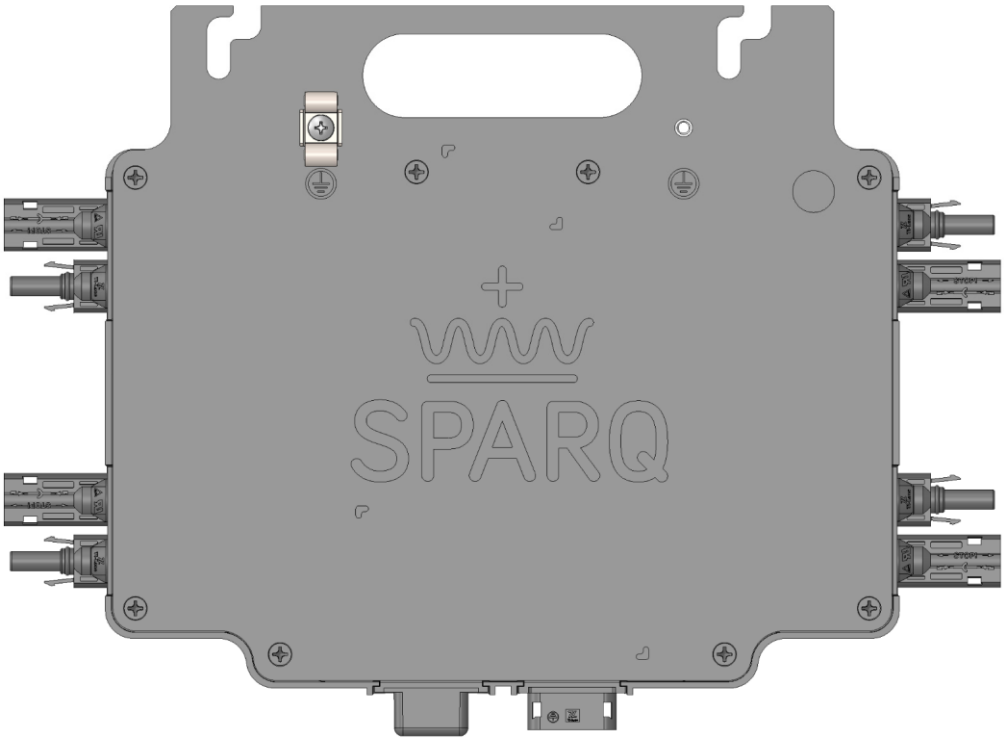
SPARQ



Quad Three-Phase Microinverter

Installation Manual

Model
Q2000-4301
Three-Phase Microinverter
Document rev 1.0

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FCC Compliance:

This product has been tested and was found to be compliant with the accepted limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.
However, there is no guarantee that interference will not occur in a particular installation. If the equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help
- Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

SPARQ

REVISIONS

Version	Date
1.0	May 2023

SPARQ

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IMPORTANT SAFETY INFORMATION

READ THIS FIRST

SAVE THESE INSTRUCTIONS: This manual contains important instructions for the SPARQ Q2000 microinverter that should be followed during installation and maintenance of the unit to reduce the risk of electric shock, and to ensure the safe installation and operation of the SPARQ Microinverter. Failure to properly follow these instructions may result in personal injury, property damage, and/or loss of warranty coverage.

This manual provides guidelines to installing your system. As always, you must respect the International Electrotechnical Commission (IEC), National Electrical Code (NEC), ANSI/NFPA 70, Canadian Electrical Code, and/or the electrical regulations of your local area.

This manual is intended to be used by a certified installer or electrician and is applicable for the following models:

- Q2000-4301

The following safety symbols appear throughout this document to indicate dangerous conditions and important safety instructions.

WARNING: This indicates a situation where failure to follow instructions and/or improper equipment utilization may cause bodily harm.

NOTE: This indicates helpful information to the installer that can be used during installation.

IMPORTANT: This indicates important information that requires special attention. Please follow these instructions closely.

IMPORTANT - WARNINGS!

- Perform all electrical installations in accordance with all local electrical codes. Do not use SPARQ microinverters, gateways or microinverters in any manner not specified. Doing so may cause injury, death, or damage to equipment.
- System grounding is the responsibility of the installer. The microinverter must be earth grounded in accordance with the national and/or local electrical laws. Be aware that only qualified personnel (certified installers or electricians) shall install or replace the SPARQ Microinverter. Be aware that installation of this equipment includes the risk of an electric shock.
- Do not install the AC junction box without first removing AC power from the SPARQ System. Always de-energize the AC trunk cable before servicing the system. Never disconnect the DC connectors under load. After AC power to the trunk cable is shut off, the DC and AC connectors can be unplugged.
- Do not attempt to repair the SPARQ Microinverter; it contains no user-serviceable parts. If

a microinverter fails, please return the unit to your distributor for maintenance. Tampering with or opening the microinverter will void the warranty.

- Before installing or using the SPARQ Microinverter, please read and follow all instructions on the microinverter.

- The system AC circuit breaker must be turned off before connecting or disconnecting the SPARQ Microinverter.

- Be aware that while handling the microinverter, the casing acts as a heat sink and after extended use can reach temperatures of 65°C (149°F) or higher. These temperatures may cause burns or injury.

- An installation test and approval from the local utility company must be performed before grid connection. This includes inspection of wiring and confirming that local and national requirements and regulations are followed. These tests should be performed only by qualified installers and electricians.

- The Q2000-4102 can operate at locations with an ambient temperature between -40^{o}C and 65^{o}C (-40^{o}F to 149^{o}F). The DC voltage range of a PV module to be used with the SPARQ Q2000 Microinverter should be between 19 and 60V. This matches most 60 cell and 72 cell modules.

- Protection against lightning and any resulting voltage surges must be in accordance with local standards. Protection against such surge phenomena could be done using appropriate surge protection devices (SPD). Failure to do so may violate the warranty.

NOTE: For the warranty terms and conditions, please visit:
www.sparqsys.com

1. INTRODUCTION

Microinverters have become the preferred technology for installing solar PV solutions on residential roofs today. Their inherent ability to address common challenges such as shade, rapid shutdown, system cost reduction, and their easy installation, has made them the preferred residential inverter solution.
SPARQ takes this concept even further with the Quad three-phase (Q3-2000), the first 4-port three-phase microinverter optimized for industrial and commercial applications and designed to meet current and future requirements. Through our patented DC-to-AC conversion technology, we developed a design that supports four panels with all the benefits of a single panel microinverter, such as eliminating high voltage DC wires while reducing part count and install time. The result is a system that is cost-effective, easier to install, and more reliable than other solutions on the market today.

