

Configuration and Normalization Guide for Multi-RDE300i Systems



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Table of Contents

1	Overview	3
2	Equipment and Software Required	4
3	Configuration.....	5
3.1	Designating Leader and Follower.....	5
3.2	Configure the Follower.....	6
3.3	Configure the Leader	9
3.4	Verify System Communication	11
4	Equipment Installation	13
5	Normalization	14
5.1	Setup.....	14
5.2	Verify System Operation.....	14
5.3	Perform Normalization	17

1 Overview

This document will guide you through the configuration and normalization of a system with two or more RDE300i units for soiling, bifacial gain, or other module-module comparison applications.

This guide presents instructions for applications where one RDE300i™ unit will be designated and configured as a Leader and the other units will be designated and configured as Followers.

The PV module on the Leader unit will serve as a reference for the PV modules on the Followers.

For soiling measurement applications:

- The PV module on the Leader unit should be routinely cleaned. It will be a clean reference for the modules on the Followers.
- The PV modules on the Follower units should be allowed to soil in the same way as other modules in the PV array.

For bifacial gain applications:

- The PV module on the Leader unit should be monofacial.
- The PV modules on the Follower units should be bifacial.

Section 3 (Configuration) may be completed in an office environment prior to field deployment. During configuration, one unit will be configured as the Leader and the remaining units will be configured as Followers.

Section 4 (Equipment Installation) and Section 5 (Normalization) must be completed in the field.

Following the steps in this document, you will normalize the Performance Index (P.I). This is equivalent to the initial calibration of the soiling ratio for soiling applications or bifacial gain for bifacial gain applications.

To successfully normalize the Performance Index, the normalization procedure must be completed on a clear sunny day within 2-3 hours of local solar noon.

The normalization procedure takes approximately 30 minutes to complete.

For more information on **RDE300i**, consult the RDE300i User Guide (880093), available from the Atonometrics website.

Note: Please read the entire RDE300i User Guide (880093) before undertaking the instructions in this guide.

2 Equipment and Software Required

Obtain the following equipment and software before performing the steps in this guide:

- Two or more RDE300i units
- Latest RDE300i firmware
 - Acquire the latest firmware version from support.atonometrics.com.
- PV Modules for RDE300i units
- Power and Communication Cables (830284 and 830303)
- Configuration Kit (810235-01 or 810276)
- Latest RDE300i Configuration Manager Software (500092)
 - Acquire the latest version from support.atonometrics.com
- RDE300i User Guide (880093)
- Laptop or PC (Windows 7 or Higher)



Figure 2-1: Connecting your laptop PC to the RDE300i

Note: For more information on RDE300i Configuration Manager Software (500092), configuration kits (810235-01 or 810276), or to find software drivers, visit support.atonometrics.com.

3 Configuration

3.1 Designating Leader and Follower

This guide presents instructions for applications where one RDE300i™ unit will be designated and configured as a Leader and the other units will be designated and configured as Followers.

Power and data logger or SCADA communication connections will be made only to the Leader, while the Followers will connect to the Leader over the Leader's private Aux network.

The user's data logger or SCADA system will read all data from the Leader.

Prior to continuing with these instructions, designate one of your system's RDE300i units as Leader and the other units as Followers. Then, proceed.

Refer to **Figure 3-1** for proper cabling set up during Section 3 Configuration.

Note: For more information on RDE300i configuration options, including Solo, Leader, and Follower configurations, see the RDE300i User Guide (880093).

Note: For more information on RDE300i system configurations and cabling, see the Soiling Products Ordering Guide (880100), available from the Atonometrics website.

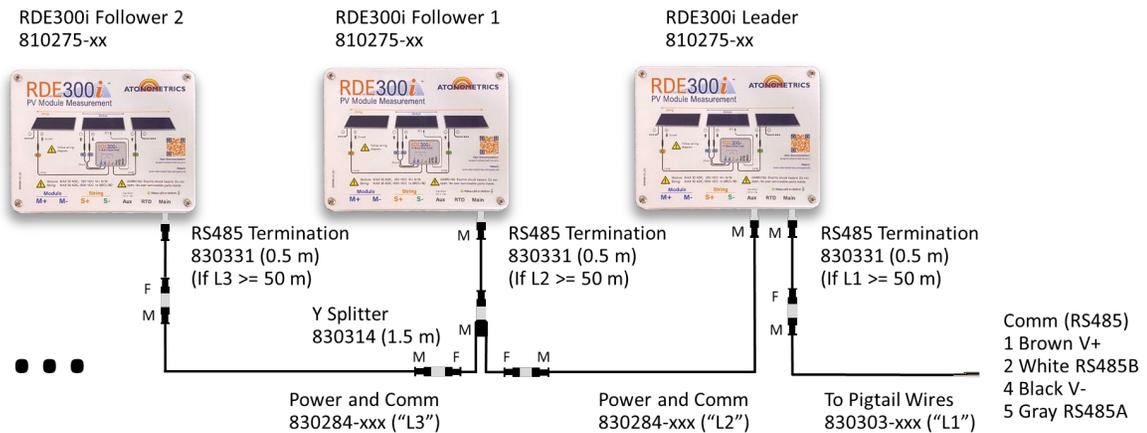


Figure 3-1: Multi-RDE300i system cabling diagram (example)

3.2 Configure the Follower

3.2.1 Connect to the Follower

Connect the Configuration Kit (or equivalent equipment) to the RDE300i unit you have designated as the first Follower and ensure the kit is powered.

Launch the RDE300i™ Configuration Manager Software on your PC.

From the RDE300i Configuration Manager, select the Connect tab and connect to your RDE300i Follower unit.

Select your PC's COM port corresponding to the USB/RS485 adapter of the Configuration Kit.

If the Modbus communication settings of your RDE300i are unknown, Scan for the RDE300i using the Find button. The software will attempt to discover your RDE300i address, baud rate, and data format.

If your Modbus communication settings are known, you may enter these in the Connect Manually box and press the Connect button.

Once your RDE300i unit is connected, the software will display the Connected status as shown in **Figure 3-2**.

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.

