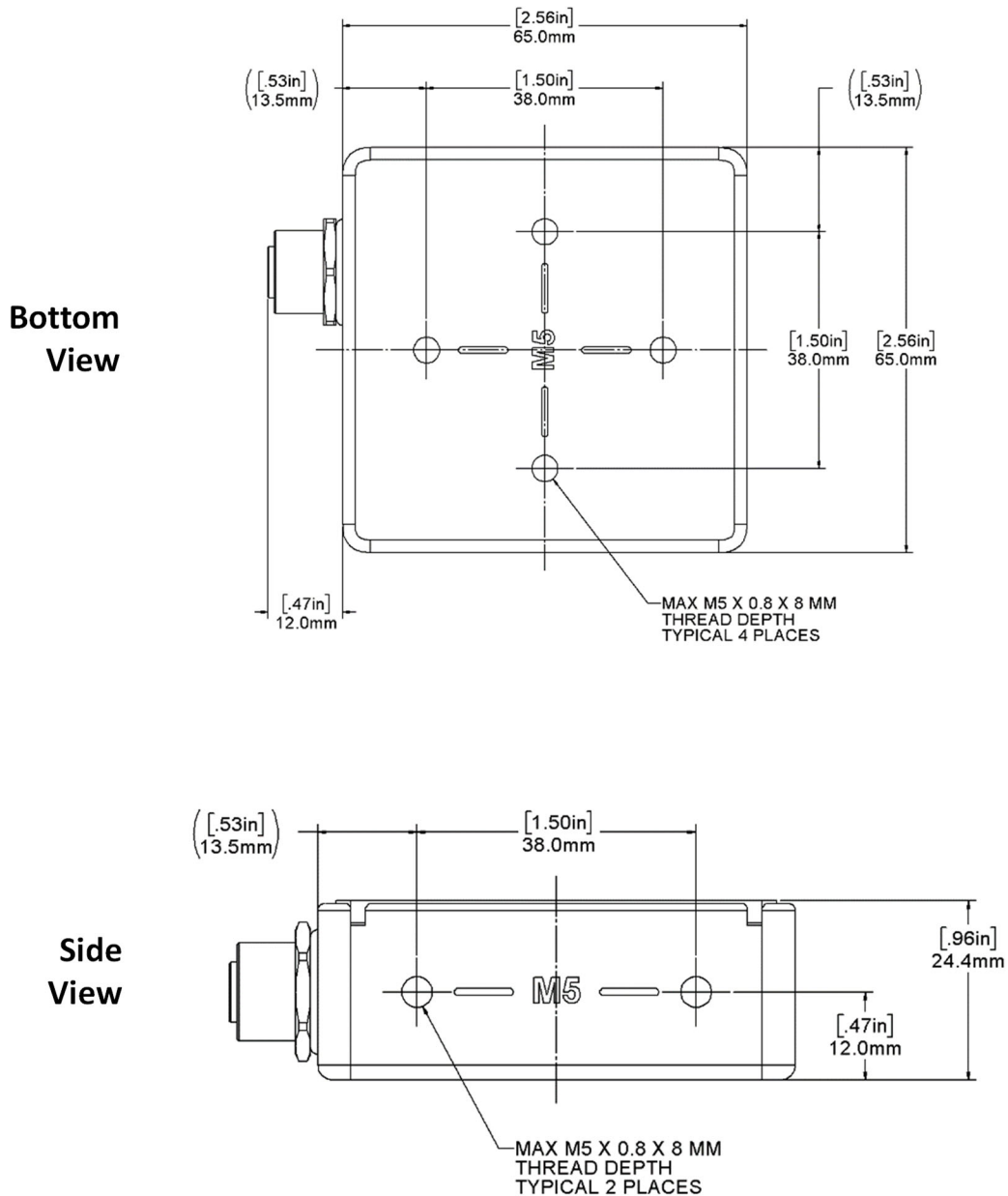


Figure 3-1: RC22 dimensions

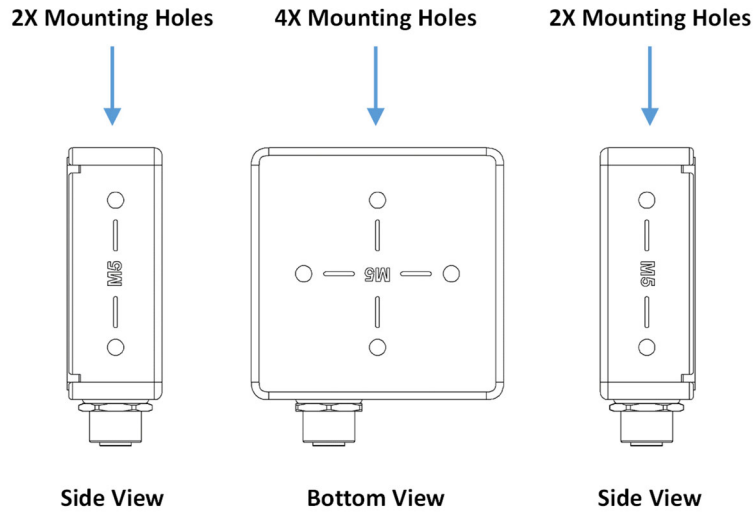


Figure 3-2: Mounting holes for M5 bolts

3.2 Orientation

To minimize the potential for water entry via the connector, please mount the RC22 unit with its cable facing down or to the side, as shown in **Figure 3-3**. Avoid mounting with the cable facing up, unless mounted on the rear side of a PV module on a tracking system.

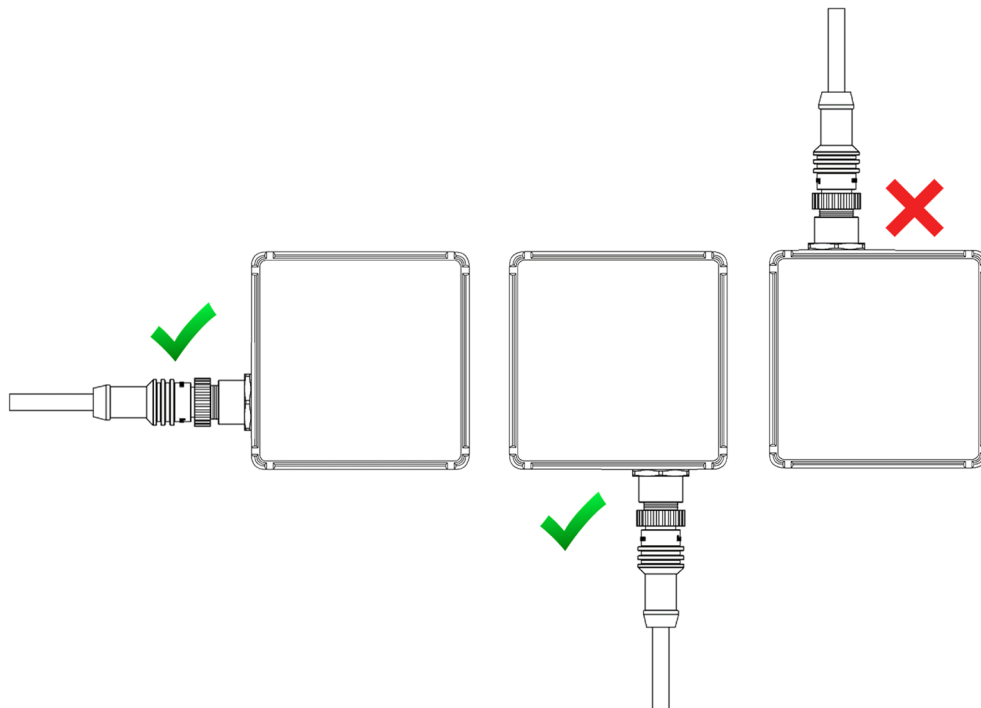


Figure 3-3: Mount with cables down or to the side if possible

3.3 Standard Mounting Plate

The RC22 Standard Mounting Plate (610494) is shipped with every RC22 unit and will be pre-mounted as shown in **Figure 2-1**.

The plate can be mounted in two orientations on the bottom of the housing and two orientations on either side of the housing, as shown below. Remove and reposition the plate as desired.

3.3.1 Bottom Mount

The bottom mount configuration using the Standard Mounting Plate, shown in **Figure 3-4**, enables you to mount your RC22 unit on surfaces parallel to the plane of measurement.