Figure 1: SPARQ Quad Three-phase (Q3-2000) microinverter.

With its new generation Q3-2000 microinverter, SPARQ has considered the entire installer experience to produce an optimum overall system design. With that in mind, we used ZigBee and WiFi networking technology and a “mobile-first” approach, resulting in a fast and simple installation of the monitoring gateway in the customer’s home. No longer will solar installers fight with intermittent powerline communication solutions or move around the area to locate the device, and a simple smartphone or tablet will provide all the interface needed to install a system. The Q3-2000 has the most advanced power conversion design in the industry today. It is the first microinverter on the market with reactive power capability, designed to meet the new interconnection, operation and metering requirements for distributed generators to be connected to a utility’s electric system. It does all of this without sacrificing performance, having ultra-fast per-panel maximum power point tracking (MPPT) to optimize production, with a peak MPPT efficiency of 99.85%.

1.1. What is a SPARQ Microinverter

The SPARQ Q3-2000 microinverter is a power conversion device that connects to up to four photovoltaic (PV) modules and converts the DC output of the modules into grid-compliant AC power. PV systems that use the SPARQ Q3-2000 microinverter produce an optimal energy harvest by employing proprietary maximum power point tracking methods (MPPT), with the algorithm running for each of the four modules individually. The SPARQ Q3-2000 is a ‘plug-and-play’ device and is auto-grid configurable worldwide, so it is very easy and safe to install. For your safety, a Ground Fault Detection Interrupter (GFDI) is incorporated to protect the system if a ground fault occurs during operation.

The SPARQ Q3-2000 microinverter is light, compact, and efficient relative to string or central inverter systems. It is designed to have a functional lifetime matching or exceeding that of the photovoltaic

module. The result is high-quality power generation and excellent system availability. In addition, the microinverter is very robust and delivers excellent performance even under adverse conditions such as snow, dust, shade and low light.

1.2. System Configuration and Monitoring

The SPARQ Communication Gateway is called SparqLinq and uses a ZigBee wireless link to create a mesh communication network with the Q3-2000 microinverter(s). SparqLinq gathers, processes, and stores microinverter performance and status information internally and can display a system dashboard via its own internal webserver. If it is connected to the internet through a WiFi or a wired Ethernet connection, it automatically uploads performance information to the SPARQ cloud-based monitoring system, SparqVu (http://sparqvu.com). All installers and home-owners are encouraged to create a SparqVu account.
Figure 2 depicts a typical wireless setup for monitoring, using the wireless-enabled SparqLinq model.

Figure 2: Power monitoring using wireless-enabled SparqLinq system.

The SparqLinq internal web server and SparqVu cloud-based server enable an installer or system owner to quickly view the performance of every component of their SPARQ energy system via a web browser on their smart device or computer. SparqLinq achieves this detailed performance tracking by periodically polling all microinverters with a typical polling cycle of five minutes.

A setup wizard walks the installer through the simple procedure of configuring the SparqLinq and microinverter system. Once configured, the SparqLinq automatically collects data from each PV module and reports it to SparqVu, allowing a detailed real-time view of performance information from any PV module in the system. Information such as energy production, operational status, and power output can be easily reviewed at a glance. The monitoring system keeps a database of historical performance data of all the panels associated with a particular site. Information is presented graphically making it easy to understand.

2. SPARQ MICROINVERTER INSTALLATION DESIGN

2.1. Preparation

Before installing Q3-2000 microinverters, ensure the following equipment is at hand, and the minimum site requirements are met:

- Outdoor-rated AC junction box
- Phillips screwdriver
- Sockets, wrenches for mounting hardware
- Suitable racking system (for PV modules)
- Ti-Lane AC Branch cable and AC disconnect tool
- Ti-Lane DC disconnect tool (additional DC disconnect tool needed that matches module connectors)
- Appropriate grounding conductor, or WEEB solution
- Grounding hardware is included with unit for copper cable

NOTE: 2 locking washers, 3/8" hexagonal nut, and 1 Phillips head bolt are included on each unit.

2.2. PV module and Microinverter Compatibility

SPARQ Q3-2000 microinverters are compatible with PV modules where the MPPT voltage range falls within the microinverter model-specific voltage range. The microinverters are designed to work with three-phase $380V_{LL}$, $400V_{LL}$,and $480V_{LL}$ AC grid.

The electrical properties of the microinverters are summarized in the following table:

Table 1: Electrical properties of the microinverters

Model Number	PV Voltage Range	PV Panel DC Power Rating	Maximum Microinverters per AC branch (380V)*
Q3-2000-4301	19V-60V	Up to 680W_p DC	9 units, 10 AWG (6mm²) Trunk

** Depending on wire gauge selected*
To ensure that the PV module can be directly plugged into the microinverter, choose a module with an MC4 style compatible connector.

2.3. Module System Design Configuration with Templates

When installing and implementing a SPARQ Q3-2000 microinverter, there are five common arrangements for the solar panels, with a version of each for portrait and landscape configurations. Using these basic designs will simplify the design and planning for each installation.

In most designs with more than a single row of modules, the *even row* modules will be installed rotated such that the junction boxes are at the bottom of the module. This is to ensure that the DC cables can reach the microinverter DC inputs. Alternate configurations can easily be supported via extension

cables.

SPARQ has created simple templates for each of these designs. In some cases, where the standard building blocks are not applicable, an extender cable may be required to ensure easy connectivity to the Q2000 microinverter.

It is critical to note that the SPARQ Q3-2000 microinverter must be installed ***under*** the module, and not exposed to direct rain or sunlight. Do not mount the microinverter in a position that allows long-term exposure to direct sunlight or in a vertical orientation that allows water to pool by any of the connectors. **ALWAYS** install the microinverter with the SPARQ Logo and grounding lug side up towards the module to ensure proper heat dissipation.

2.3.1. Rectangle

The most common and easiest design for the Q3-2000 is simply called “The Rectangle”. The Rectangle reflects four modules together in either a *portrait* or *landscape* layout. This configuration applies to the most common deployments seen today, including:

- The rails are attached one-quarter of the way down the module frame, or about 16” or 400mm from the top and the bottom of a typical 60-cell and 72-cell module frame.
- Junction boxes are usually near one end of the module frame, with the cables extending 40” or 1m long.
- In some cases where the rails are attached further from the module end, the microinverter may need to be attached to the other side of the rail, but in most cases the following design guidelines will work, allowing the cabling to be routed cleanly.

