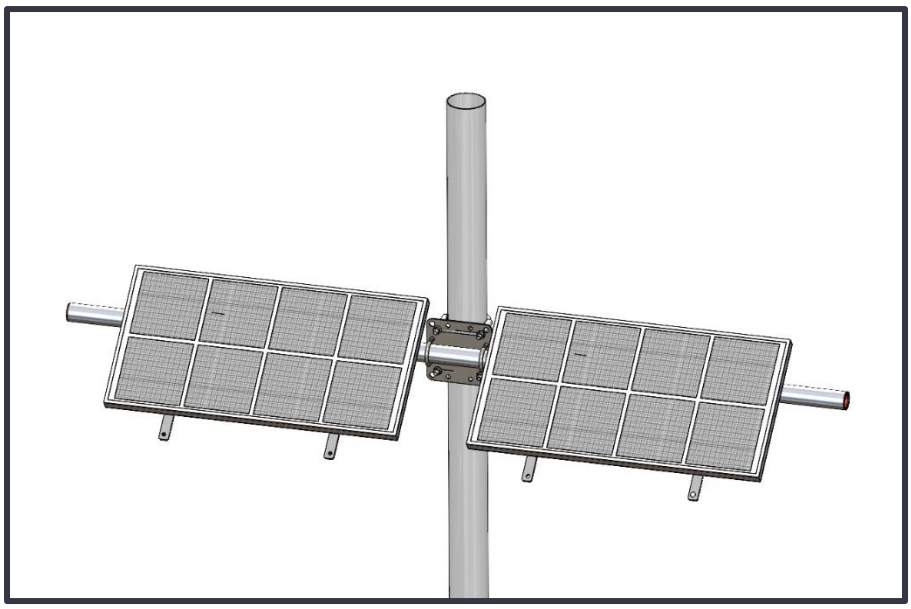


Introduction

These instructions explain how to use the NRG Systems 35W Soiling Measurement Kit with a SymphoniePRO Data Logger. The physical installation of kit #15152, the complete 35W tower-mounted kit is covered first, followed by wiring and SymphoniePRO logger configuration for all NRG Soiling Measurement Kit designs.

Kit #15152 utilizes the NRG PVT1 PV Temperature Sensor to measure back-of-module (BoM) temperature. The previous version of the Soiling Measurement Kit (#14586) utilized IMT BoM temperature sensors. Please contact NRG Technical Services for Rev 4.0 of this document, which contains information about kit #14586.

The standard Soiling Measurement Kit (#15152) is designed to use the NRG Pipe Boom mounting system. The procedure for mounting that system to an NRG Solar Tower is in the section below.

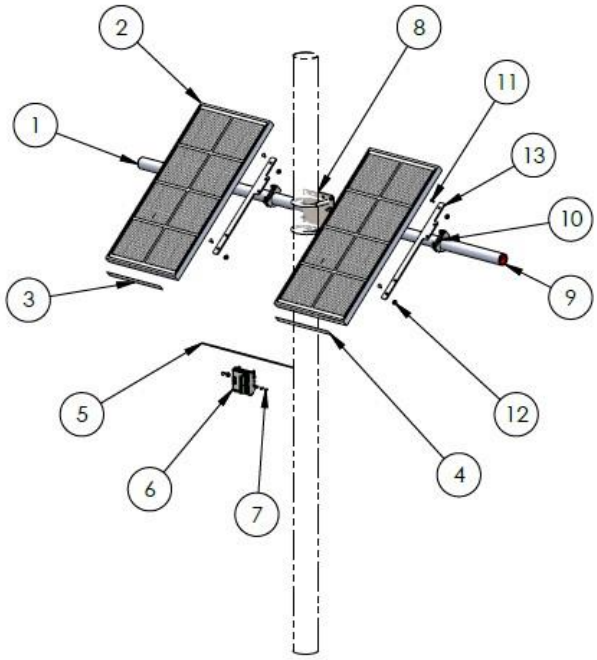
Using Alternative Mounting Methods

When using the Soiling Measurement Kit with a different mounting design, skip this section and use the mounting instructions that pertain to your specific design instead. The wiring & configuration procedures remain the same though and are covered in these instructions in subsequent sections.