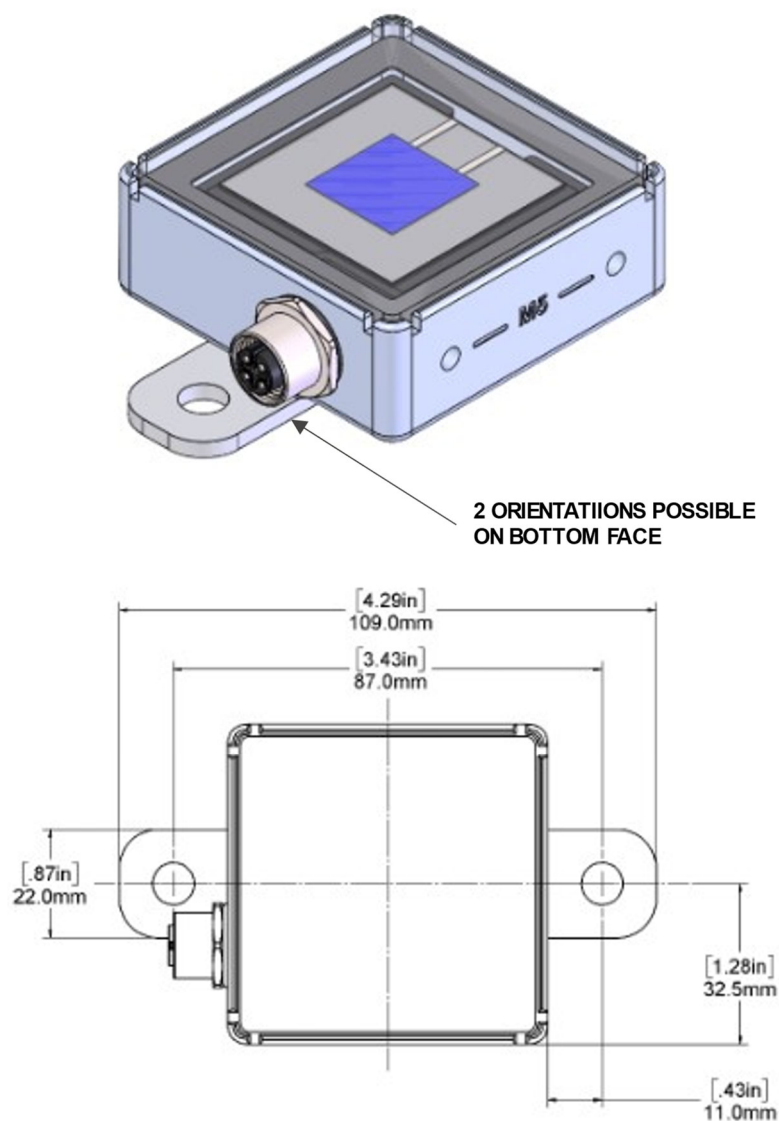


Figure 3-4: Bottom mount configuration

3.3.2 Side Mount

The side mount configuration using the Standard Mounting Plate, shown in **Figure 3-5**, enables you to mount your RC22 unit on surfaces at a right angle to the plane of measurement.

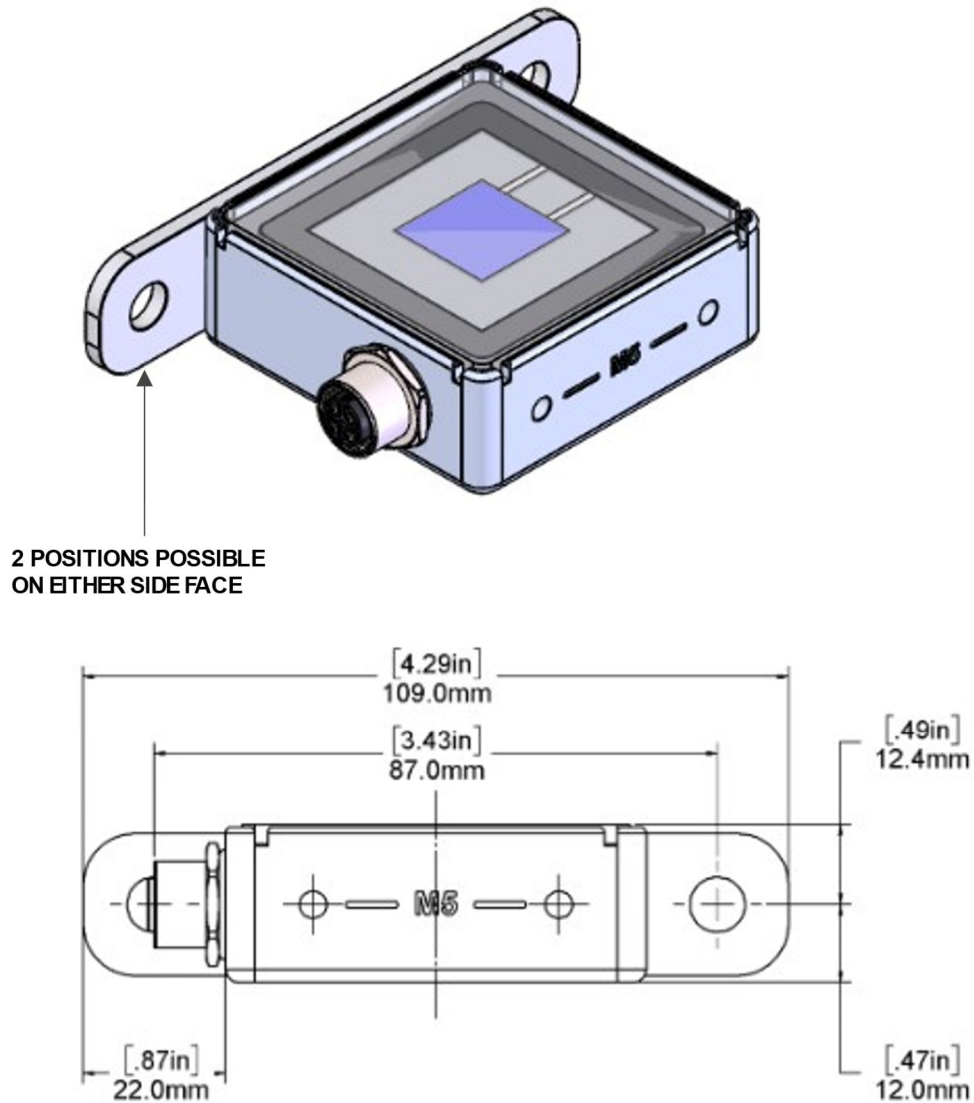


Figure 3-5: Side mount configuration

3.4 Rear-Side Module Clamp

The RC22 Rear-Side Module Clamp Kit (810302), sold separately, is used to mount RC22 on the rear side of a bifacial PV module to measure rear plane of array irradiance.

See **Figure 3-6** and **Figure 3-7**.

Mount the clamp to your RC22 unit with two included M5 screws, then clamp it anywhere onto the rear side of a module frame, overlapping the frame area between two modules.

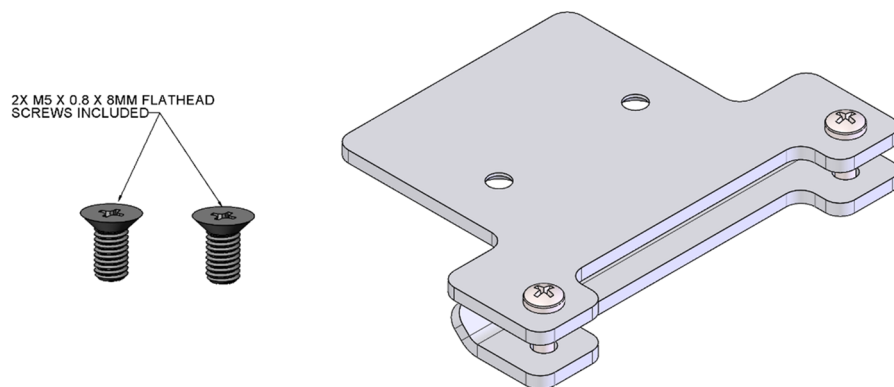
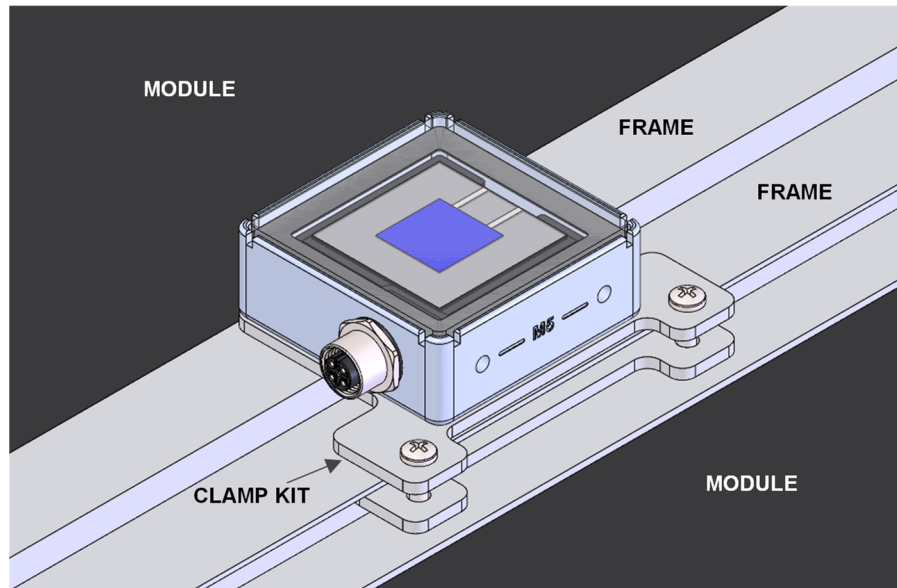