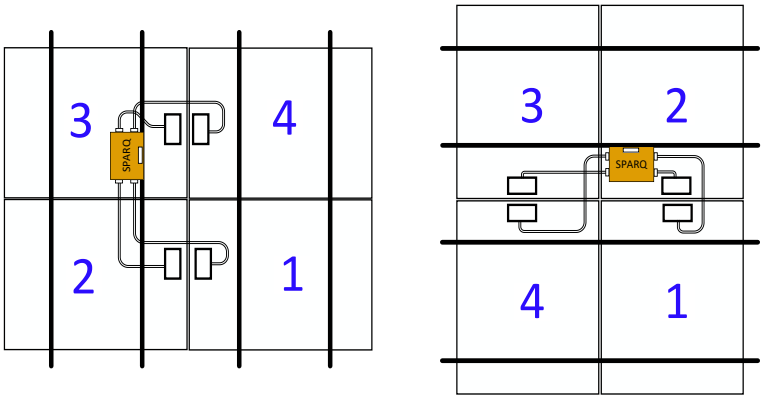


Figure 3: Q3-2000 – Rectangle arrangement (landscape [left] and portrait [right]).

Often a residential design will have areas that do not fit so cleanly into the Rectangle pattern. To meet these applications, one of the other common patterns may apply. For each of these, one or more pairs of DC extender cables will be required.

2.3.2. Row of Four

The second most common configuration is four modules in a row, either portrait or landscape as shown below. Some example installation techniques are given here, either can be reversed as desired. Knowing

this before arriving at the site will ensure easy cable and Q3-2000 layout.

Landscape layout

- When placing four in a row in landscape, allocate numbers to panels from right to left as follows: one (1) two (2), three (3), and four (4). (See following diagram.)
- Connect modules 1 and 2 first and connect them to the racking. Then connect the module 4 but do not tighten it, instead rest it in a temporary and stable position. Then connect the one under module 3 over the Q3-2000 and connect it to the rack. Last, place module #4 in its permanent position, tightening it last.

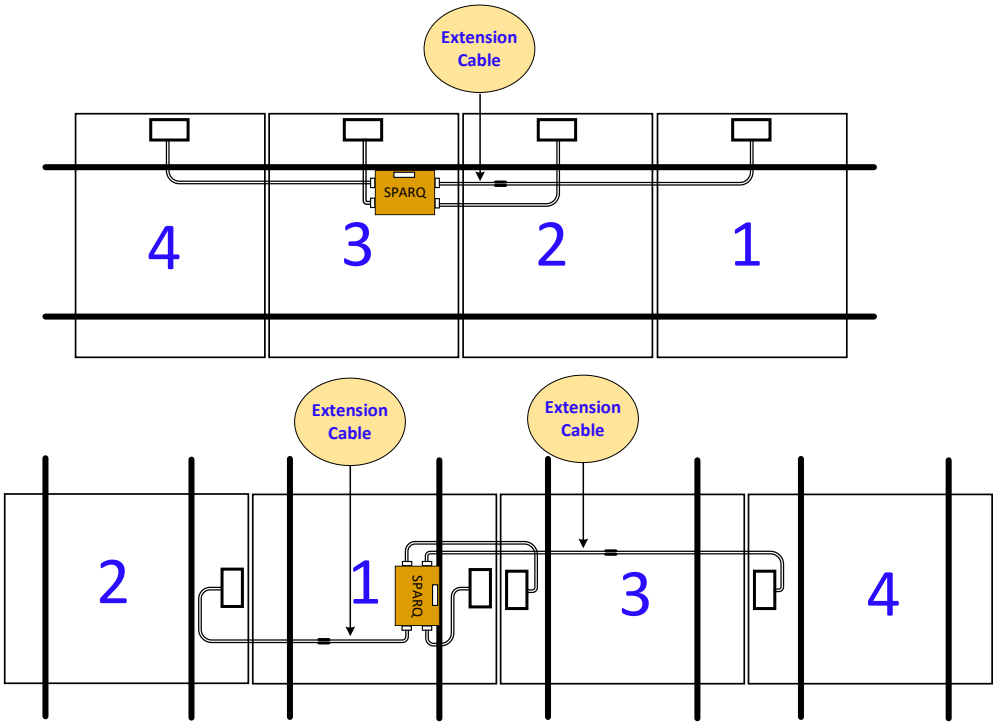


Figure 4: Q3-2000 – Row of four arrangement.

2.3.3. L-shape

Sometimes to make things fit in unusual configurations or to work around obstacles on the roof, an L-Shape solution can be an effective option in either portrait or landscape mode as shown below:

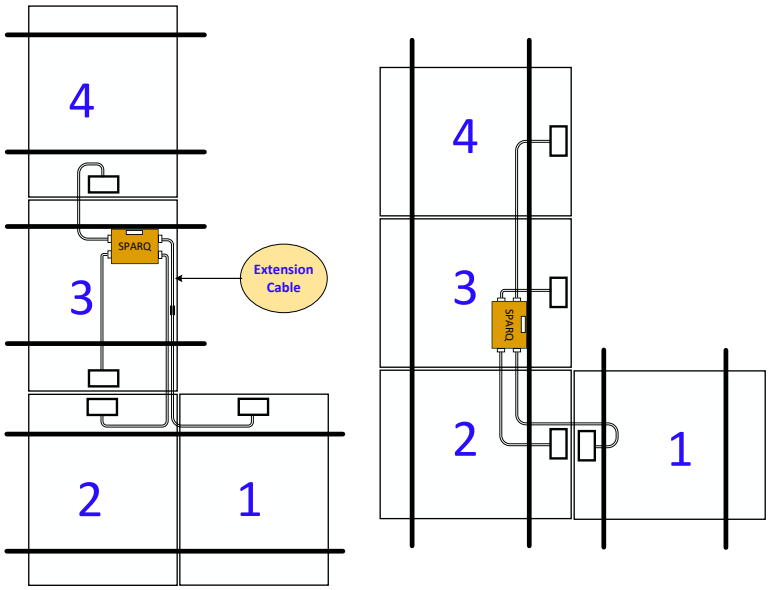


Figure 5: Q3-2000 L-shape arrangements

2.3.4. T-Shape

Another standard shape to help make things fit in unusual configurations, a T-Shape solution can be useful in either landscape or portrait mode as shown below:

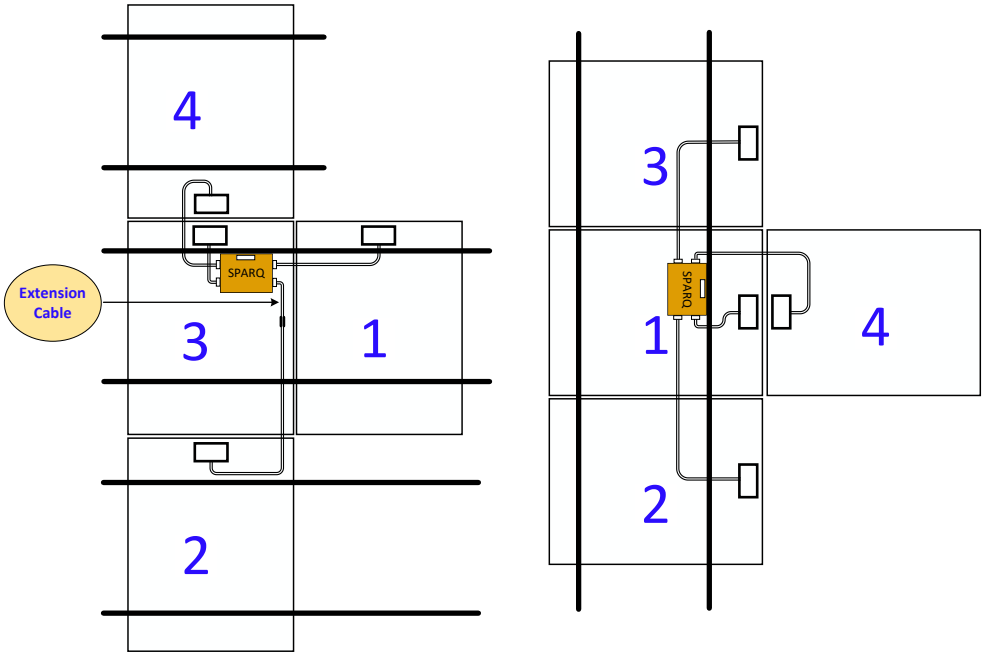


Figure 6: Q3-2000 T-shape arrangements.

2.3.5. S-Shape

A final standard shape to help make things fit in unusual configurations, an S-Shape solution can be useful in either landscape or portrait mode as shown below:

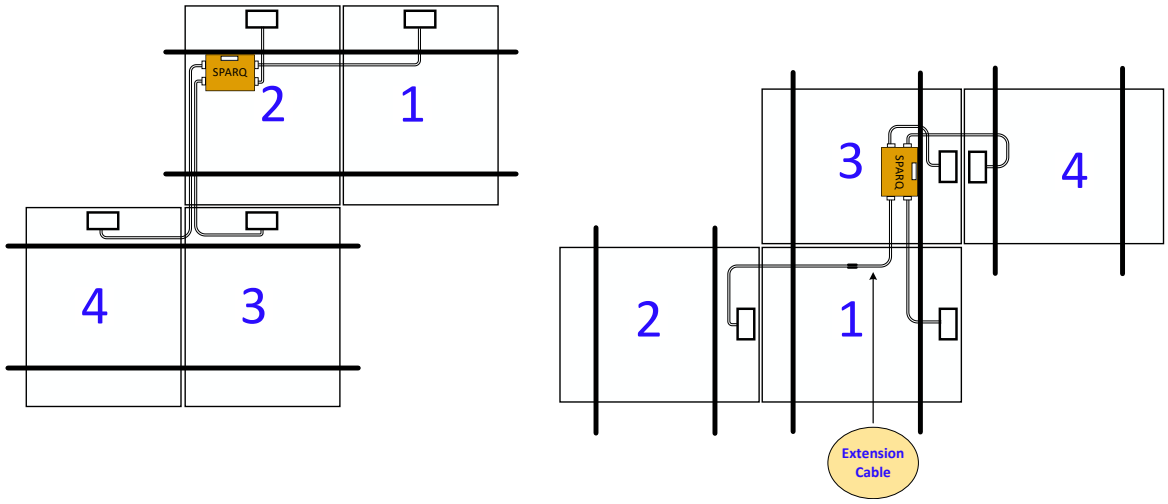


Figure 7: Q3-2000 - S-shaped arrangements.

2.4. Accessories

Extension Cables

As noted, sometimes a DC extension cable will be needed to reach the centrally located Q3-2000. These are noted in the designs above. These DC extension cables can be easily built on site as needed or purchased in advance from SPARQ or our authorized distributors. 0.3 meter length is typical, with the landscape 4 in a row potentially using a 1.3 meter solution. For the installation, there are some basic tools and components that will be required. SPARQ recommends having an AC and DC Disconnect tool and a Junction box or splice to join the AC cable to the home run cable.

Other options

- AC Cable splice – to connect and/or extend two sections of cable.
- AC Cable connector waterproof cap – to cover and seal unused AC plugs.

3. INSTALLATION PROCEDURE OVERVIEW

The system must be installed by skilled Solar specialists. It is critical that the system is designed and approved by a certified electrical authority in your jurisdiction. After the racking system is installed, it is relatively easy to install the Q3-2000 and the PV modules on the racking. To do so, the following steps are required:

- Set up AC Trunk cabling and tie downs to match planned microinverter placements.
- Mount the SPARQ microinverter to the racking using two fasteners tightened to 10 ft-lbs / 13.5 N-m.
- Connect the AC Branch Cable to the microinverter and WEEB or ground wire to grounding terminal.
- Install AC junction box to facilitate connecting the AC Branch cable to the home run cable that goes back to the breaker in main service.
- Connect each of the PV modules leads to the microinverter DC inputs as they are being installed.

- Note: This can be an electric shock hazard. The DC conductors of this photovoltaic system may be energized.
- Run the SparqLinq Setup Wizard. This can be done during or after the modules are installed; see next section.

- Test system by turning on main breaker or AC disconnect and monitor the system through the SparqLinq webpage.

WARNING: Before installation, ensure that the system is disconnected from the utility and that the AC junction box is not energized! There is a risk of shock and injury if this is not followed.