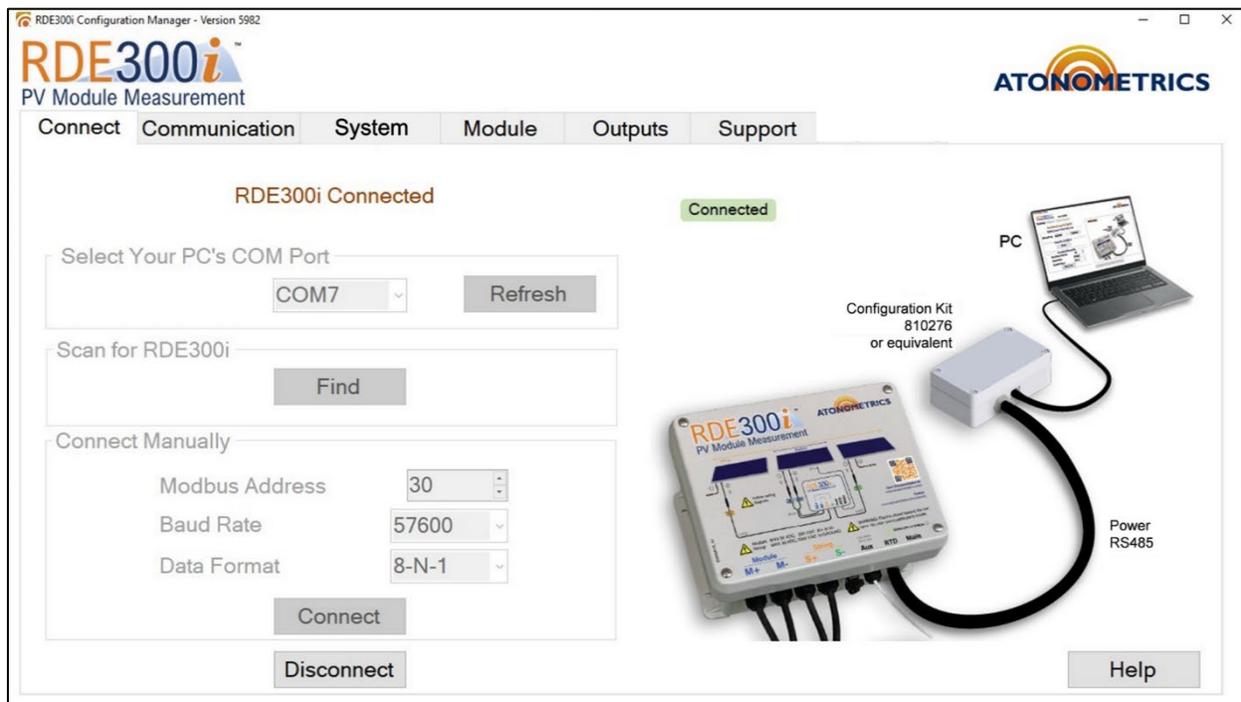


Figure 3-2: RDE300i connected

3.2.2 Configure as Follower

To set RDE300i to the Follower configuration, select the System tab, and select Follower from the Choose Device Configuration drop-down menu. Then, select 1st from the Follower drop-down menu corresponding to the first Follower unit, as shown in **Figure 3-3**, and press Apply.

The diagram displayed on the tab provides visual confirmation of the Follower operation and illustrates how the Follower works with a Leader.

The System Status box displays the operation status of the connected RDE300i as well as its part number, serial number, and installed firmware version.

Note: When RDE300i is set to the Follower configuration, the unit will operate using default Modbus communication parameters as shown in the diagram below. These parameters are not user settable. The Follower operates on the Leader's private Aux network, and user data acquisition is from the Leader only.

Note: If you are not connected to a PV module, you will see a yellow indicator, Status: Warning (1), and Event Code 100: Low module current/voltage in the system status box. This is okay for all of Section 3 Configuration.

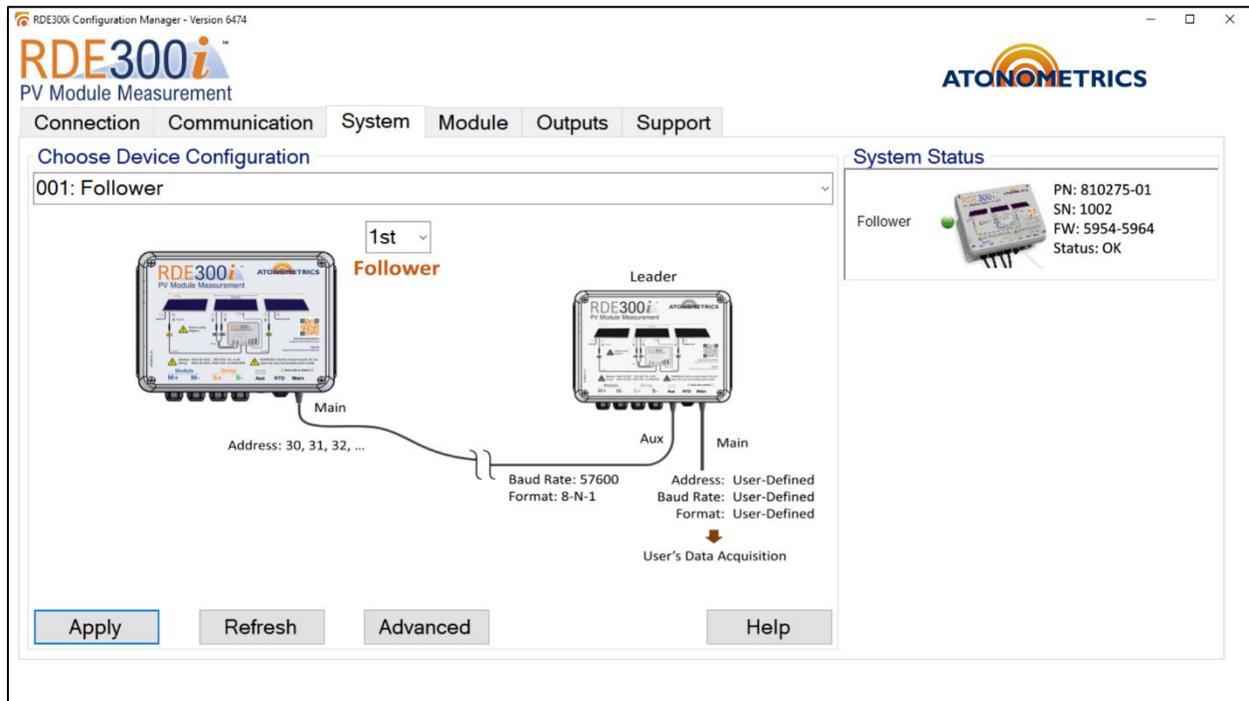
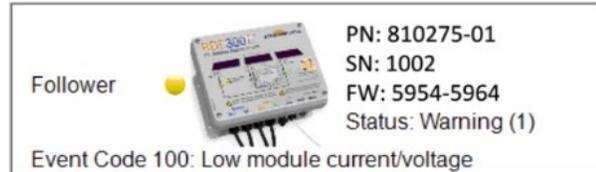


Figure 3-3: Setting Follower configuration

3.2.3 Set Module Parameters

RDE300i™ needs calibration data on its connected PV module to calculate performance metrics. Calibration parameters include the modules short-circuit current (Isc) and maximum power (Pmax) at reference conditions of irradiance and temperature.