Figure 3-6: RC22 Rear-Side Module Clamp Kit (810302)

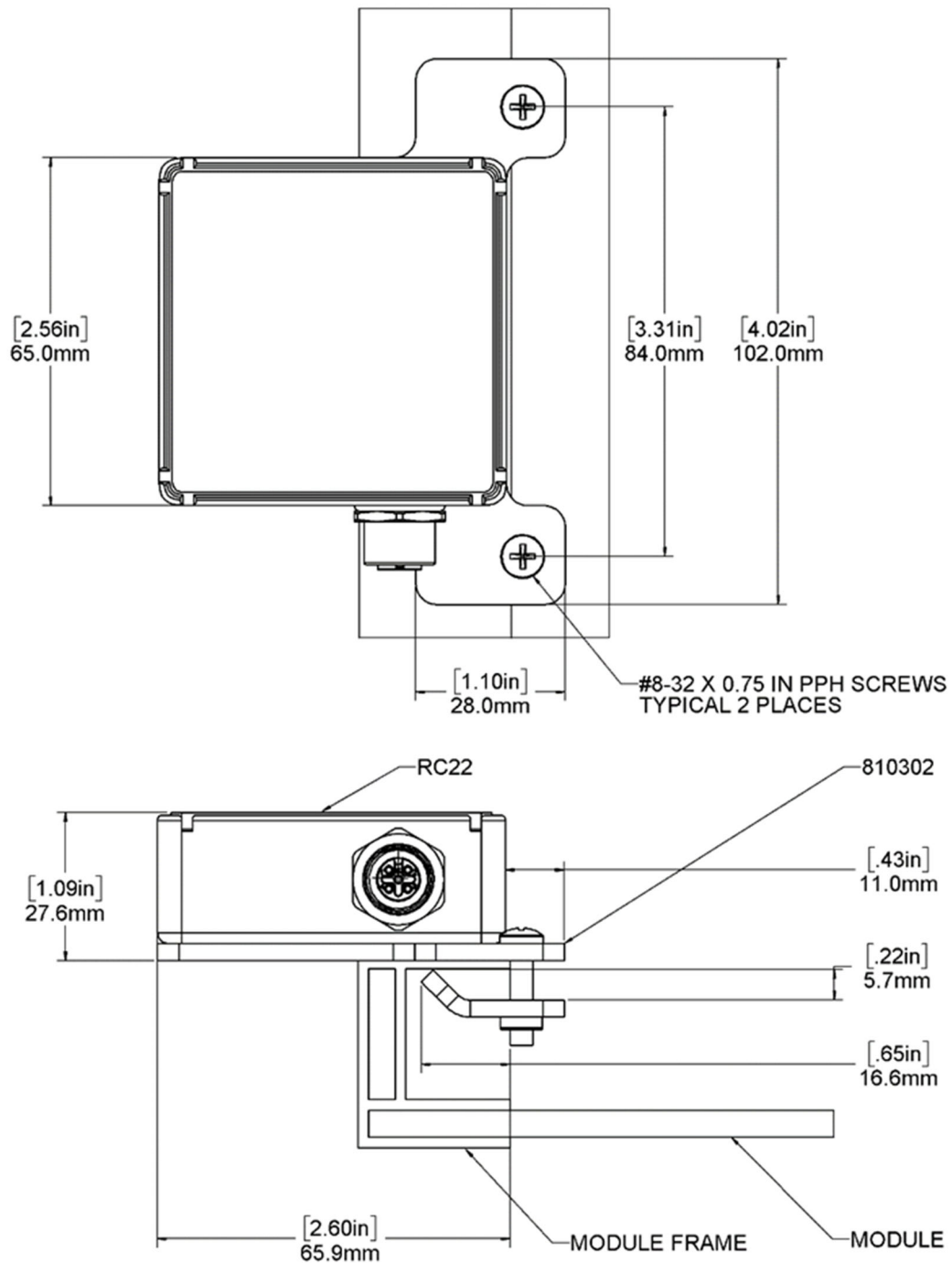


Figure 3-7: RC22 Rear-Side Module Clamp Kit (810302) dimensions

3.5 Torque Tube Mounting Clamp

The RC22 Torque Tube Mounting Clamp Kit (810313), sold separately, allows mounting RC22 units on the torque tube of a single-axis tracking system. See **Figure 3-8** and **Figure 3-9**.

Mount your RC22 units on the mounting plate using the M5 screws included with each RC22 and then join the plate to the tube clamps and torque tube with the two threaded bolts. (If your original M5 screws were misplaced, replace them with M5 x 0.8 x 8mm flathead screws.)

The Torque Tube Mounting Clamp Kit may be used with multiple RC22 configurations. Applications include front and rear plane of array (POA) irradiance and soiling measurement.

An additional 610533 mounting plate for the rear (bottom) side of the torque tube mounting kit may be purchased separately to enable both front and rear POA measurements.

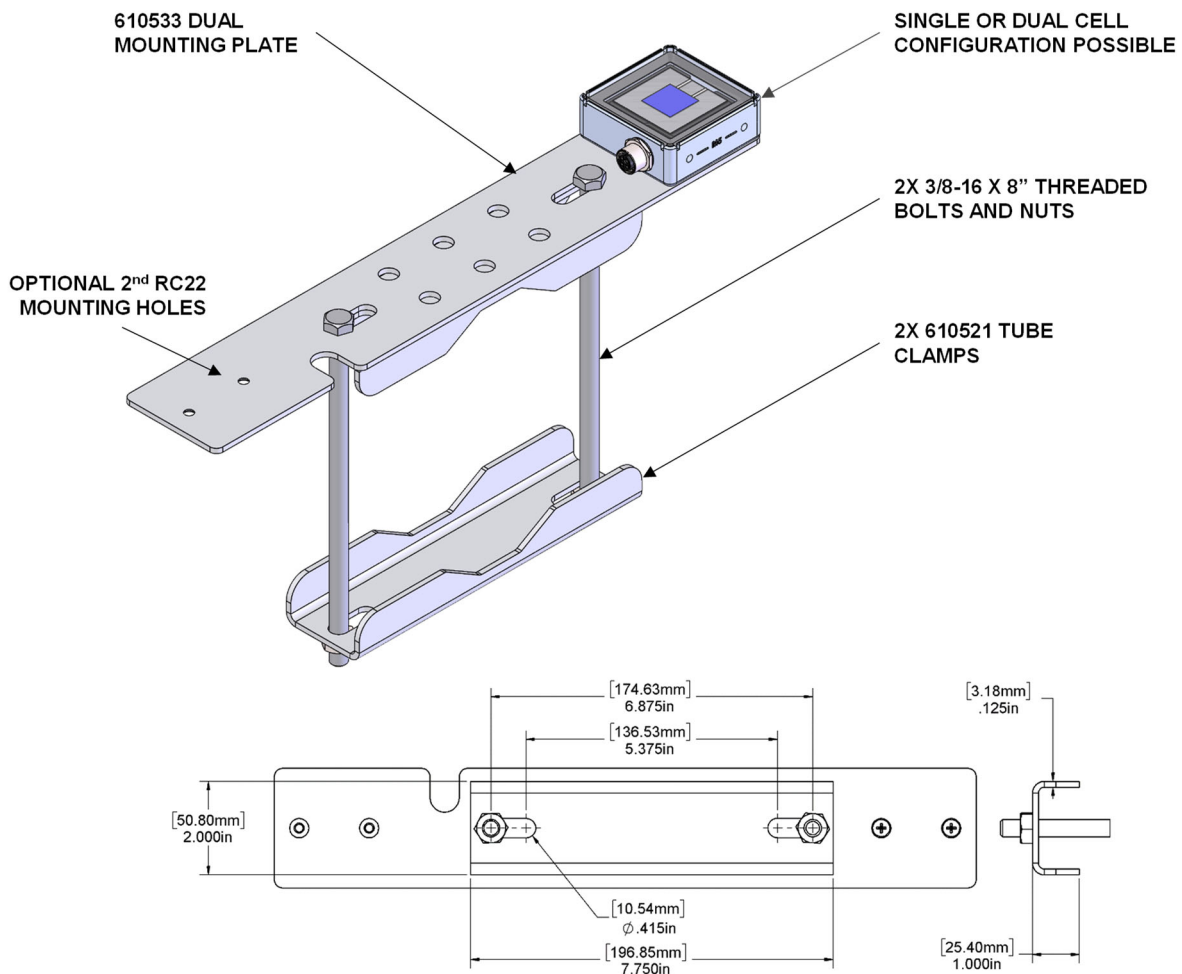


Figure 3-8: RC22 Torque Tube Mounting Clamp Kit (810313)

The Torque Tube Mounting Clamp Kit clamps around square, circular, or octagonal torque tubes that are 4.5 - 6.0 inches (114 to 152 mm) in diameter, as shown in **Figure 3-9**. Please observe the orientation of the tube clamps on each torque tube profile.