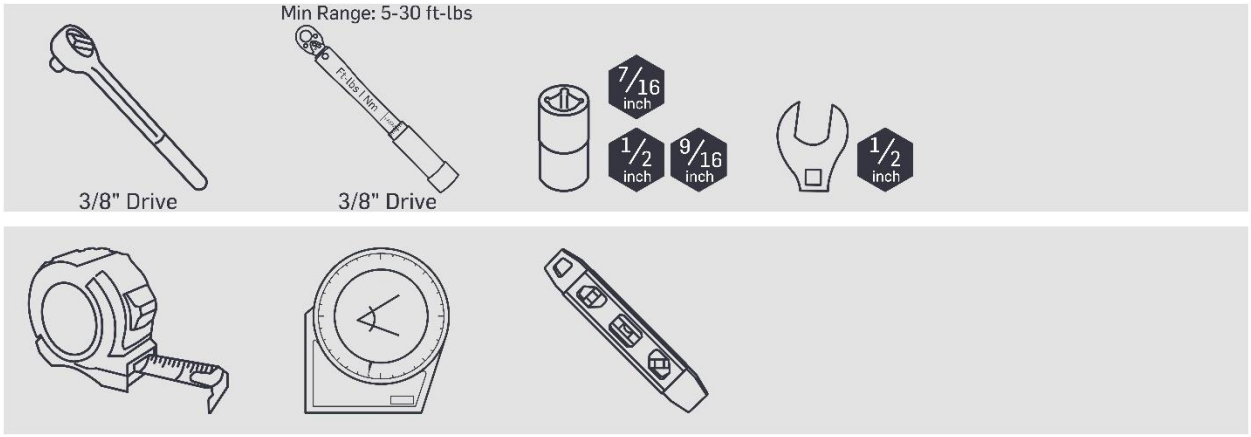
#15152: Parts/BOM

NRG Part Number	Part Description	Part Specification	Qty	Diagram Key
14593	Mounting Boom	6061 Aluminum | Sch. 40 | 1.65” nominal OD | 72” length	1	1
15151	(2) 35 W PV Panels	Matched pair for soiling w/ PVT1 Back of Module Temperature Sensors attached.	1	2
11044	Clean label	Outdoor label - “Clean”	1	3
11046	Dirty label	Outdoor label - “Dirty”	1	4
11068	6C cable	6C | 18” long	1	5
15210	Interface Module	Soiling Station Interface Module	1	6
11233	Self-tapping Screw	#8x.375” Self-Tapping Hex Screw	3	7
14092	Mounting Bracket	0.17” Thickness | Stainless	1	8
14232	Clamping U-bolt	3.625” ID | Zinc-plated steel | With nuts	2	8
14099	Clamping U-bolt	1.75” ID | Galvanized steel | With nuts	2	8
14391	Pipe Cap	Pipe Cap | 1.25” ID nominal	2	9
14223	Clamping U-Bolt	1.75” ID | 5/16-18 thread | w/ Clamp	5	10
15870	Carriage Bolt	1/4-20 thread | .75” length | Stainless	9	11
15869	Locknut	Serrated flange | 1/4-20 thread | Stainless	9	12
15651	Mounting Plate	.19” thickness | Aluminum	4	13