IMPORTANT: It is important that the Q3-2000 microinverter is grounded either through the built-in grounding lug using a separate 6 AWG (16mm²) or 8 AWG (10mm²) solid copper grounding conductor or using an electrical equipment grounding washer or WEEB (Washer Electrical Equipment Ground).

3.1. SparqLinq Configuration

The SparqLinq is the SPARQ gateway used to provision, monitor and maintain the SPARQ system. Setting it up is fast and easy and consists of connecting it to the network and following the installation wizard.

3.1.1. SparqLinq Setup

A technician can start setting up the SparqLinq gateway for the site at any time but Q3-2000 microinverters can only be scanned once the Q3-2000 is connected to a PV Panel and in the daytime when there is enough sun to power the Q3-2000.

NOTE: *DHCP IS REQUIRED on the cable modem/DSL router/Fiber connect Internet access device and it is required to connect the SparqLinq to the internet before or after installation so it can set the internal clock and perform any software updates before completing the installation.*

Warning: The Q3-2000 warranty is void if they are not connected to the internet through a SparqLinq.

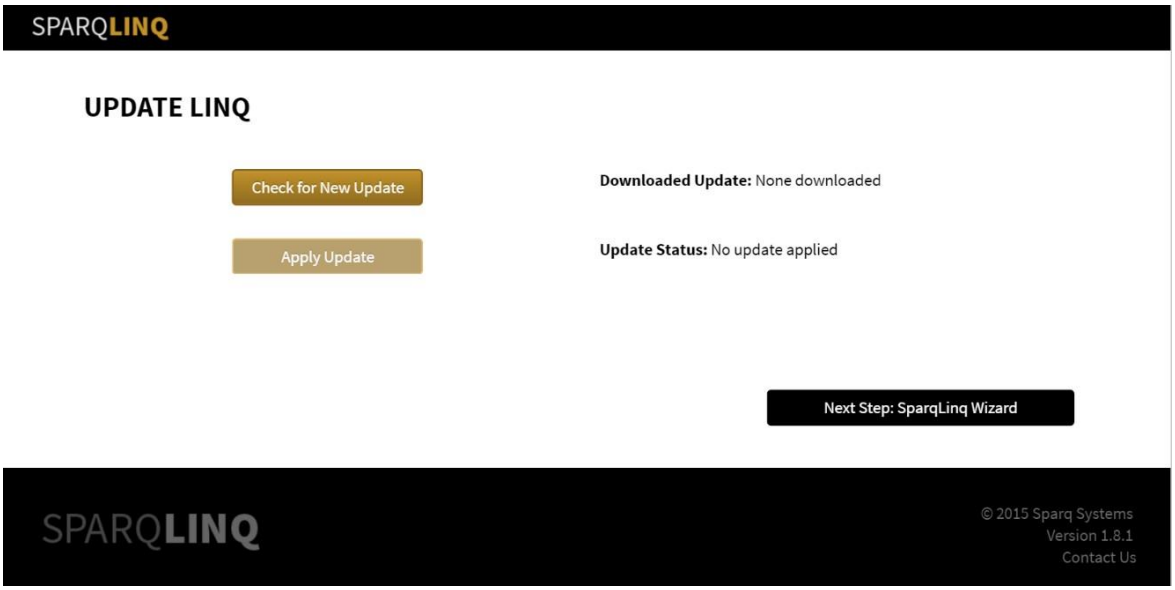
Figure 8: SparqLinq and WiFi USB adaptor.

Preferred SparqLinq setup using Wired Ethernet cable and WiFi adapter:

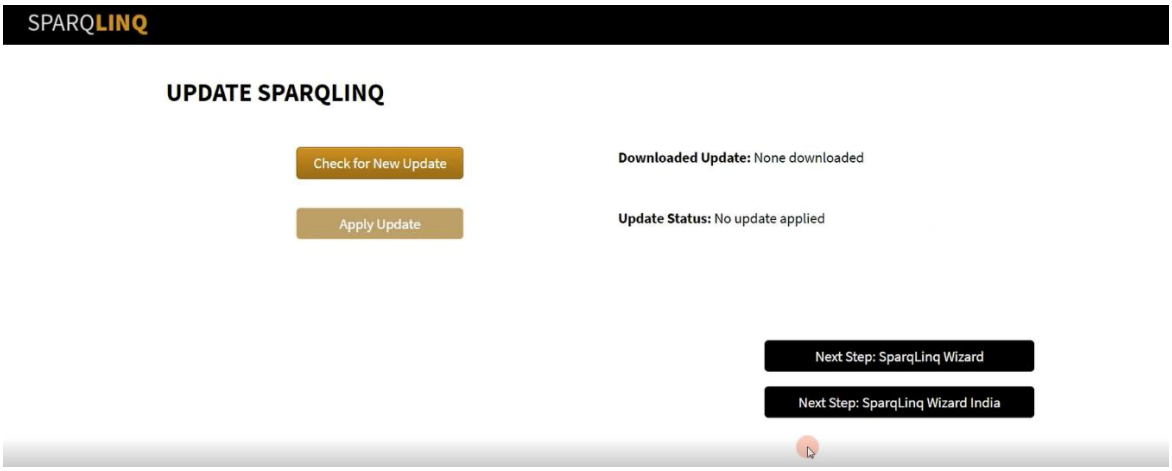
1. Zigbee antenna is provided separately in the SparqLinq box. Screw in the Zigbee antenna securely. Please tighten by hand. Position the antenna to be vertical for best performance.
2. Plug in the included Ethernet cable to the Home Internet Router.
3. Then plug in the AC power supply. It will take approximately one minute for the SparqLinq to fully boot.
4. On a phone, tablet or PC, open WiFi application to display the available Network SSIDs.
5. The SparqLinq will create a WiFi access point with SSID “SparqLinq”. Select this to connect to your device to the SparqLinq for connection.
6. Enter the default password “SparqLinq 80211” and be sure to include the space in the middle. Tick “Connect Automatically” on your device if the option is available. Your device may indicate “No Internet Access” which is OK. Do not connect to customer’s home network at this time.
7. Open a web browser (we recommend Chrome or Firefox) and enter address http://192.168.111.1/ to start the system configuration wizard. This is the default IP address of the SparqLinq.

Note: See the *Troubleshooting* section for suggestions on connecting to the Linq via Ethernet only (that is, without using the WiFi adaptor).