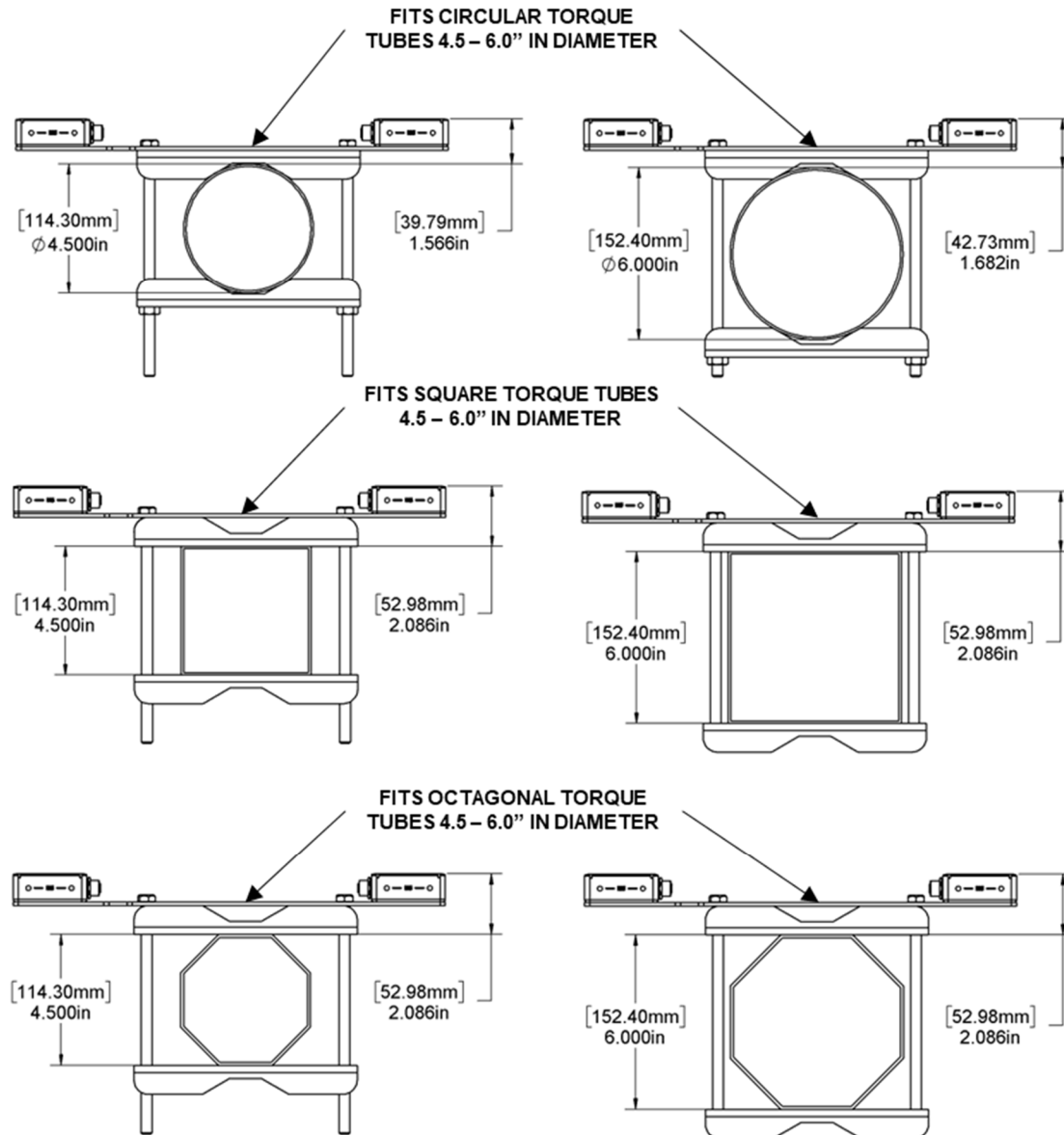


Figure 3-9: Torque tube options using the 810313 kit

3.6 Dual Mounting Plate

The Dual Mounting Plate (610533), sold separately, can be used to mount one or two RC22 units. See **Figure 3-10**. This plate is ideal for mounting the RC22 on the front side of a fixed-tilt PV array on customer-supplied purlins or purlin extensions such as angle extrusion or Unistrut.

Mount RC22 units to the 610533 plate using the M5 screws included with each RC22. (If your original M5 screws were misplaced, replace them with M5 x 0.8 x 8mm flathead screws.) All other hardware to mount the 610533 plate to the customer's racking must be customer-supplied.

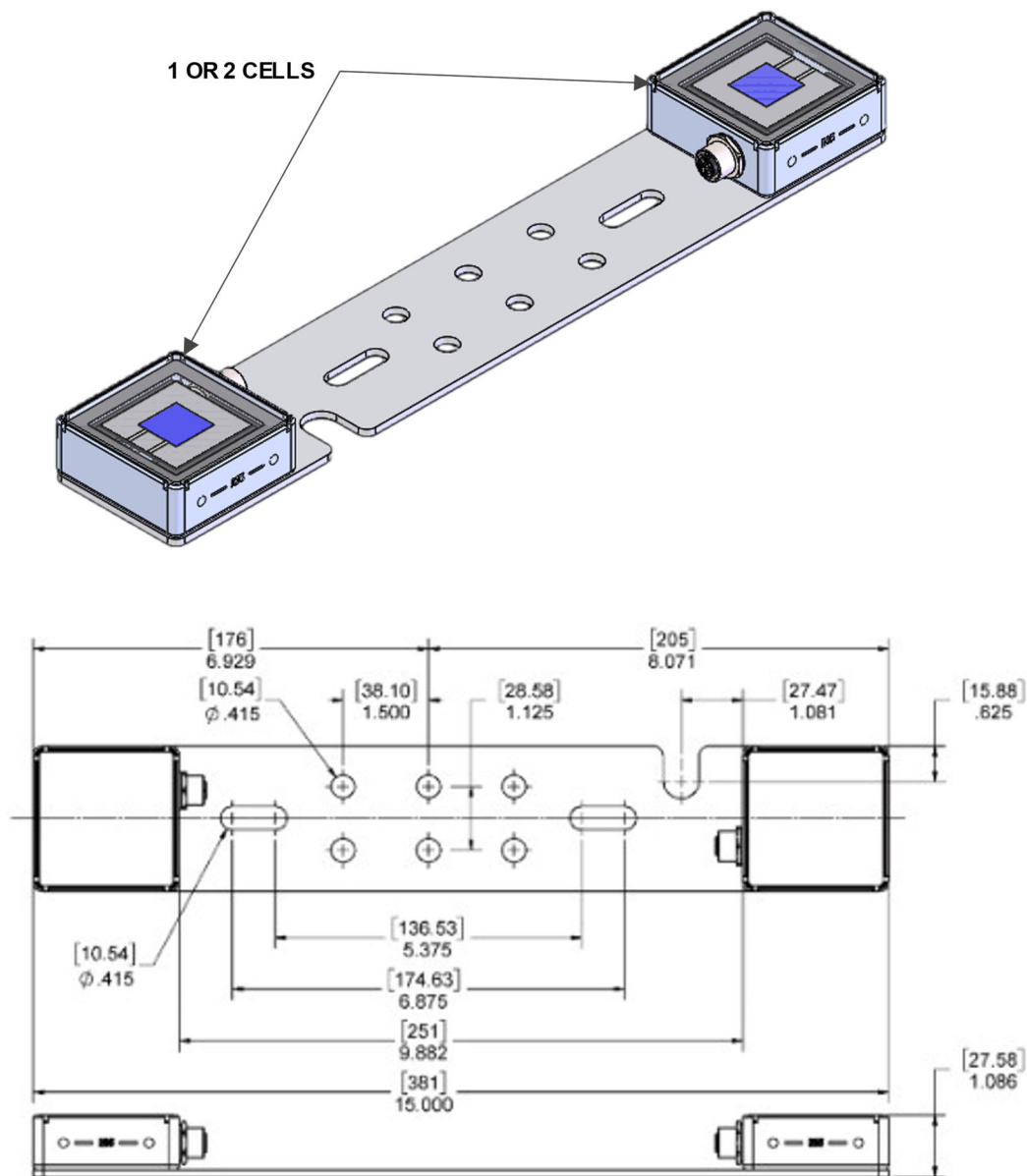


Figure 3-10: RC22 Dual Mounting Plate (610533)

3.7 Tube Mounting Plate

The RC22 Tube Mounting Plate (610493), sold separately, enables the user to mount the RC22 to tubes such as meteorological station crossarms. See **Figure 3-11**.