Exploded Diagram



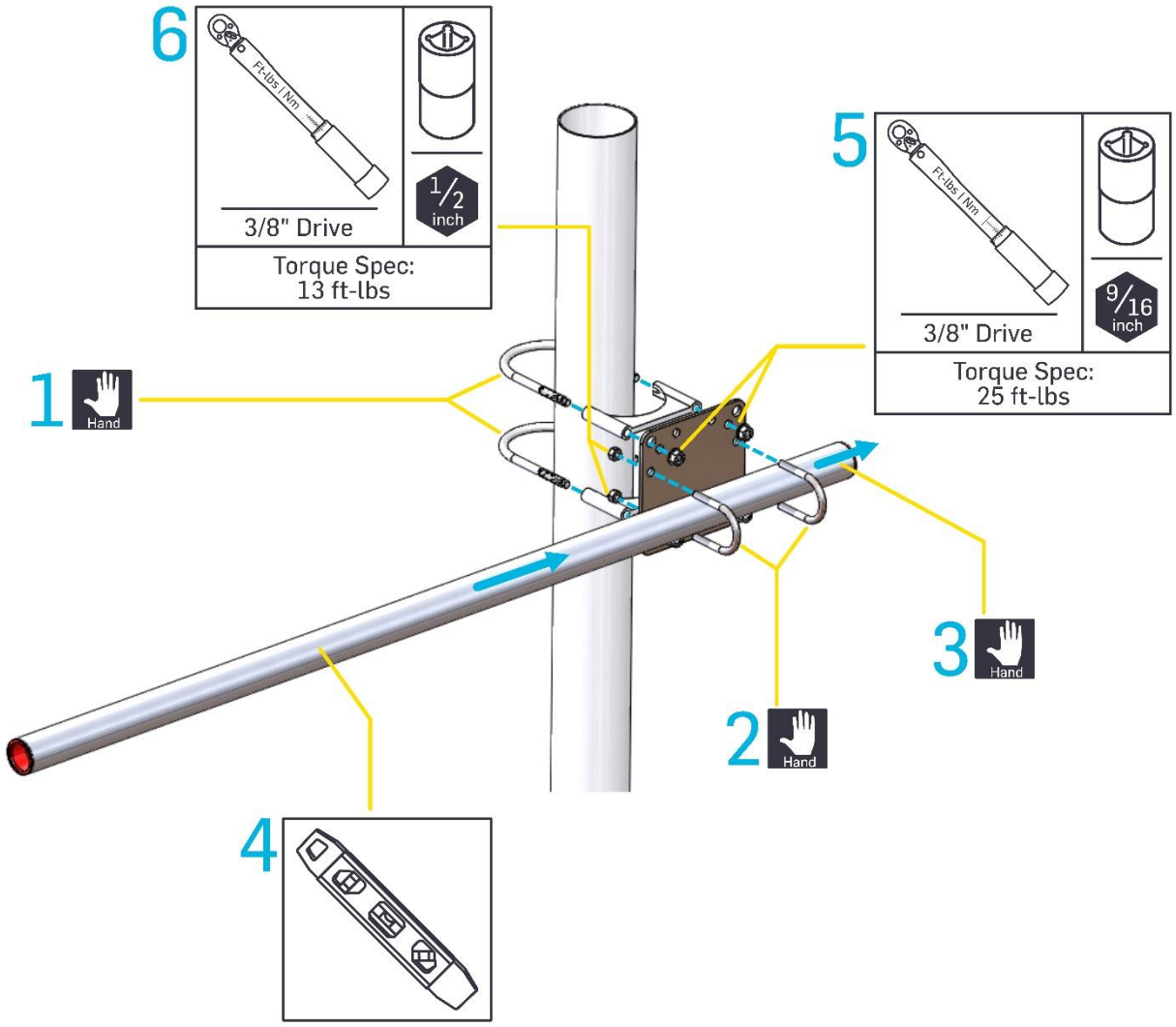
#15152: Assembly Tools



Procedures

Boom Mounting & Assembly

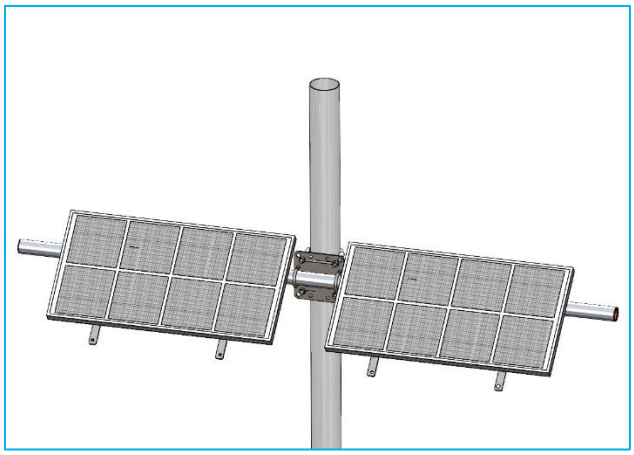
1. Place the bracket against the tower tube and feed two 3.625” U-bolts around the tower, through the clamping piece, and through the appropriate holes in the bracket.
2. Feed the 1.75” galvanized U-bolts through the appropriate holes in the bracket, from the side opposite of the tower. Thread the galvanized nuts onto the end threads of each U-bolt.
3. Feed the Sch. 40 aluminum pipe through the galvanized U-bolts to the desired location, depending on the intended length of boom on each side of the tower.
4. Orient the boom to your desired heading and level.
5. Torque the 3.625” U-bolt nuts to spec.
6. Torque the 1.75” U-bolt nuts to spec.

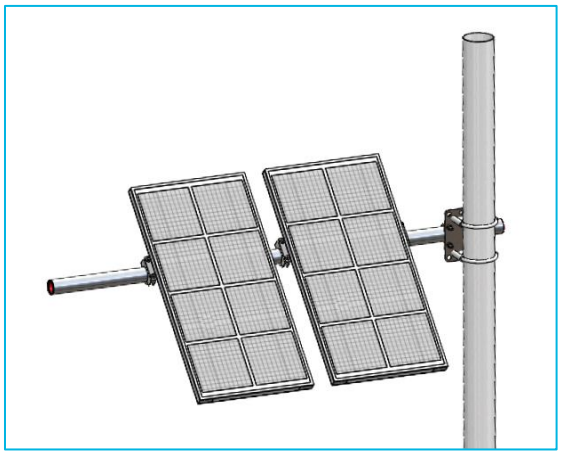


35W PV Panel Pair Mounting

PV Panel Orientation

The PV Mounting Plates (#15869) are designed to accommodate horizontal layout (“landscape”) or vertical (“portrait”) of the 35W PV panels.





The procedure below shows the panels being mounted in portrait orientation. Where appropriate, notes have been added for mounting the panels in the landscape orientation.

Procedure

1 Determine if the panels will be installed in a horizontal layout (“landscape”) or vertical (“portrait”).

Horizontal is the ideal orientation but may not be possible due to the layout of the tower or the amount of boom available on one side of the mounting bracket.

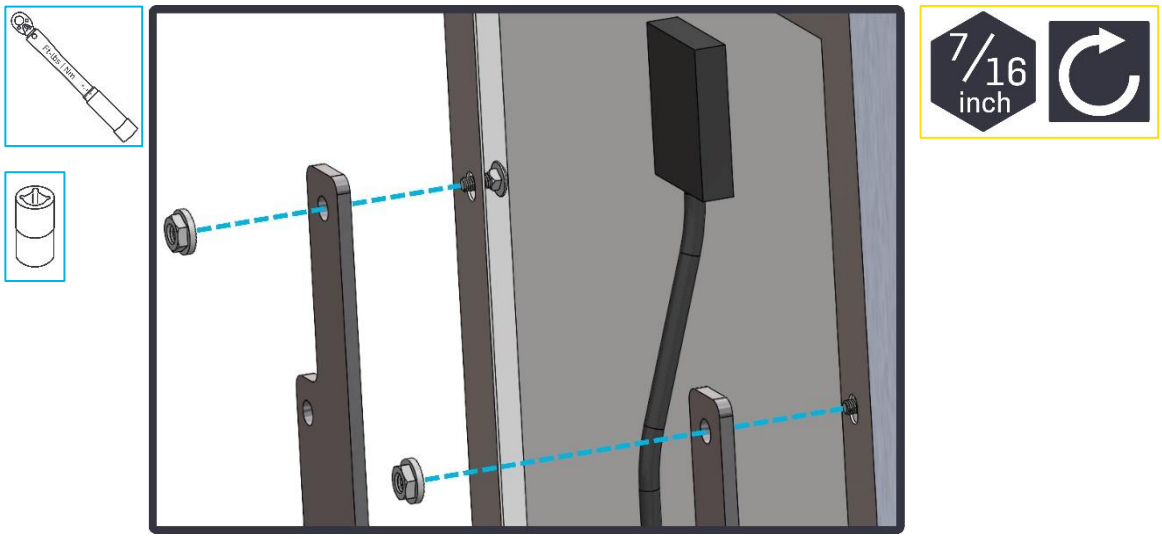
Ensure that no shadowing of the PV panels by other booms and sensors occurs at the desired mounting location. This is important for the collection of accurate data by the panels.

When installing PV panels in the horizontal layout, complete Step 3 (Attach the PV Mounting Plates to the pipe boom) prior to Step 2 (Attach the PV panels to the PV Mounting Plates).
The clamping U-bolts are covered by the PV panels in the horizontal layout, making it more difficult to thread nuts onto the U-bolts.

2 Attach the 35W PV panels to the PV Mounting Plates.

Use the 1/4-20 carriage bolts (#15870) & serrated flange locknuts (#15869) to attach the PV Mounting Plates (#15651) to the 35W PV panels.