3.1.2. Software Updates



(a)



(b)

Figure 9: SparqLinq Software updates.

1. Perform Software update check – this can only be done once the SparqLinq is connected to the Internet.
   - Press "**Check for new Update**" on the screen as shown in Figure 9(a).
   - If "**Apply Update**" button is highlighted, select this option, and wait till the SparqLinq update is completed. This could take a few minutes as it is dependent on the speed of the internet connection.
   - After the update process is finished, **refresh** the browser webpage. Figure 9(b) shows the screenshot of the refreshed web page.

2. Select "**Next Step: SparqLinq Wizard**" to start the installation wizard. The wizard will guide the installer through the next steps in enabling the system.

3.1.3. Technician & Customer Information

Enter the following Installer and Customer Information in the boxes provided as shown in Figure 10.

- Technician Name
- Phone Number
- Customer Name
- Create a Site Name – The Site Name is your system's unique identification and it will be displayed on the SparqVu dashboard.
- City, State

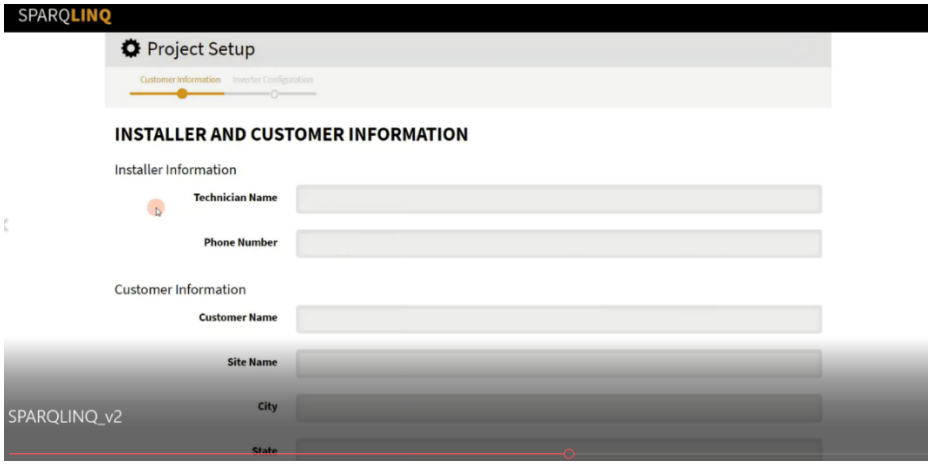


Figure 10: Inverter detection.

Select "Next Step: Inverter Configuration" to identify and configure the Q3-2000 microinverters that have been installed..

3.1.4. Inverter Configuration

Inverter configuration begins with the "scanning" activity, wherein, the SparqLinq surveys the nearby radio environment listening for any Q3-2000 microinverters who are generating power as shown in Figure 11. This can only be done when the microinverters and the PV modules are installed and there is enough light on the PV modules to power the microinverters. Therefore, this activity cannot be performed at night.

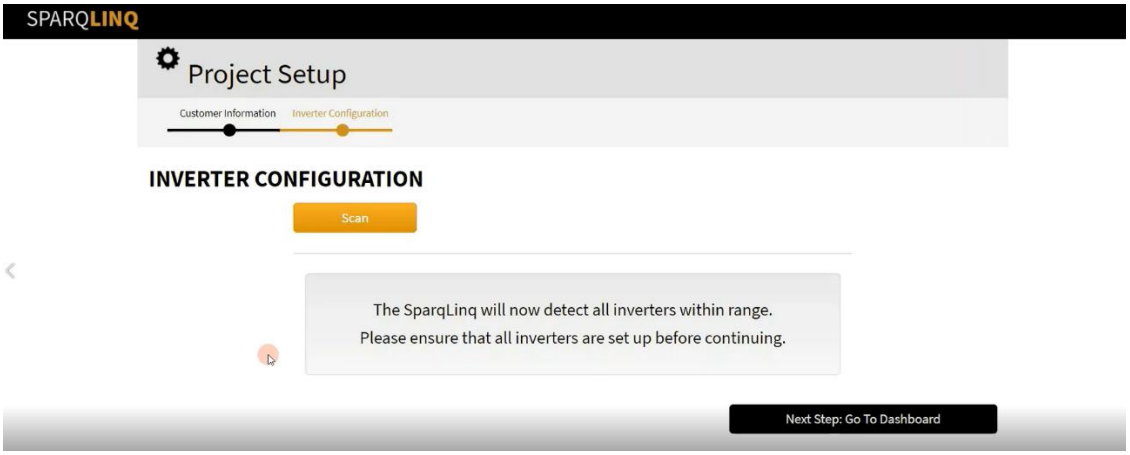


Figure 11: Inverter detection.

Once the scan is complete (1 minute) the Scan button becomes inactive and the microinverters start appearing in a list as they are discovered, as shown below in Figure 12.

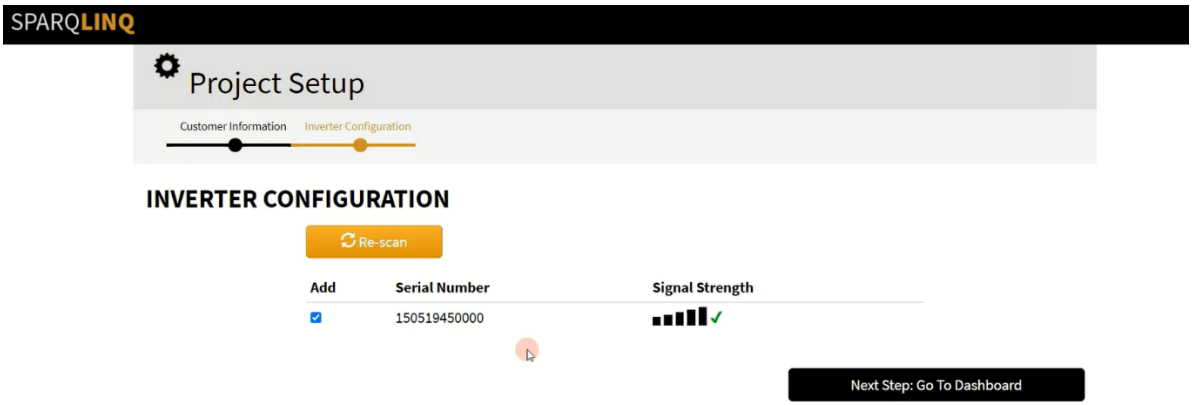


Figure 12: Scanned inverters.