Mount the RC22 to the flat plate using the M5 screws included with each RC22 and join it to the user's tube with two customer-supplied U-bolts, as specified in **Figure 3-11**. (If your original M5 screws were misplaced, replace them with M5 x 0.8 x 8mm flathead screws.)

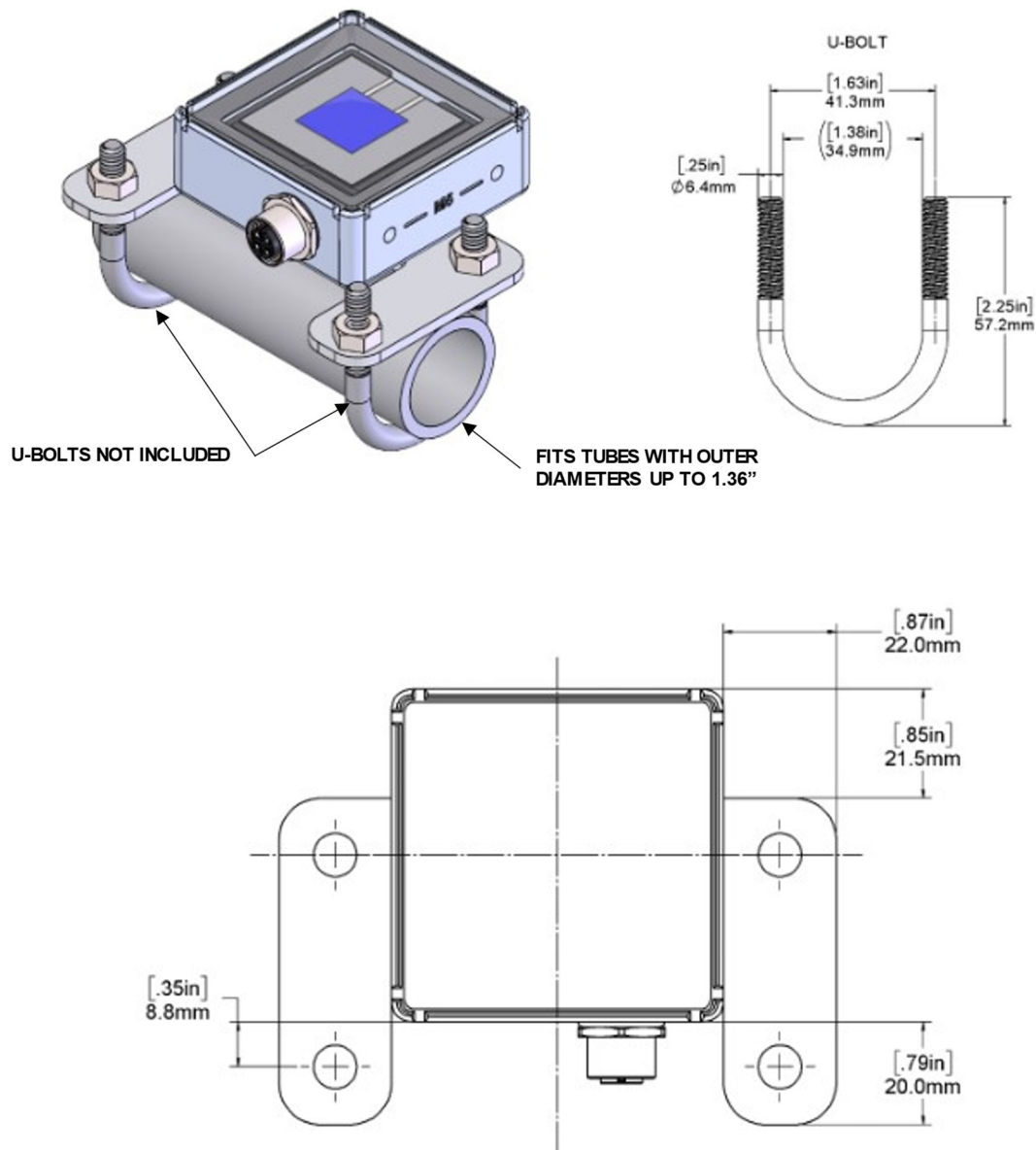


Figure 3-11: RC22 Tube Mounting Plate (610493)

3.8 Mars-RC22 Mounting Bracket Kit

The Mars-RC22 Mounting Bracket (810301), sold separately, enables the user to mount RC22 to the Mars Optical Soiling Sensor, as shown in **Figure 3-12**.

This is used for our no-maintenance soiling measurement system. See the “Module-Cell-Optical” section of the 880100 document for more information on this product configuration.

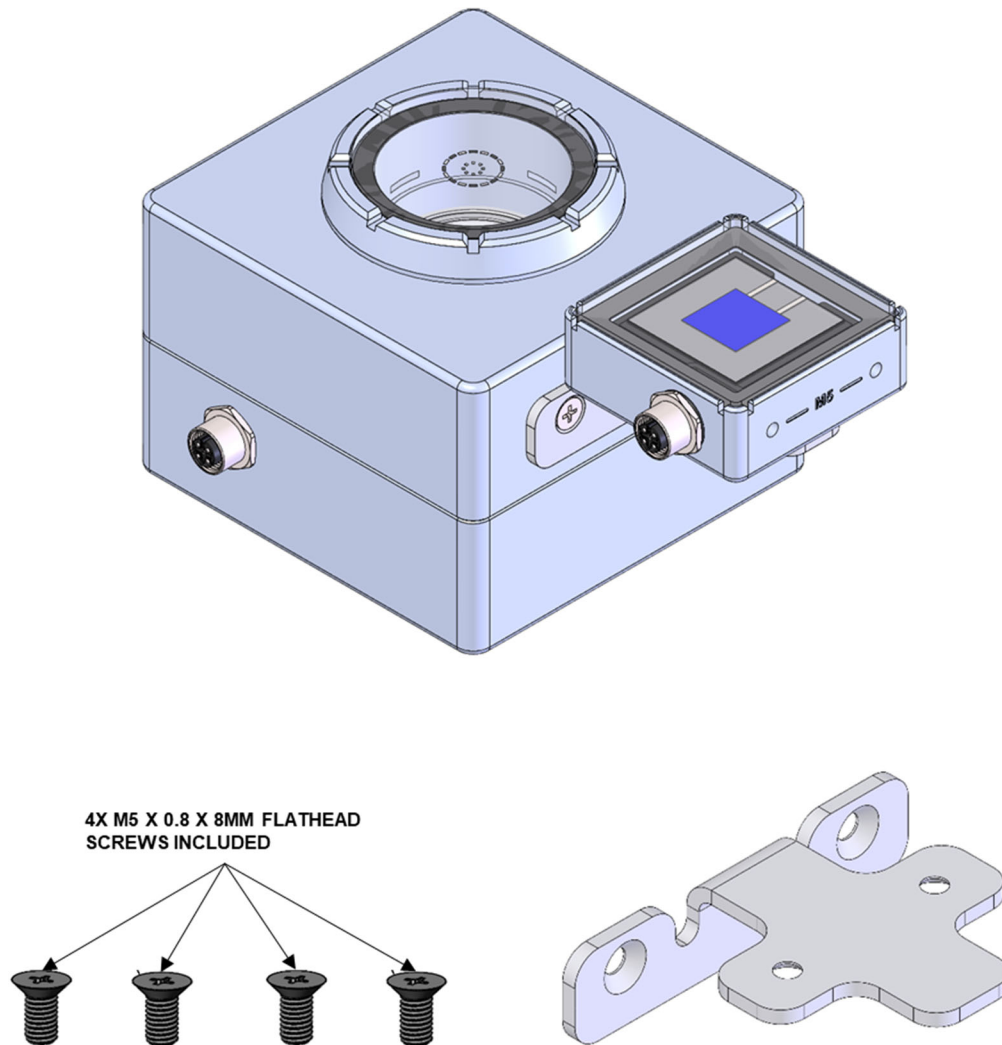


Figure 3-12: Mars-RC22 Mounting Bracket Kit 810301

4 Wiring

4.1 Power

The RC22 unit requires 10-30 VDC and draws ~10-15 mA in operation.

4.2 Cable Assemblies

Power and communication cable assemblies 830303 are listed in **Table 4-1** with wire colors shown in **Figure 4-1**.

Note: When using cables 50 m or longer, insert an 830331 RS485 termination cable between the 830303 cable and the RC22 to suppress RS485 signal reflections.

Note: Atonometrics-supplied 830303 M12 power and RS-485 cables include an additional wire not used for the RC22 product. See Section 4.3.