Typically reference irradiance and temperature are standard test conditions (STC) of 1000 W/m² and 25 °C, but other conditions may be used. Isc and Pmax temperature coefficients must also be provided.

You may use datasheet information for the Module parameters or obtain these parameters from a calibration report, if available.

Select the Module tab to set these values, as shown in **Figure 3-4**. Enter the module parameters and press Apply.

Parameter	Value
Isc Ref (A)	8.925
Pmax Ref (W)	311.0
Irradiance Ref (W/m ²)	1000.0
Temp Ref (°C)	25.0
Isc Temperature Coefficient (%/°C)	0.05
Pmax Temperature Coefficient (%/°C)	-0.41

Figure 3-4: Setting Module parameters

3.2.4 Configure Remaining Followers

Repeat Section 3.2 to configure each of the remaining RDE300i Follower units.

3.3 Configure the Leader

3.3.1 Connect to the Leader

Disconnect the configuration kit from the Follower. Then, connect or daisy chain 830284 power and communication cables from the Followers' Main ports to the Leader's Aux port as shown in example **Figure 3-1**.

To daisy chain multiple Follower units, use the 830314 Y-splitter cable at the Followers' Main ports. Use 830331 RS485 termination cables where necessary, per the Soiling Measurement Ordering Guide (880100), available from the Atonometrics website.

Connect to the Leader with the configuration kit and software following the steps in Section 3.2.1.

Note: Your system may have two or more RDE300i units. For more information on RDE300i system configurations and cabling, see the Soiling Products Ordering Guide (880100).

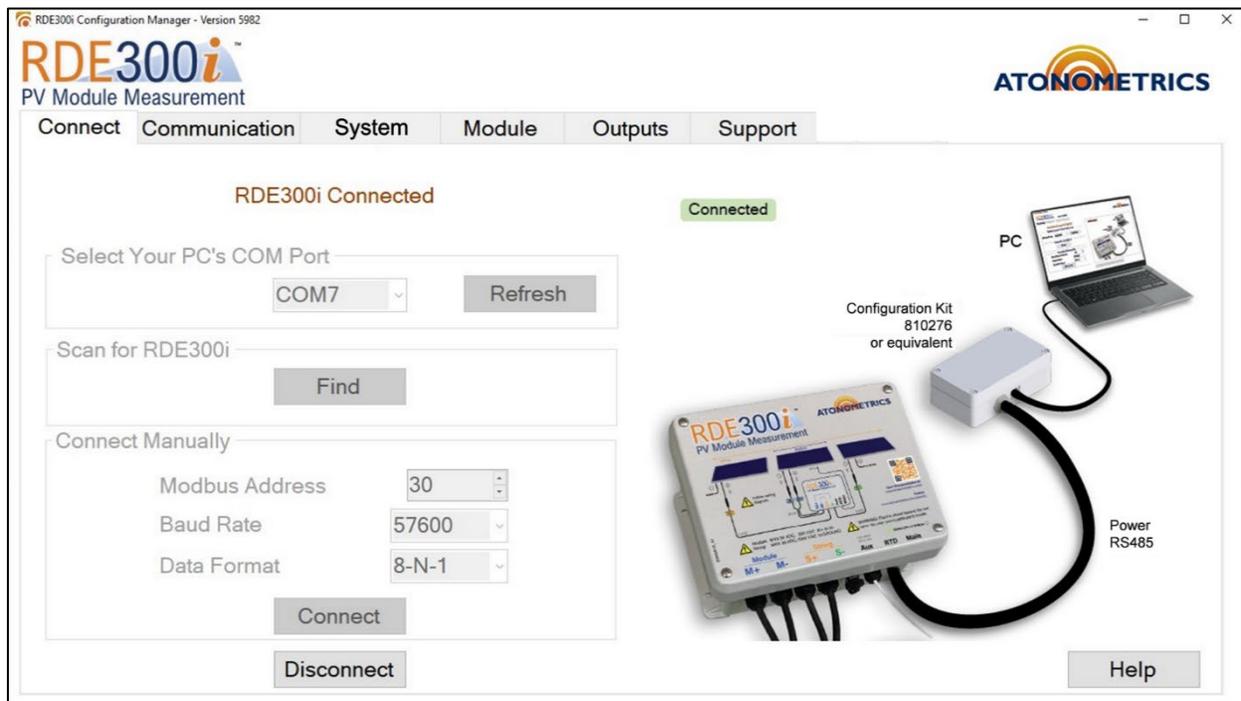


Figure 3-5: RDE300i connected

3.3.2 Configure as Leader

To set the RDE300i to the Leader configuration, select the System tab, and select Leader from the Choose Device Configuration drop-down menu. Then, select the number of Follower units from the Followers drop-down menu, as shown in **Figure 3-6**. Press Apply.

The diagram displayed on the tab illustrates how the Leader works with the Followers.

The System Status box displays the operation status of the connected RDE300i Leader and Followers as well as their part numbers, serial numbers, and installed firmware versions.

Note: When RDE300i is set to the Leader configuration, its Modbus communication parameters may be set by the user, but the Follower must be operating at default parameters as shown in the diagram below.

Note: If using Mars and / or RC22 in combination with RDE300i, see the Configuration and Normalization Guides for RDE300i, Mars, and RC22 Systems (880096-03) or RDE300i and RC22 Systems (880096-02).