Note the *Serial Number* values at your site will *not* match those depicted above. Instead, they will be the factory assigned serial numbers for the microinverters installed at your site.

After the scan is complete, all the microinverters discovered are listed and the Re-scan button is displayed. Carefully inspect the information and ensure that all the installed microinverters are in the list, perform a Re-scan to direct the SparqLinq gateway to start another scanning activity if some microinverters are not in the list.

If, after successive scans, the number of microinverters still does not equal the expected total, relocate the SparqLinq. Try moving the SparqLinq to a different position by first pointing the SparqLinq antenna in the direction of the installed microinverters. If this is not successful, the next step is to move the SparqLinq closer to the microinverters. Once an Inverter has been found, it will stay connected to the SparqLinq even after the SparqLinq is moved back to the starting position.

Note: Plasma TVs can interfere with the ZigBee communications used by SparqLinq if the TV is located between the gateway and solar modules.

When all the microinverters appear on the Inverter Configuration page, they are detected. Select the "Next Step: Go To dashboard". Once selected, the next screen will look like the one shown in Figure 13.

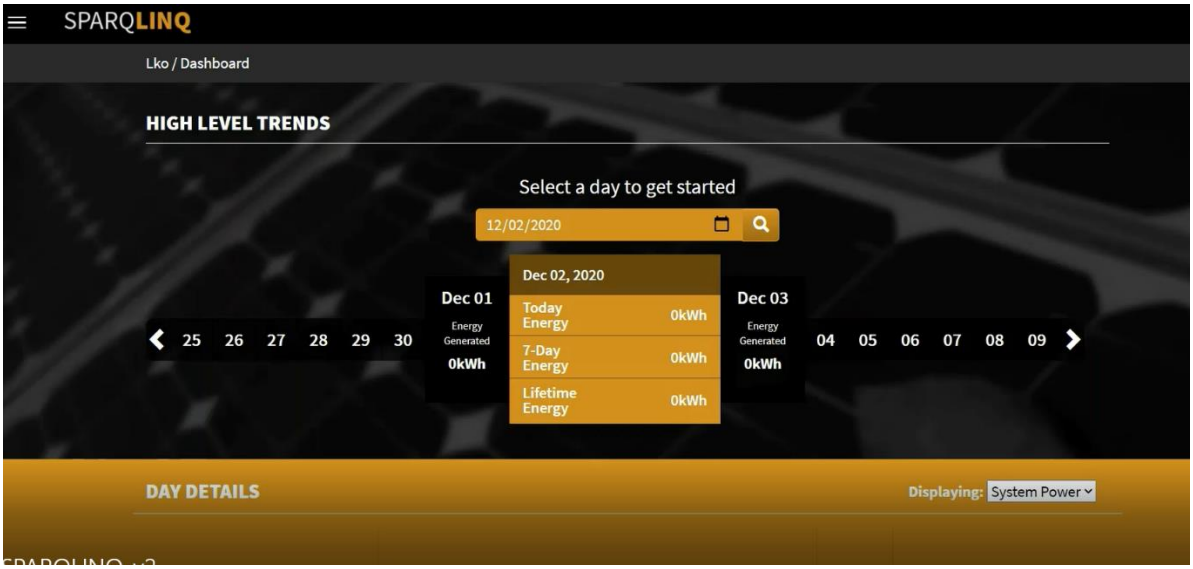


Figure 13: SparqLinq Dashboard.

3.1.5. Network Configuration

The following steps indicate how to connect the SparqLinq to the internet through WiFi. This step is only required if the SparqLinq cannot be connected to the home internet router using the Ethernet Cable.

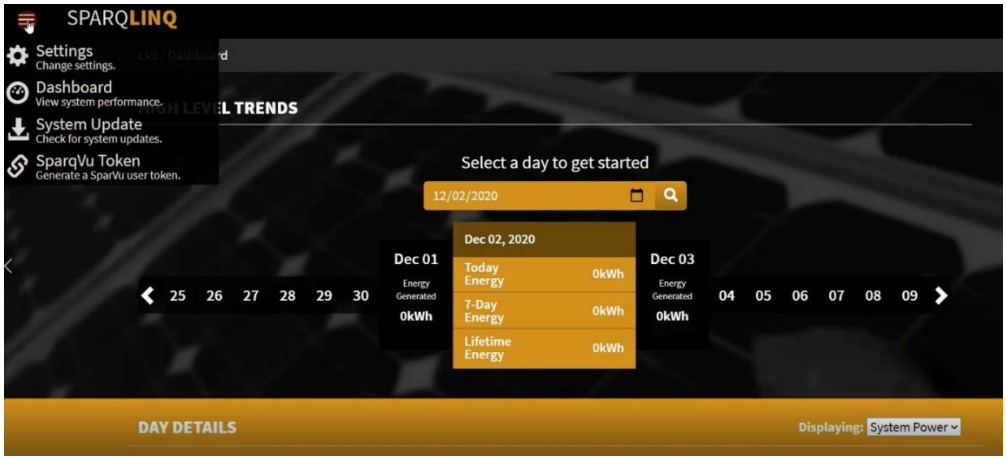


Figure 14: Network configuration via SparqLinq dashboard.

1. Click on the menu icon (three horizontal bars) in the top left corner of the dashboard page and then select the Settings option as shown in Figure 14.