Table 4-1: Atonometrics-supplied cables (sold separately)

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

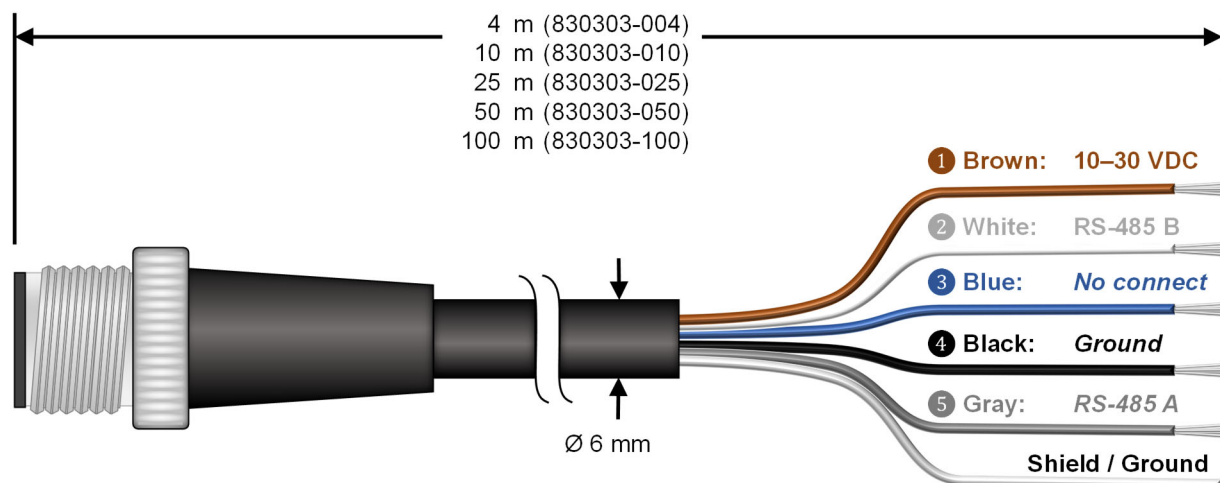


Figure 4-1: Wire colors for 830303 M12 power & RS485 cable

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

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

4.3 Protecting Unused Wires

Protect any unused wires from accidental contact by cutting to unequal lengths, folding back, and insulating, as shown in **Figure 4-2**.

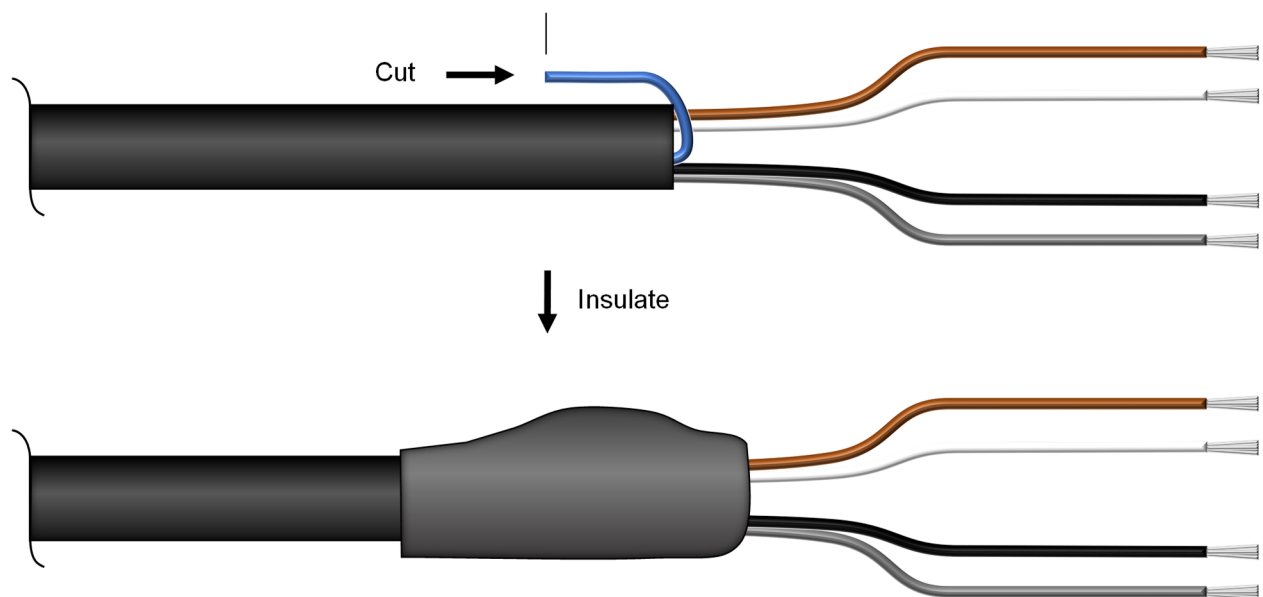


Figure 4-2: Protecting unused wires from accidental contact

5 Configuration

5.1 Documentation

Before starting configuration or programming, visit support.atonometrics.com and get the latest copy of this document (RC22 User Guide, document 880095).

5.2 Configuration Kit

The Configuration Kit (810276), sold separately, allows you to conveniently power your RC22 unit, perform configuration, and test communication and system status. Relevant kit contents are shown in **Figure 5-1**.

Note: The 810276 Configuration Kit supports multiple products. It may include some accessories that are not required for RC22 and are not shown below.

Note: The kit is optional. You may duplicate its functions with your own supplied equipment and cables if desired.

5-pin Power / RS485

To RC22



5 M pins 830296 8 F pins

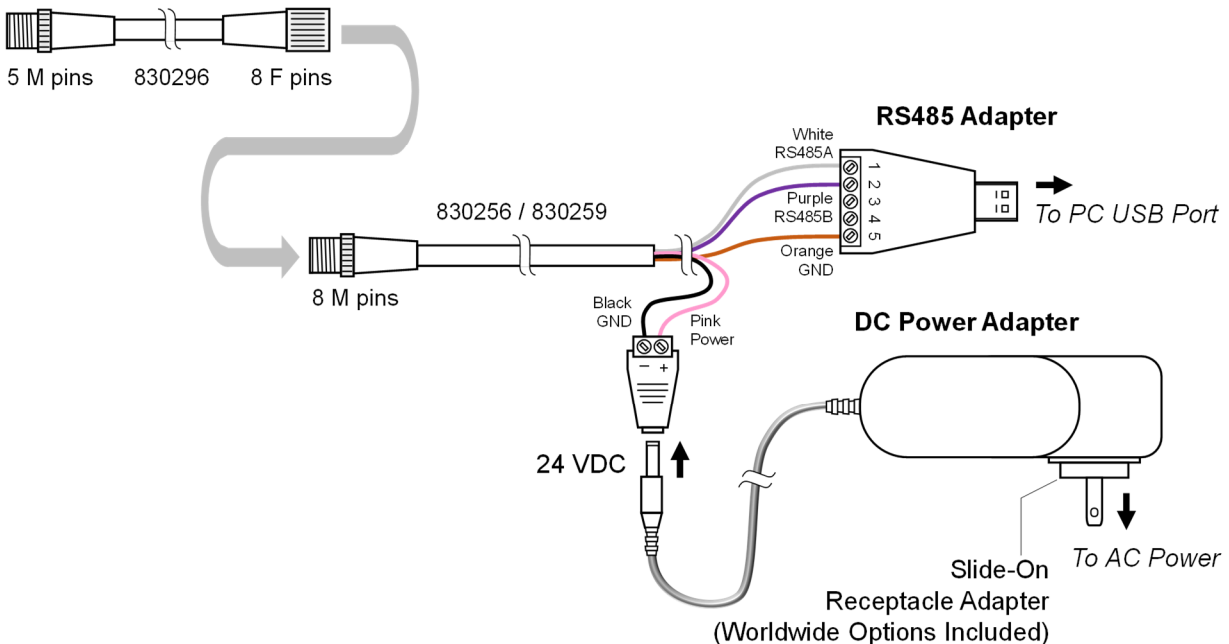


Figure 5-1: Using Configuration Kit 810276 (sold separately) with RC22

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 RC22 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.

5.3 Configuration Manager Software

RC22 Configuration Manager Software (500099) allows you to connect to your RC22, 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.

5.4 Connect to RC22

Connect the Configuration Kit (or equivalent equipment) as described above in Section 5.2 and ensure the kit is powered.

Launch the RC22 Configuration Manager Software on your PC.

From RC22 Configuration Manager, use the Connect tab shown in **Figure 5-2** to connect to your RC22 unit as follows:

- 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 RC22 unit, Scan for the RC22 using the Find and Connect button. The software will attempt to discover your RC22 address, baud rate, and data format.
- If you know your Modbus communication settings, you may enter these in the Connect Manually box and press the Connect button.

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 5-2: Connecting to RC22

Once your RC22 unit is connected, the software will display the Connected status, as shown in **Figure 5-3**. Your unit's firmware version, serial number, and part number will also be displayed at the top of the screen.