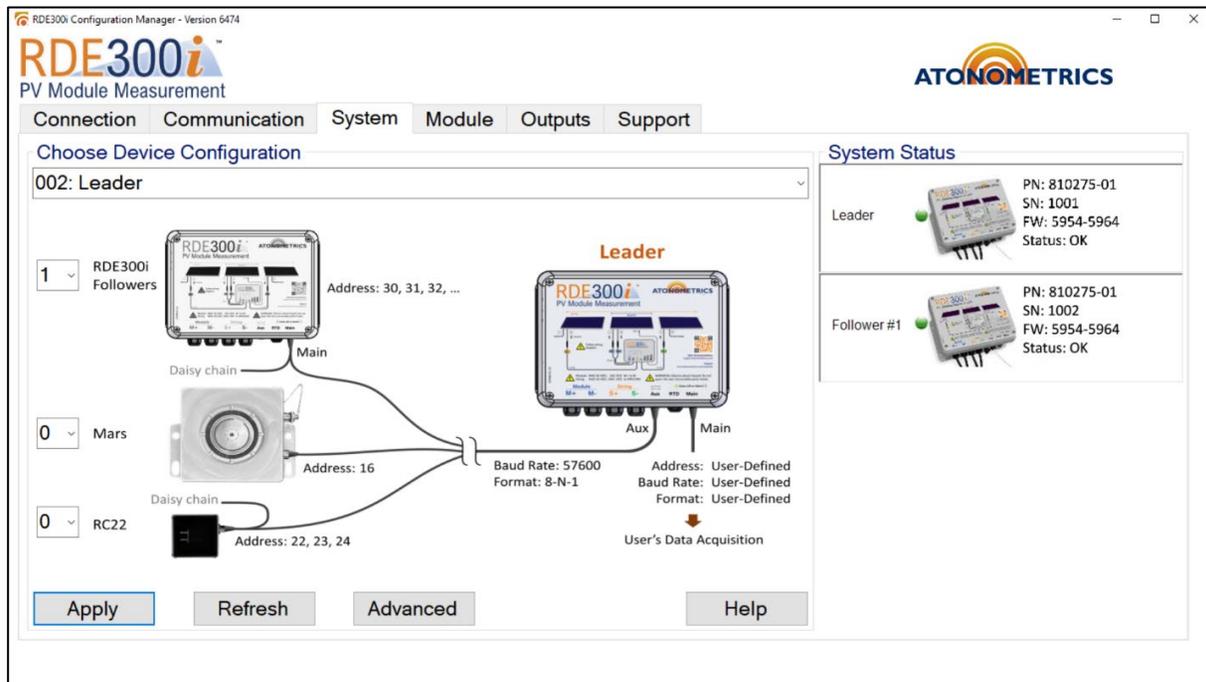


Figure 3-6: Setting Leader configuration

3.4 Verify System Communication

Remain connected to the Leader unit. Confirm that the Status LED on each of the Followers lights up.

Select the System tab and verify that the Status is OK for both the Leader and all the Follower units as shown in **Figure 3-7**.

The System Status box displays whether communication from the Leader to the Follower units is working properly and displays the operation status of the Leader and Follower units as well as their part numbers, serial numbers, and installed firmware versions.

Note: If a Follower unit is not properly configured or connected, its status may be displayed with an error in the System Status box. To resolve this condition, ensure that the Leader and Follower units are connected, and that the Leader unit is properly configured.

Note: If you are not connected to a PV module, you will see a yellow indicator, Status: Warning (1), and Event Code 100: Low module current/voltage in the system status box. This is okay for all of Section 3 Configuration.

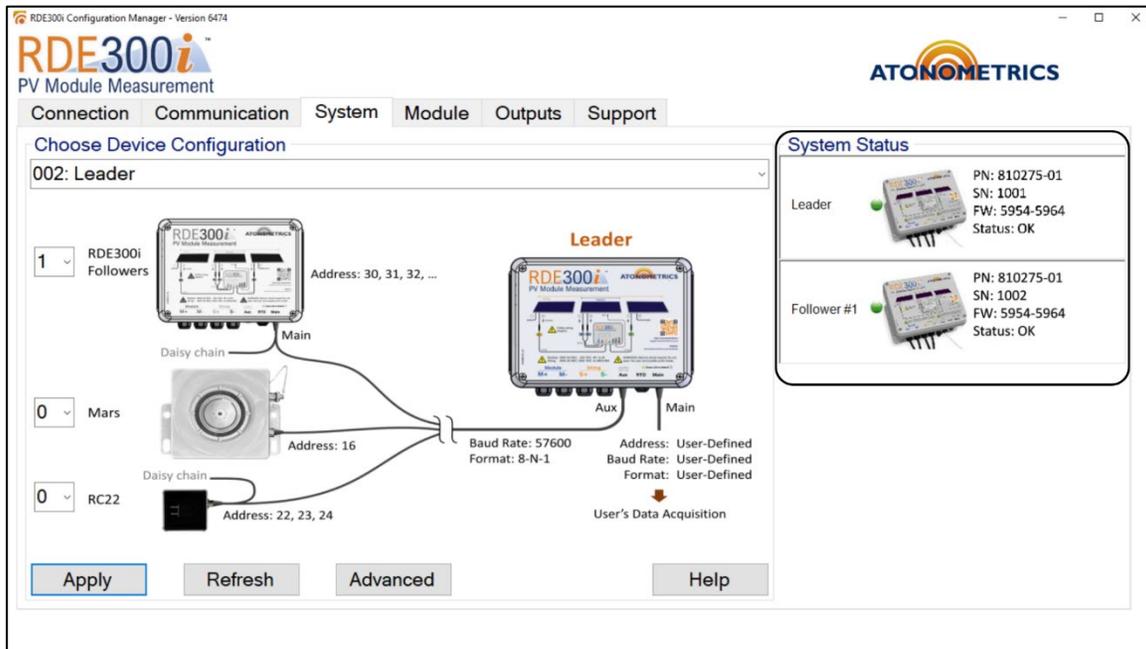
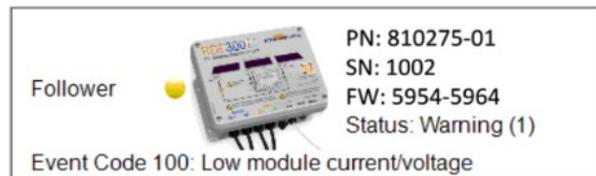


Figure 3-7: Verifying communication between Leader and Followers

3.4.1 Set Module Parameters

Enter the module parameters for the Leader's PV module, following the steps in Section 3.2.3.

3.4.2 Set Leader Communication Options

Your RDE300i™ unit's default Modbus serial communication parameters for its Main communication port are Address = 30, Baud Rate = 57600, and Data Format = 8-N-1 (8 data bits, no parity, 1 stop bit).

To update the communication parameters, use the Communication tab of RDE300i Configuration Manager, shown in **Figure 3-8**.

Enter your new parameters in the Update Modbus Settings box and press Apply to transmit these to the unit. These are the communication parameters that you will use with your data logger or SCADA system to communicate with the Leader unit.