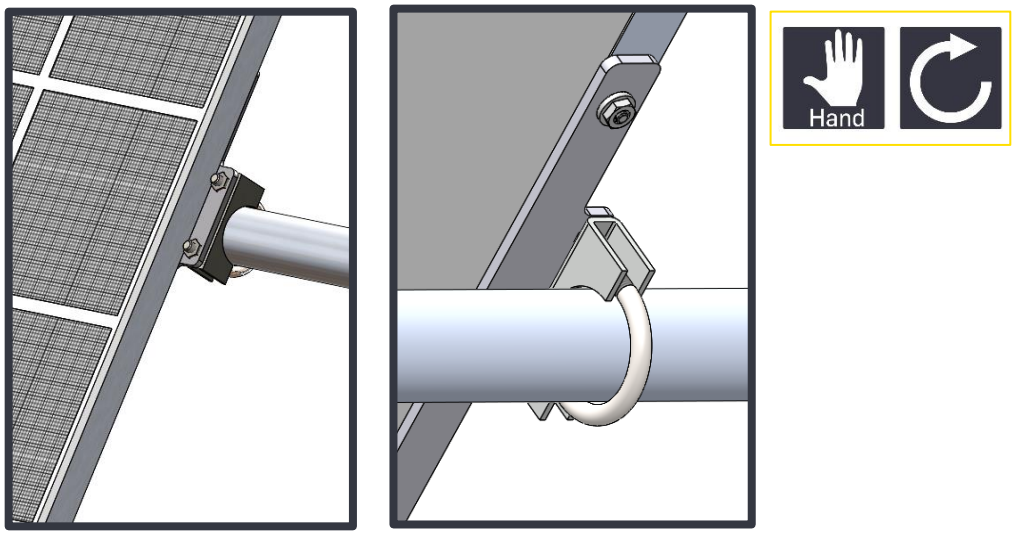
Torque locknuts to 8 ft-lbs.



The PV Mounting Plates can be attached to the 35W PV panels in either portrait or landscape orientation.

3 Attach the PV Mounting Plates to the pipe boom.

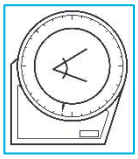
Install two clamping U-bolts (#14223) on each PV Mounting Plate in the holes located outside the PV panel frame.



Keep the U-bolts loose so the PV panel can slide on the boom.

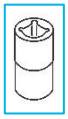
4 Install panels on mounting boom and set to desired angle.

- Slide the panels onto the mounting boom
- Tighten slightly so they stay in place but can be adjusted by hand.
- Use an angle finder to set the angle of the panels to the same angle as the Production PV panels on the solar farm.
- Once at the correct angel, tighten the U-bolts until they are locked in place.
- Clean the bottom edge of the PV panels with an alcohol wipe to remove dirt.



5 **Fix the panels in place on the boom.**
Once the panels are at the desired location and correct angle, torque the U-bolt nuts in place to secure them.

- Torque specifications: **13 ft-lbs (17.6 Nm)**



Portrait

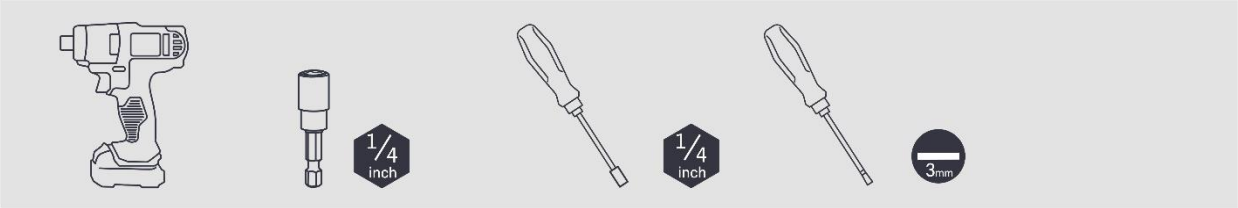
Landscape

6 Label the panels using the “CLEAN” and “DIRTY” stickers supplied with the kit.

The panels are now mounted, secured, and ready to be connected to the Interface Module.

Logger Wiring & Configuration

Wiring Tools

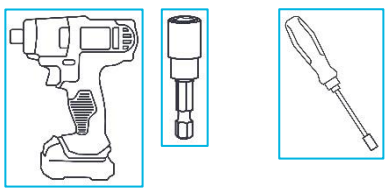


SymphoniePRO Wiring Procedure

1 Install the DIN rail section in the shelter box.

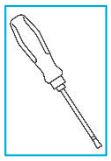
- Unplug and remove the SymphoniePRO wiring panel cable.
- Attach DIN rail to the back plate of the FRP shelter box approximately 9” from the bottom of the shelter box, using the 3M VHB tape affixed to the back of the rail.

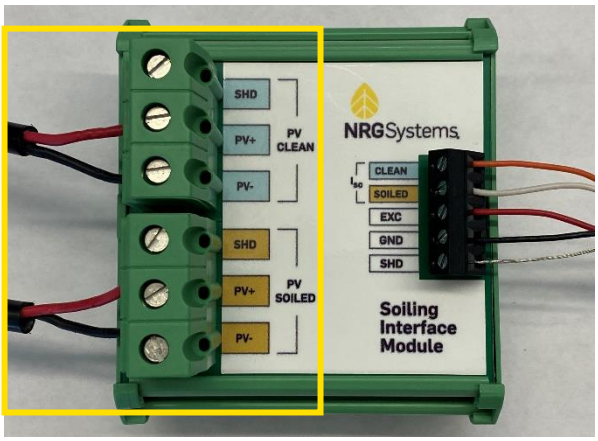
If desired, the DIN rail can be affixed to the back plate using the supplied self-tapping screws.



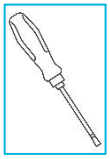
2 Wire PV panels into Interface Module.