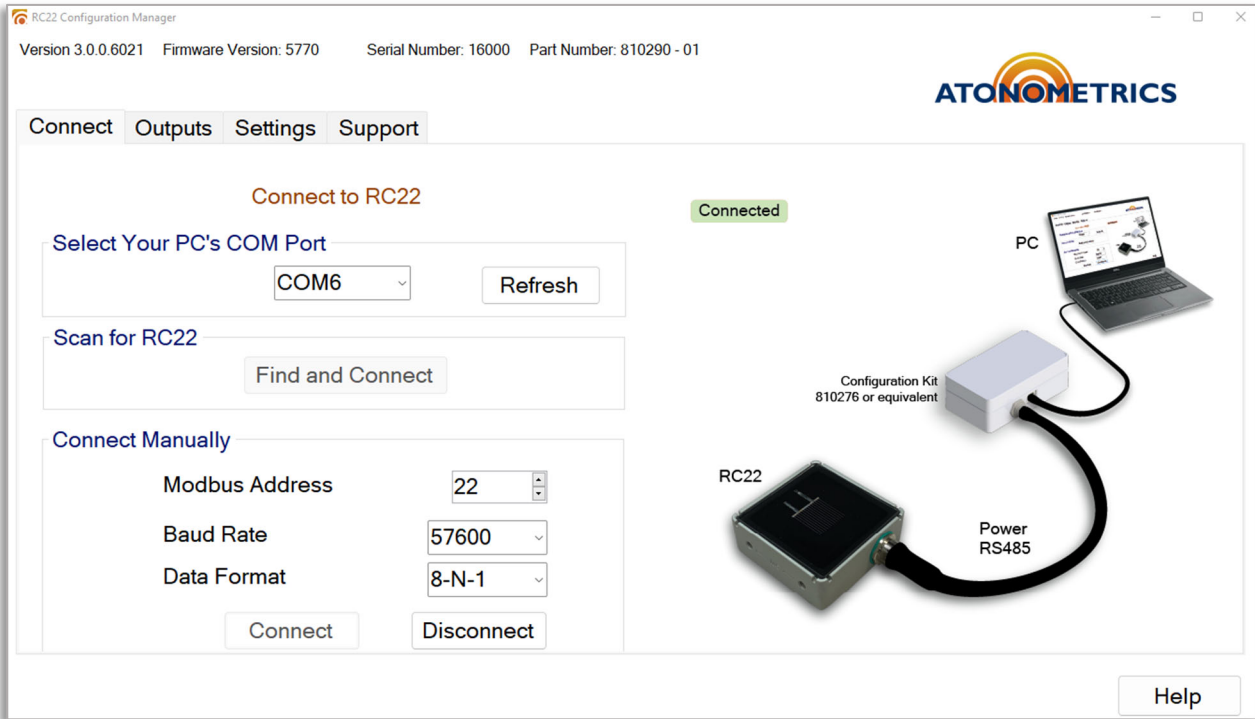


Figure 5-3: RC22 connected

5.6 Setting Communication Parameters

Your RC22 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 RC22 Configuration Manager, shown in **Figure 5-4**.

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.

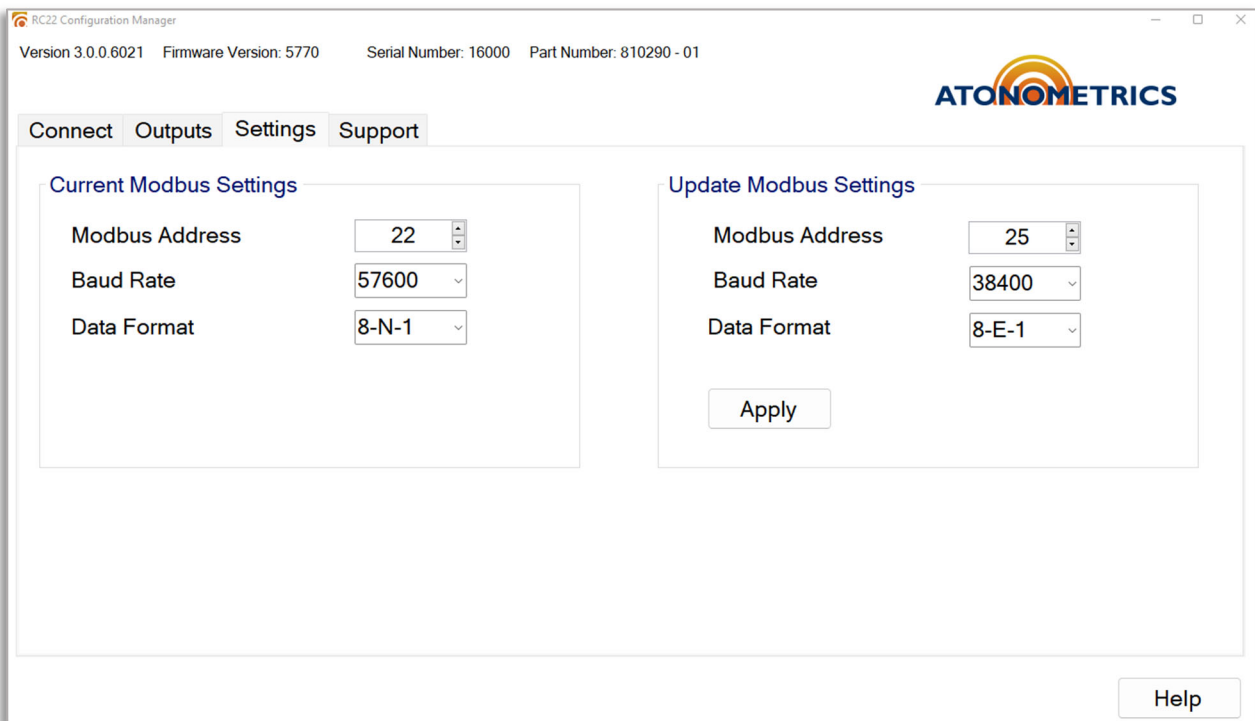


Figure 5-4: Setting communication parameters

5.8 Checking Output Data

Use the Outputs tab to check the measurement results from your unit, as shown in **Figure 5-5**. The tab displays your RC22's measured irradiance, I_{sc} , and cell temperature.

The readings on the Outputs tab will update continuously. To pause the readings, click the Pause button, causing the readings to freeze on their current values, as shown in **Figure 5-6**. To resume the automatic update of readings, click Resume.