Addresses from 1 to 247 are allowed.

Supported baud rates are 9600, 19200, 38400, 57600, and 115200.

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

Note: If performing configuration in an office environment, this is your last step. Remove the Aux cables and Configuration Kit. The following sections must be completed in the field.

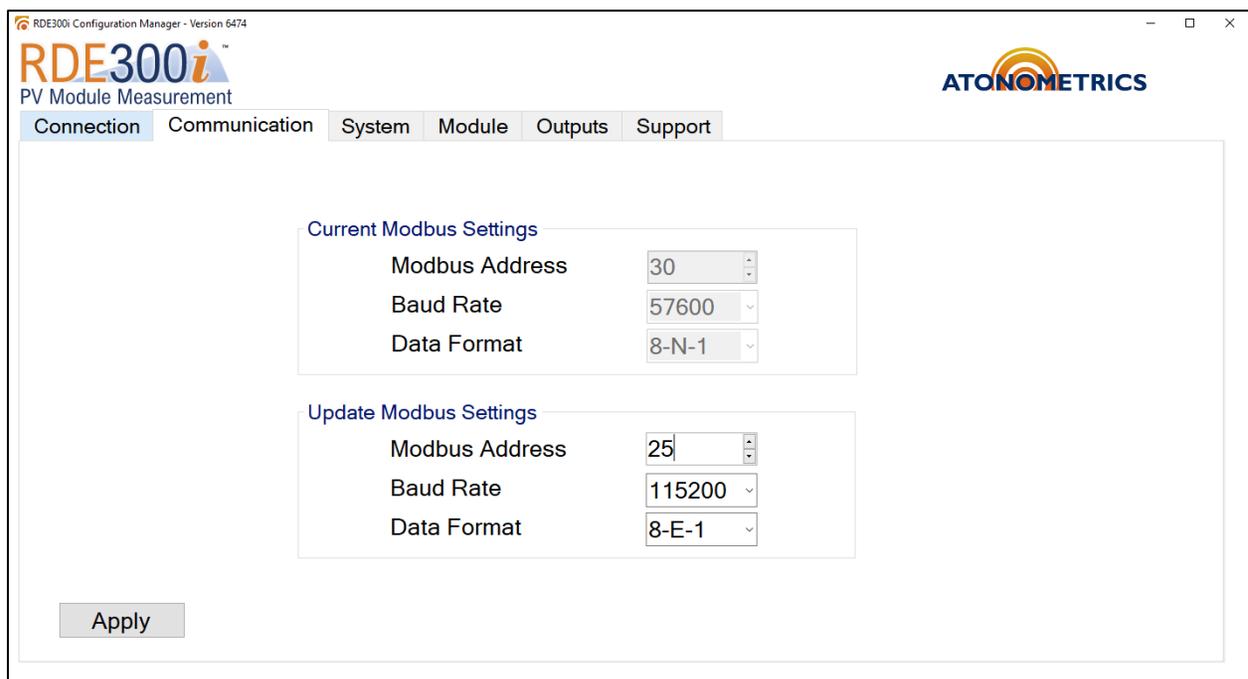


Figure 3-8: Setting Leader communication parameters

4 Equipment Installation

Refer to the RDE300i User Guide (880093) for the installation procedure and wiring instructions to install the RDE300i Leader and Follower units.

See **Figure 4-1** below for our recommended field layout for the RDE300i Leader and Followers for module-module soiling measurement application. Additional examples are shown in the Soiling Products Ordering Guide (880100).

WARNING: Follow all installation and wiring instructions per the RDE300i User Guide (880093). Failure to follow instructions properly may result in serious damage to the product or connected equipment and/or hazards to human health and safety.

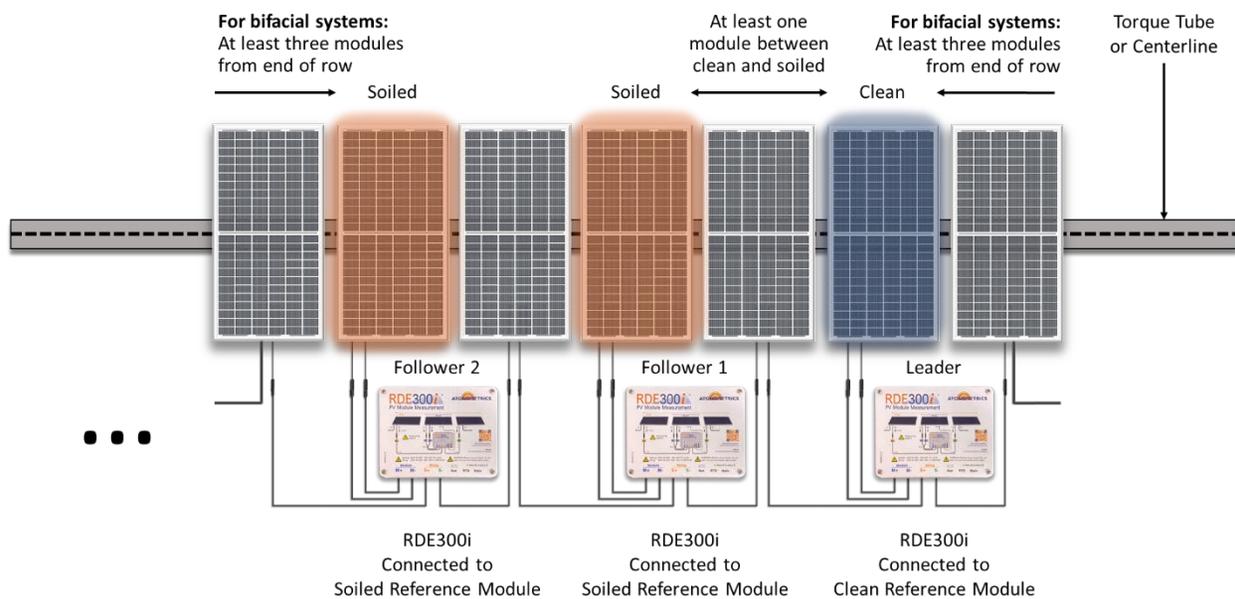


Figure 4-1: Recommended field layout for soiling application example

5 Normalization

5.1 Setup

- Ensure that it is a clear sunny day, preferably within 2-3 hours of local solar noon.
- Ensure all modules are at the same tilt angles, preferably within 0.5 degrees. Use a handheld inclinometer to confirm. Check the tilt in both directions across each module. If necessary, use shims to adjust the modules to be at the same tilt angle.
- Ensure angle of incidence to the sun is small, preferably less than 35 degrees.
- Clean all modules thoroughly. This will directly affect the normalization process.
- For bifacial gain applications, cover the rear side of the Leader's PV module.