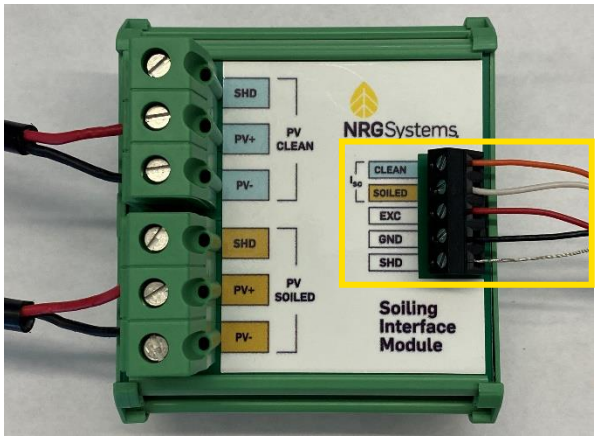
- Feed the PV panel wires down the tower and into the shelter box.
- Wire the leads from the “Clean” PV panel into the ‘PV Clean’ terminals.
- Wire the leads from the “Dirty” PV panel into the ‘PV Soiled’ terminals.





3 Wire the 4C cable to the Interface Module outputs.





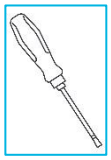
4 Attach the Interface Module to the DIN rail.

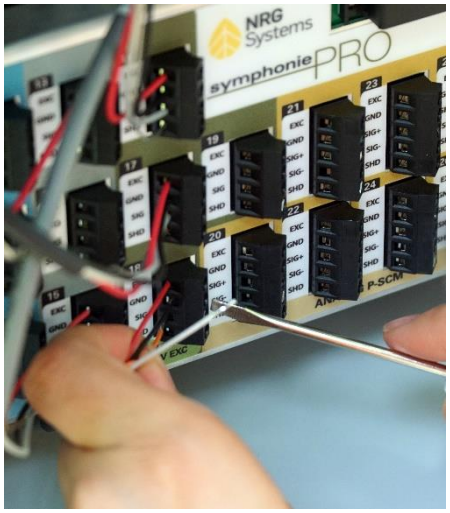
The Interface Module snaps into place on the DIN rail. The electronics enclosure is a standard piece designed for this purpose.

After mounting to the DIN rail, feed the short 4C cable down under the 26-Channel Wiring Panel and to the terminals they will be connected to.

5 Wire Interface Module into logger wiring panel.

Wire the short 4C cable from the Interface Module into the data logger wiring panel.





The following channels may be used:

- **Channels: 16-19 | No P-SCM**
- **Channels 20-26 | P-SCM #9132**

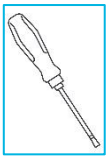
Interface Module Wiring Key:

Interface Module	Wire Color	Channel Input
Isc Clean	Orange	CH **18** SIG
Isc Soiled	White	CH **19** SIG
EXC	Red	CH **18** EXC
GND	Black	CH **18** GND

***Note**: When using a different set of channels than those shown above, connect the EXC & GND wires to the same channel as the Isc Clean wire.*

6 Wire PVT1 into the wiring panel.

Feed the wires from the PVT1 Back-of-Module temperature sensors into the shelter box and to the wiring panel.



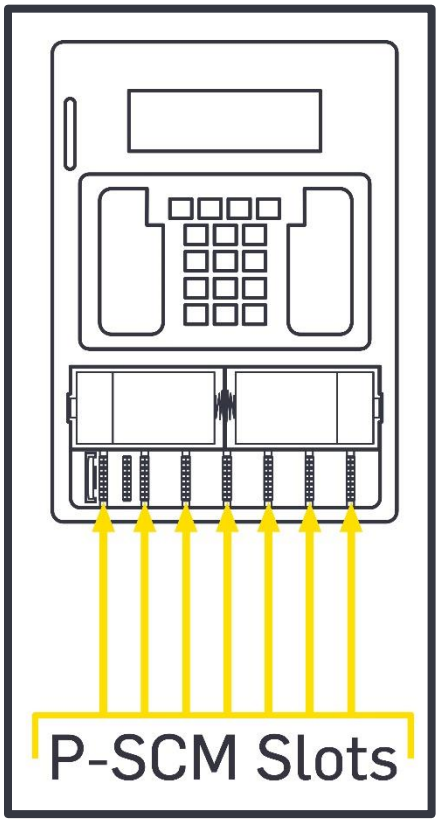
- **Channels: 20-26**
- **P-SCM: #9420**

PVT1 wiring key:

PVT1 Wire Color	Logger Terminal
Red	EXC
Black	GND
Green	SIG+
White	SIG-
Bare Wire	SHD

7 Install P-SCM cards into the PRO logger.

- Install each P-SCM in the channels corresponding to each sensor wire connection on the wiring panel.
- The P-SCM slots are labeled with their channel.



Isc Clean and Dirty:

- **Channels: 16-19 | No P-SCM**
- **Channels 20-26 | P-SCM #9132**

NRG PVT1 Back-of-Module Temperature:

- **Channels 20-26 | P-SCM #9420**

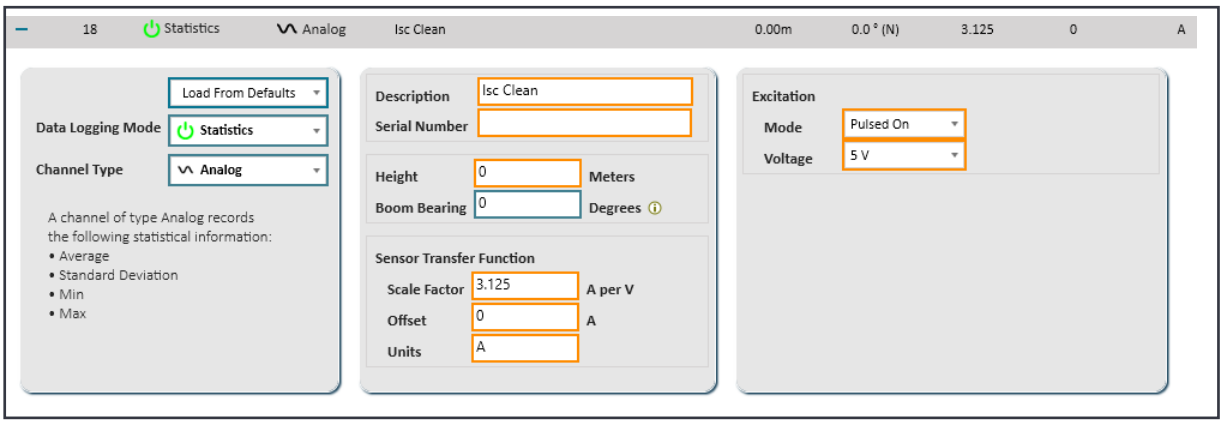
SymphoniePRO Configuration

Use the SymphoniePRO Desktop App to do the following configuration steps.