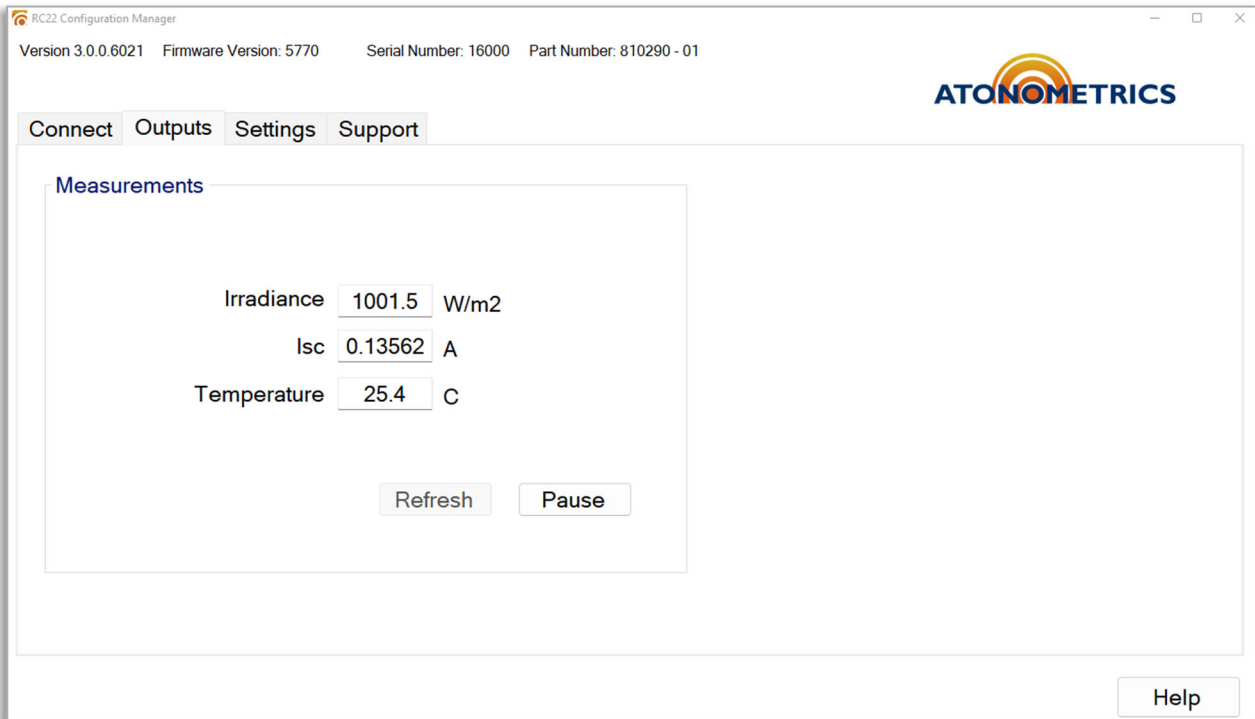


Figure 5-5: Checking output data, with outputs continuously updating

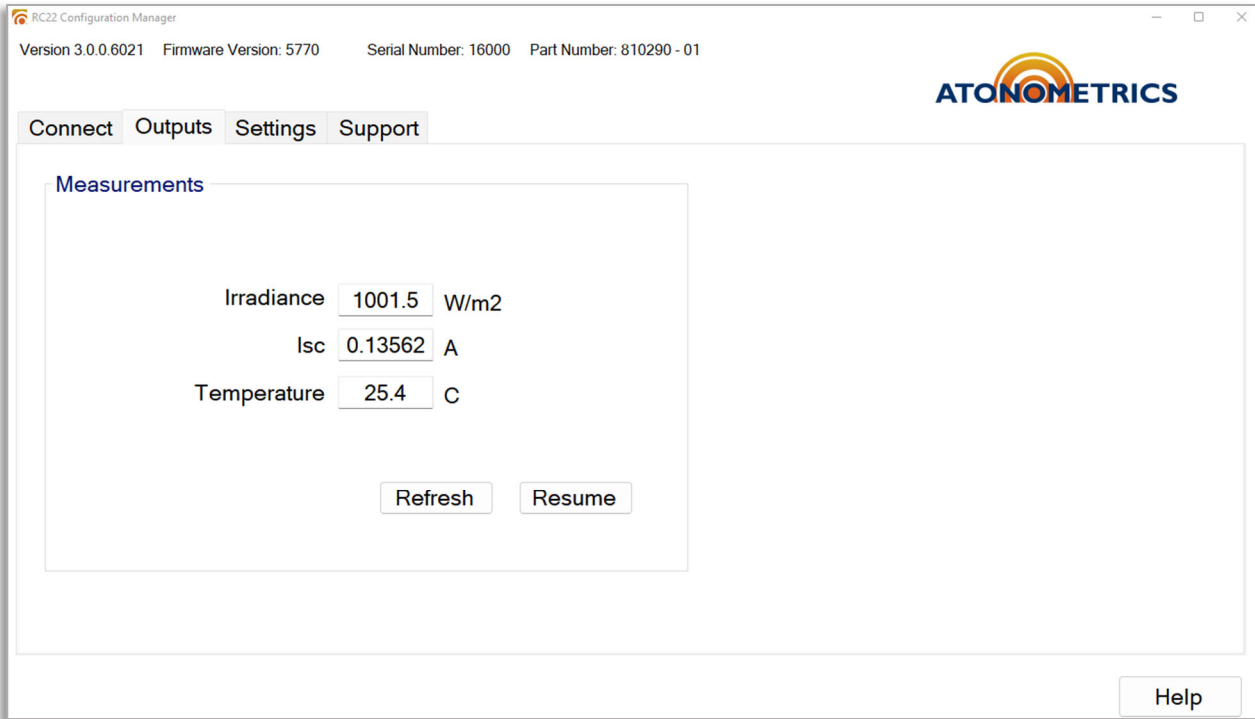


Figure 5-6: Checking output data, with outputs paused

5.9 Updating Firmware

To obtain the latest firmware for RC22, visit support.atonometrics.com. If a firmware update is available, download the file to your PC.

To install a firmware update, use the Support tab of RC22 Configuration Manager software, shown in **Figure 5-7**, to upload the firmware file to your device.

Note: As shown below, the Support tab also provides convenient links to the Atonometrics support website for obtaining product documentation or support.

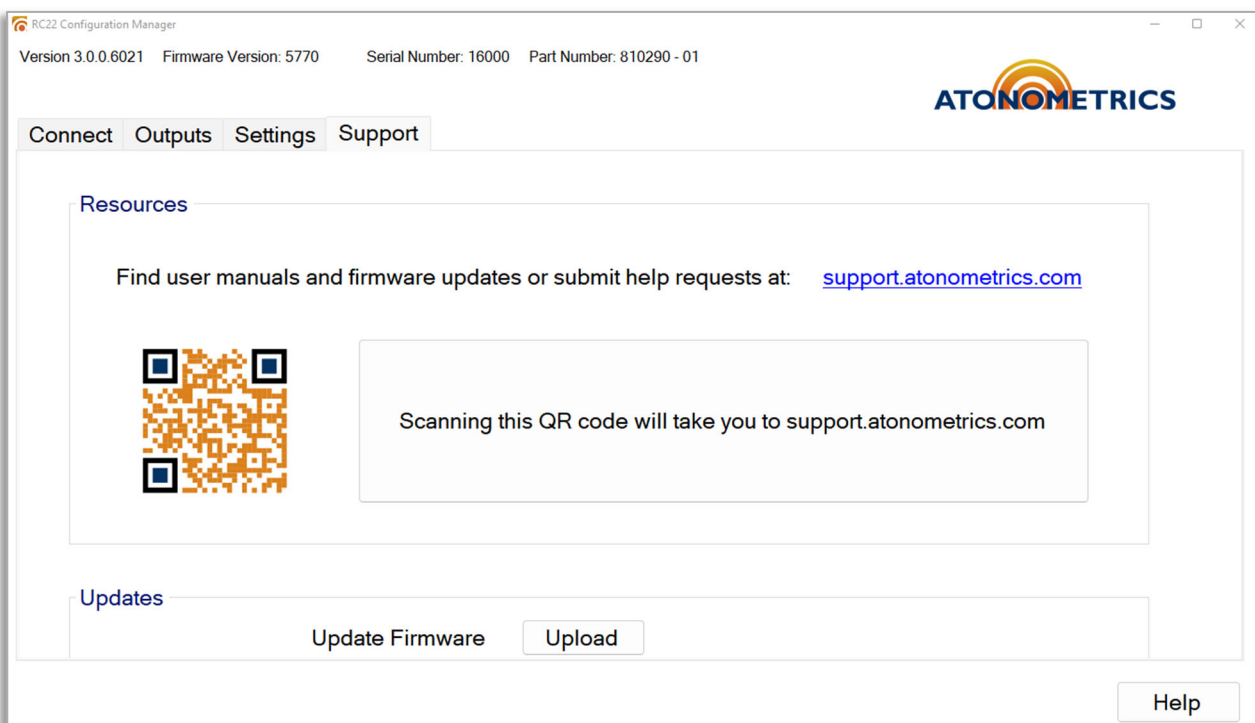


Figure 5-7: Support tab

6 Modbus

Table 6-1 lists the registers available for your client software to read data from the RC22 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 6-1 to determine the Modbus address.

Note: Recommended parameters for Modbus communication are scan period ≥ 1 s, timeout ≥ 200 ms, delay between polls ≥ 30 ms. Do not poll the unit more than once per second. Using shorter timeouts may result in communication errors.

Table 6-1: Modbus map

Register Start	Register End	Parameter Name	Units	Data Format	Bytes	Description
1	2	Irradiance	W/m ²	Float32	4	Measured irradiance
3	4	Short-Circuit Current	A	Float32	4	Measured short-circuit current of the PV cell
5	6	PV Temperature	°C	Float32	4	Measured temperature of the PV cell

7 Specifications

Table 7-1: Specifications

Main Data	Model name	RC22 Series
	Part number	810290
	Measurement range	0 to 1500 W/m ²
	Resolution	0.1 W/m ²
	Operating temperature	-40 to 80 °C
	Input power	10-30 VDC
	Current consumption	10-15 mA
	PV cell	Crystalline Si, 20 mm x 20 mm
	Window	Low-iron solar glass
	Temperature measurement	Pt1000 RTD
	Calibration data	Internally calibrated; no calibration data to manage
	Setup	Optional configuration kit allows PC-based setup
	Protocol	Modbus over RS485 (RTU), user-settable address
	Baud rate	9600, 19200, 38400, 57600
Enclosure	Material	Anodized aluminum housing
	Ingress protection	IP67
Dimensions	Dimensions	2.56 x 2.56 x 0.96 in / 65 x 65 x 24.4 mm
	Weight	0.375 lbs / 170 g
	Mounting	Side and bottom mounting holes
		Multi-option mounting brackets
Cable	Type	Shielded, UV-rated, 24 awg / 0.2 mm ²
	Length options	4 m, 10 m, 25 m, 50 m, 100 m (order separately)
		Optional Y-cable for multi-sensor networks
	Connector	M12 circular connector, IP67
	Pinout	Power, Ground, RS485 A & B, Shield
Measurement	Irradiance calibration	1000 W/m ² (STC) and 135 W/m ² (BSTC)
	Irradiance uncertainty	± 2.0% @ 1000 W/m ²
	Cell temperature	± 1 °C
	Stability	0.5% / year
Standards		IEC 61724-1 Class A, IEC 60904-2, CE