5.2 Verify System Operation

If not already connected, repeat the steps in Section 3.3.1 to connect to the RDE300i Leader unit. Select the System tab and ensure that the Status is OK for both the Leader and the Follower units, as shown in **Figure 5-1**.

Note: If the Follower units are not properly configured or connected, its status may be displayed with an error in the System Status box. To resolve this condition, ensure that the Leader and Follower units are connected and properly configured.

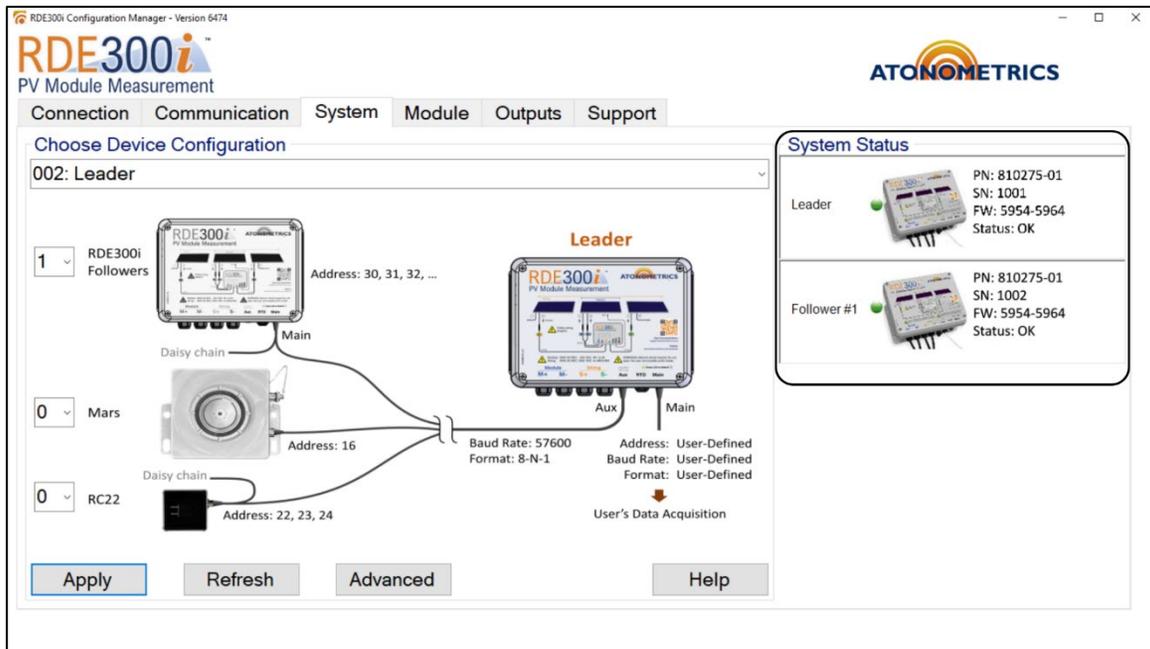


Figure 5-1: Verifying system operation between Leader and Followers

5.2.1 Check Module Output Data

Select the Outputs tab to check the measurement results from your system, as shown in **Figure 5-2** and **Figure 5-3**/

The tab displays the most recently measured IV curve and the most recent readings of all the measured and calculated parameters, including Pmax, Isc, module voltages and currents, string data, performance indices, and more. Scroll through the tab to examine all the parameters.

The Leader's data are displayed as Module 1 and the Followers' data are displayed below that as Module 2, Module 3, etc.

All the data displayed on the Outputs tab are available for data acquisition via the Modbus interface.

In the Outputs tab, check that the module Isc and Pmax values are periodically updated (every 2-60 seconds, depending on configuration options) for the Leader and Follower units, and that reasonable values are being recorded, as shown in **Figure 5-2** and **Figure 5-3**.

Note: If values are not being updated, ensure that all RDE300i units are connected to each other **AND** connected to their respective reference modules.