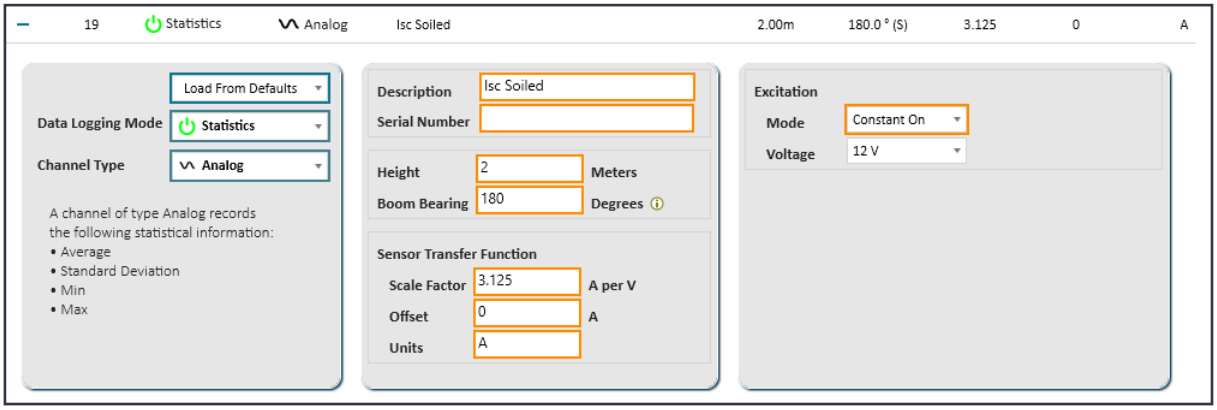
1 Configure the Isc Channels:

Isc Clean:

- ***If using Ch. 16-19,*** click **Load from Defaults** and choose "NRG RH5X Humidity" from the drop-down
- ***If using Ch. 20-26***, click **Load from Defaults** and choose "Custom Analog (0-5V)" from the drop-down
- Change the **Description** to "Isc Clean"
- Enter **Height** and **Boom Bearing** (the direction the panels are facing)
- Enter a **Scale Factor** of "3.125", an **Offset** of "0" and **Units** "A" (for Amps)



Repeat the configuration steps for the channel being used for Isc Dirty:

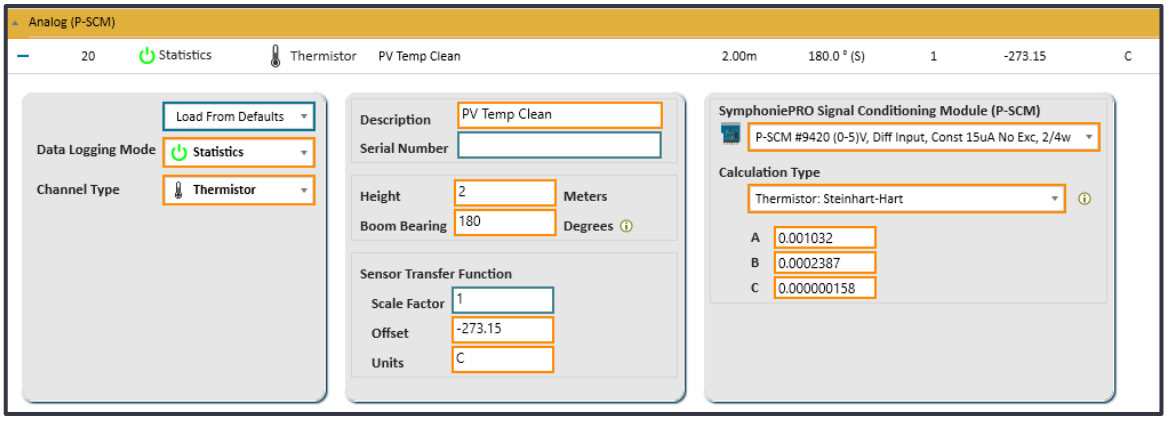


Configure the PVT1 Channels:

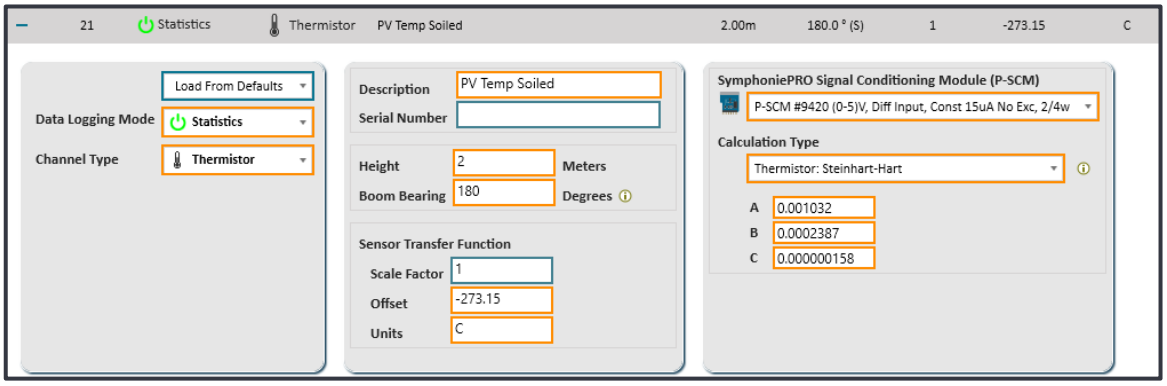
2

PV Temp Clean:

- The NRG PVT1 sensors must go on channels 20-26
- Click **Load from Defaults** and choose “NRG PVT1 PV Temperature Sensor” from the drop-down
- Change the **Description** to “PV Temp Clean”
- Enter the **Serial Number** from the end of the sensor cable.
- Enter **Height** and **Boom Bearing** (the direction the panels are facing)
- Leave the **Scale Factor** and **Offset** as they are.
- Make sure there is a P-SCM #9420 is installed in the P-SCM compartment.



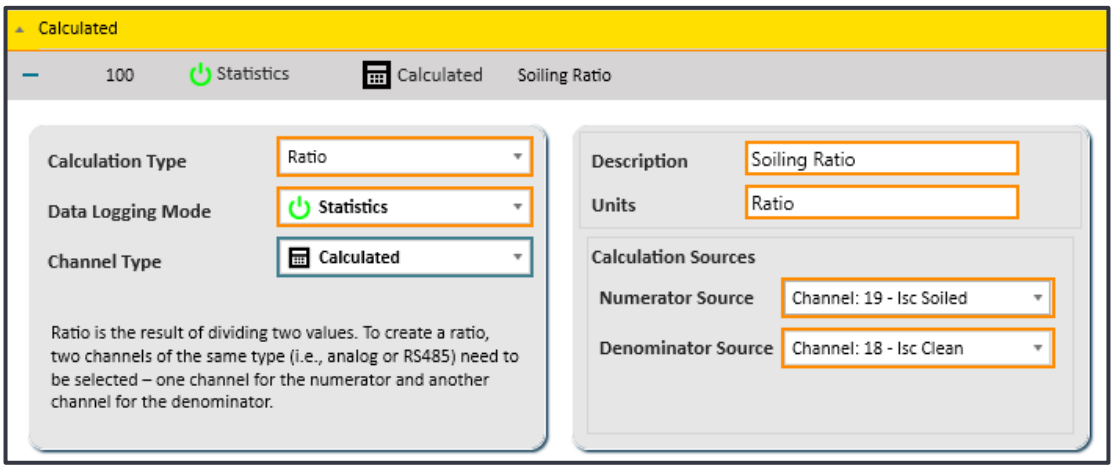
Repeat the configuration steps for the channel being used for PV Temp Dirty:



3 Configure Soiling Ratio on a Calculated Channel.

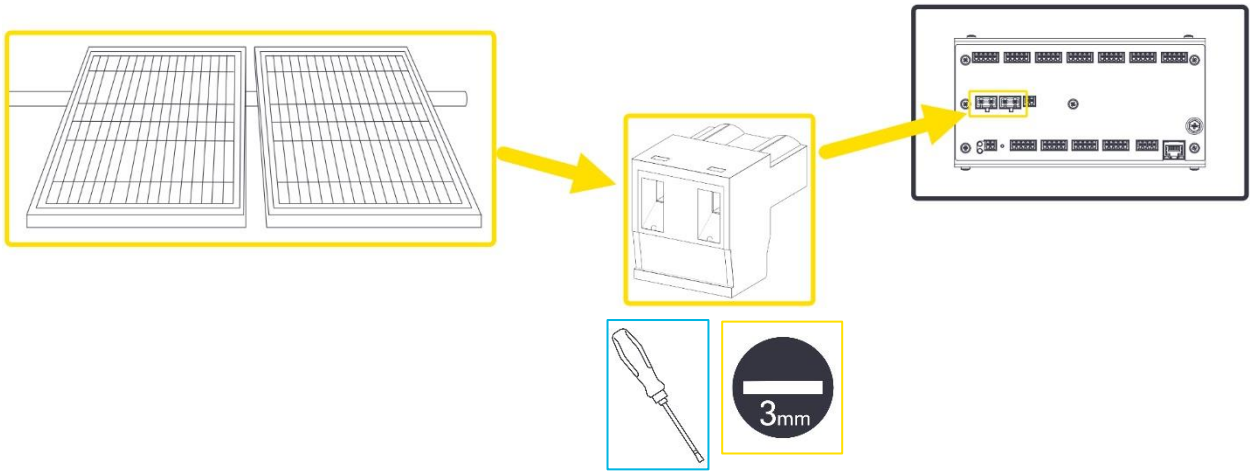
The SymphoniePRO can calculate the soiling ratio from the Isc Clean and Isc Soiled inputs. To activate this feature, scroll down to channel 100.

- Choose “Ratio” from the **Calculation Type** drop down menu
- Edit the **Description** to say “Soiling Ratio”
- Edit the **Units** to say “Ratio”
- Choose the **Isc Soiled** channel as the **Numerator Source**
- Chose the **Isc Clean** channel as the **Denominator Source**