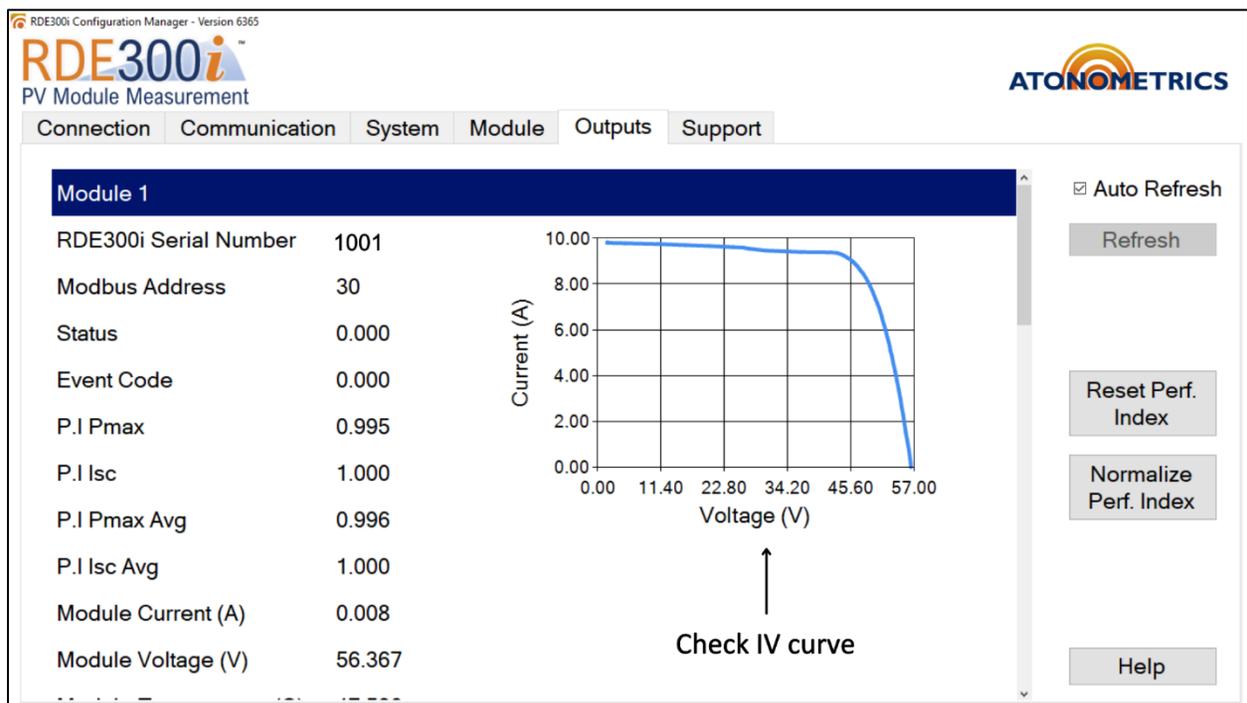


Figure 5-2: Checking output data and IV curves

RDE300i Configuration Manager - Version 6365

RDE300i™
PV Module Measurement

ATONOMETRICS

Connection Communication System **Module** Outputs Support

Module Current (A)	0.008
Module Voltage (V)	56.367
Module Temperature (C)	47.561
Module Temperature RT...	NaN
Module Temperature VO...	NaN
Module Pmax (W)	412.224
Module Imp (A)	9.041
Module Vmp (V)	45.595
Module Isc (A)	9.823
Module Voc (V)	56.389
Module Irradiance (W/m2)	992.705

Scroll down

Auto Refresh
 Refresh
 Reset Perf. Index
 Normalize Perf. Index
 Help

← Check Module Pmax
 ← Check Module Isc

Figure 5-3: Check module outputs

5.3 Perform Normalization

5.3.1 Reset Performance Indices

In the Outputs tab, click the “Reset Perf. Index” button, as shown in **Figure 5-4**. This clears performance index set in system memory and resets timers. A “Reset Successful” message will appear. Click OK.

5.3.2 Collect Normalization Data

Now allow the system to collect baseline performance index data for **10 MINUTES**. The Performance Index (P.I.) values should read NaN during this time.

Remain connected to the RDE300i Leader unit with the configuration software open.

The screenshot shows the RDE300i Configuration Manager interface. The 'Outputs' tab is selected, displaying a table of performance metrics for 'Module 1'. A dialog box titled 'Performance Index Reset' is open, showing 'Reset Successful!' and an 'OK' button. A callout box points to the 'NaN' values in the table, with the text 'Check that values are NaN after reset'. The 'Reset Perf. Index' button is circled in the interface.

Module 1	
RDE300i Serial Number	1001
Modbus Address	30
Status	0.000
Event Code	0.000
P.I Pmax	NaN
P.I Isc	NaN
P.I Pmax Avg	NaN
P.I Isc Avg	NaN
Module Current (A)	0.008
Module Voltage (V)	56.367

Figure 5-4: Reset Perf. Index

5.3.3 Verify Performance Indices Updating

At the end of **10 MINUTES**, verify that the P.I. indexes show values on the order of 1.0 and are no longer NaN, for the Leader and Follower modules.

Note: These values represent the measured output of each module compared to expectations from the rated module parameters normalized for the Leader's rated I_{sc} . For more information on Performance Index calculations, see the RDE300i User Guide.

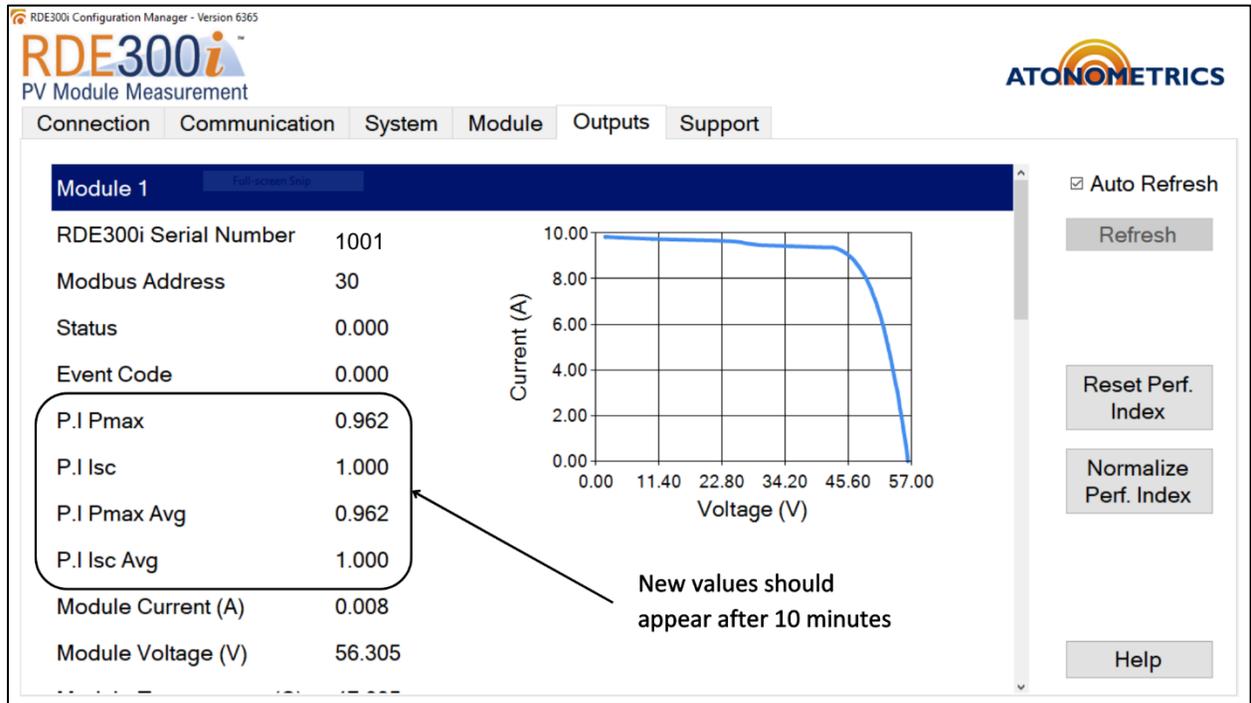


Figure 5-5: Verify new P.I. values

5.3.4 Set Normalization Factors

In the Outputs tab, click the “Normalize Perf. Index” button, as shown in **Figure 5-6**. A message will appear stating “Normalization factors have been sent to RDE300i!”. Click OK.

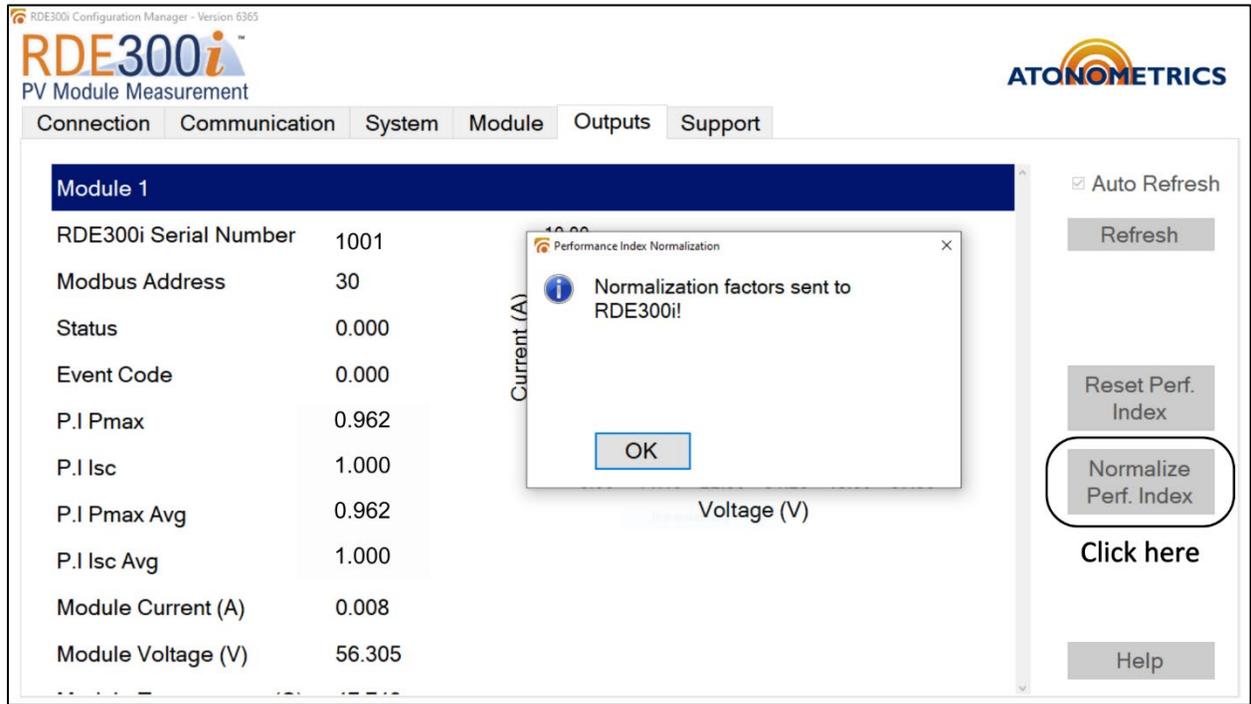


Figure 5-6: Normalize Perf. Index

5.3.5 Verify Normalization

Allow the system to collect data for **10 MINUTES**. Remain connected to the RDE300i leader unit with the configuration software open.

During this time, the Leader RDE300i unit will be calculating performance indices using the normalization constants programmed in the previous steps. It will report new results at the end of the 10-minute window.

When your 10-minute wait is complete, verify that the P.I. values for all Leader and Followers read **1.000 +/- 0.010** as shown in **Figure 5-7**. These values reflect the efficacy of the normalization process.

If the values are not in the range **0.990 to 1.010**, repeat the previous steps from Section 5 Normalization.

Note: Unstable irradiance conditions negatively affect the normalization process.

Note: The normalization process must be completed on a clear sunny day, preferably within 2-3 hours of local solar noon with solar angle of incidence to the modules less than 35 degrees.

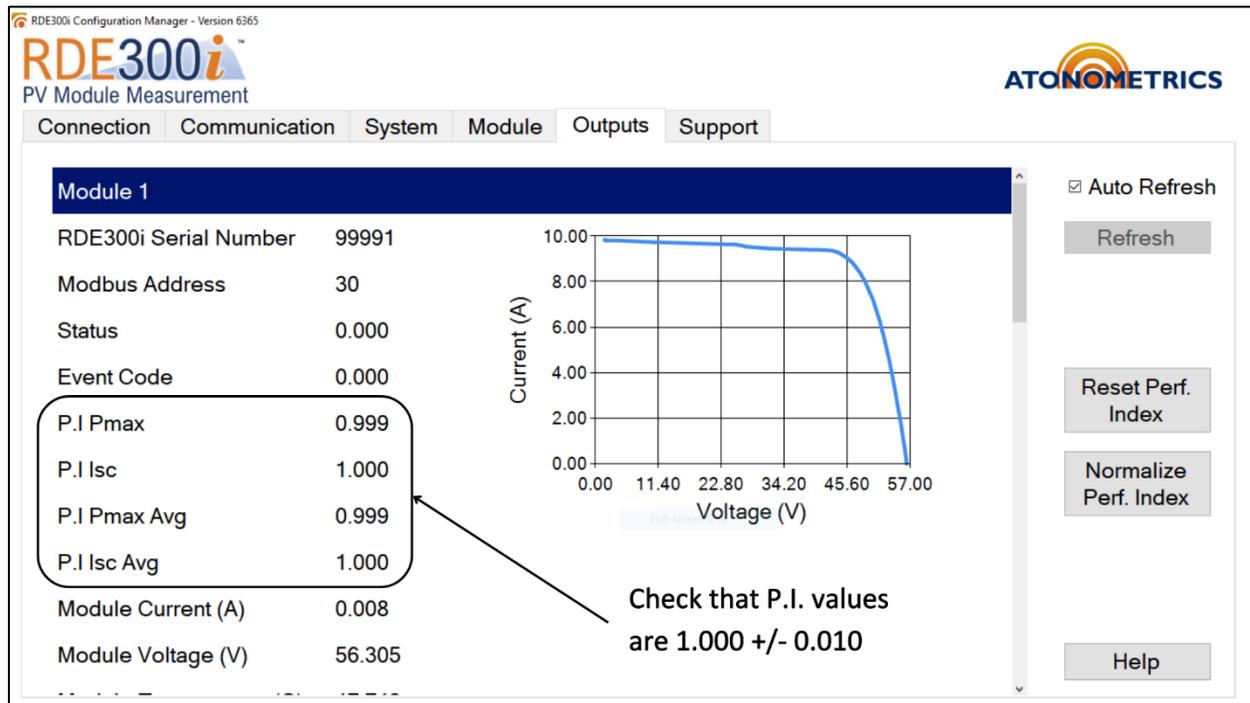


Figure 5-7: Verify P.I. new values

The configuration and normalization of your RDE300i Leader and Follower system is complete. The system is ready to go!