LOGR-S Wiring

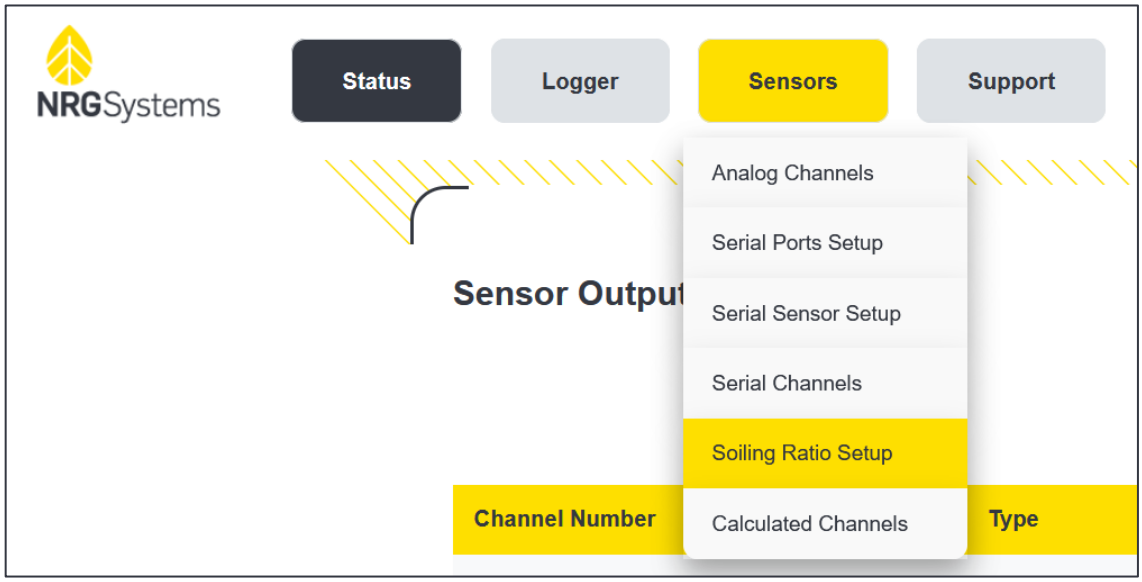
Connect the leads from the “Clean” & “Dirty” PV panels to the dedicated terminals on the front of the LOGR-S enclosure. They are labeled “PV SOIL” & “PV CLEAN” above each removeable terminal block.



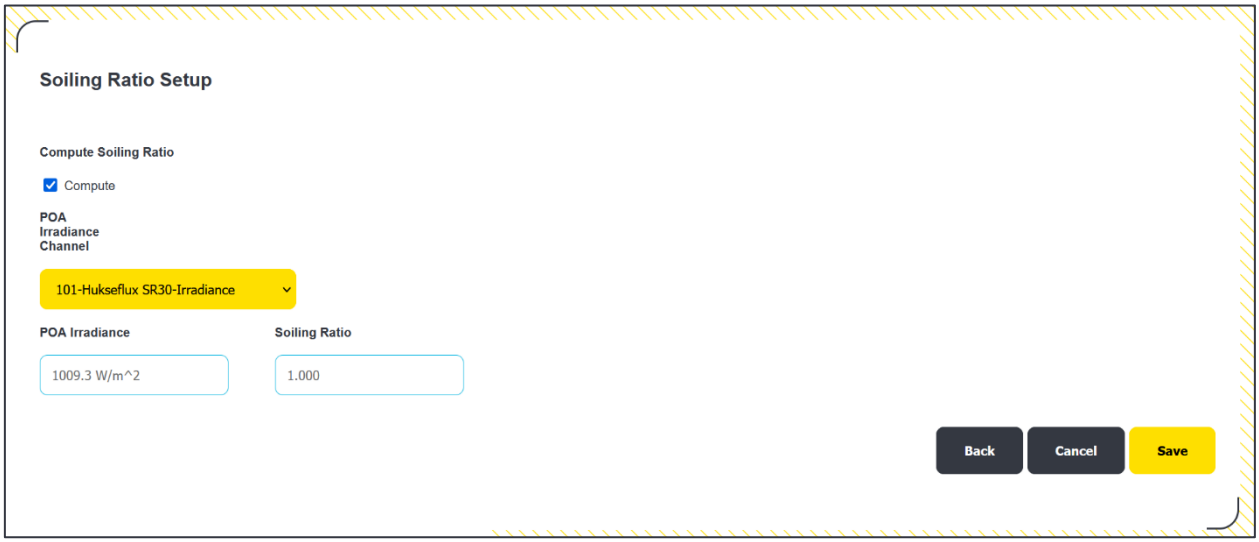
LOGR-S Configuration

Use the LOGR-S Web Interface to complete the following steps.

1 Select **Soiling Ratio Setup** from the Sensors dropdown menu on the web server.



2 Check the **Compute** checkbox in the **Soiling Ratio Setup** section and select the channel that matches a POA Irradiance measurement with the dropdown menu. Click the yellow **Save** button.



LOGR-S Panel Cleaning

When the "Clean" panel has been cleaned, access this page and click the yellow **Clean Panel** button to record the event in the log.

Site Maintenance

- Back-of-panel temperature and short-circuit current for each panel are continuously measured by the system, and (typically) averaged each minute.

- The clean panel should be regularly cleaned thoroughly with deionized water and a soft, non-abrasive cloth (about once a week or as recommended by your analyst). Deionized water is free from calcium and salt so it will not leave deposits on your PV panels.

- Certain sites may have very abrasive mineral deposits, so be mindful of abrasion when cleaning the PV panels.

- Rainfall also has a natural cleaning effect and should also be recorded at the site with an instrument such as a tipping bucket rain gauge connected to the same data logger.

Data Processing

- The measured values (Temp CLEAN, Isc CLEAN, Temp SOILED, Isc SOILED) can be used to determine a Soiling Ratio which compares the soiled PV output to the clean PV output. By monitoring the soiling ratio over time and using additional analysis techniques, the potential impact of soiling losses on a PV farm's energy production can be characterized.

- The simplest of methods is to divide the soiled PV Isc by the clean PV Isc, which can be recorded by the data logger by activating a Calculated Channel.

- Note that other, more complex methods are often utilized. One good reference paper which defines a soiling ratio is called *"Accurately Measuring PV Soiling Losses with Soiling Station Employing Module Power Measurements"*. If you are unsure how to process the data, please consult with your analyst, as there are various ways to handle the data.