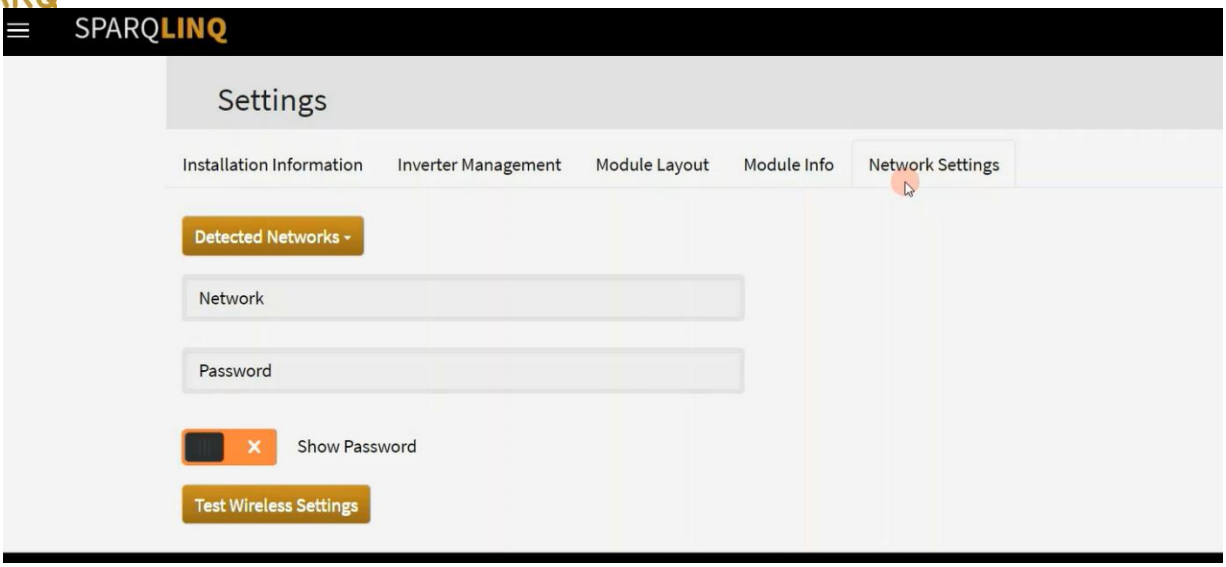


Figure 15: Network detection.

2. On the Settings page select the "Network Settings" menu as shown in Figure 15.
3. Click the detected network button to find the desired access point (consult with the homeowner)
4. If required, enter the homeowner's WiFi password (Press "Show Password" to display text)
5. Press the "Test Wireless Settings" button.

The SparqLinq will take down its WiFi access point and attempt to connect to the wireless network selected using the credentials provided. After testing it will re-enable its WiFi access point. The installer may need to re-connect to the SparqLinq access point unless "Connect Automatically" was set on the installer's device.
If the test was successful, the following screen will be displayed as shown in Figure 16.

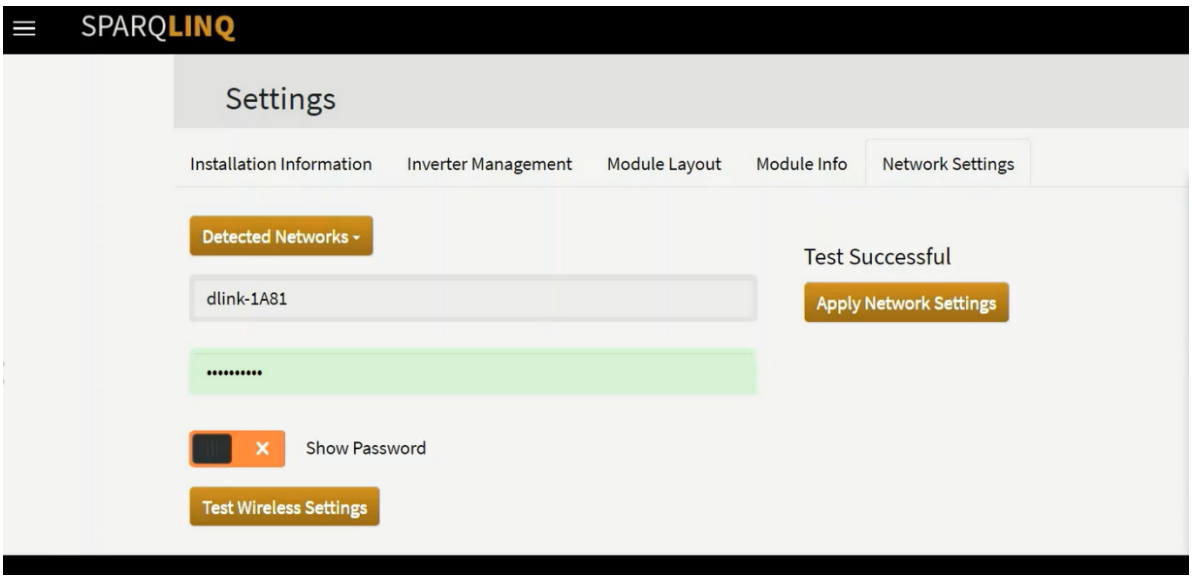


Figure 16: Successful network detection.

6. Click on “Apply Network Settings”. You will see a prompt to connect to the home wireless network.

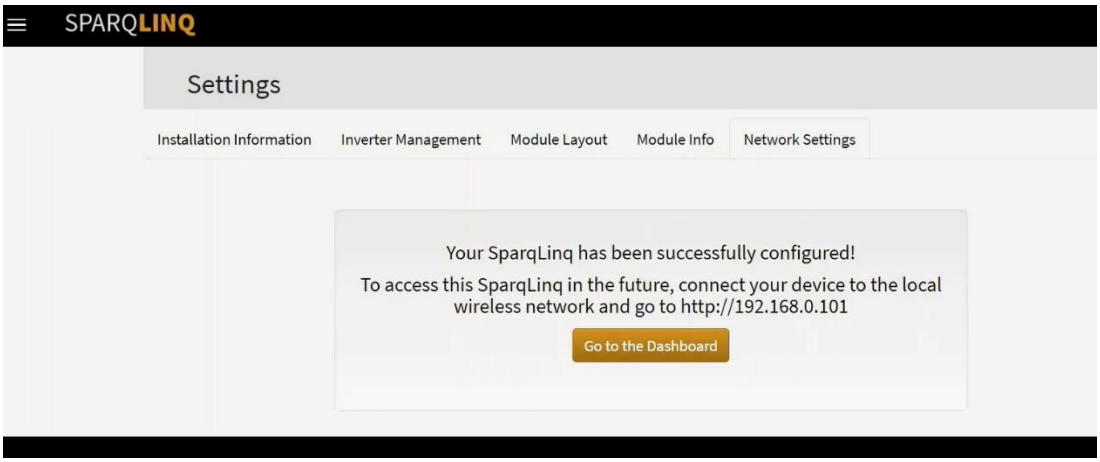


Figure 17: SparqLinq setup complete.

After the network settings is established, you will see a screen like Figure 17. Please note the IP address for accessing SparqLinq. Click on the “Go to the Dashboard” button. You will be redirected to the SparqLinq Dashboard. Your setup is now complete!

If the WiFi connection was not successful, the page shown in Figure 18 below appears. To address the problem, try unplugging and moving the SparqLinq to a different location and re-run the test from the Settings menu.

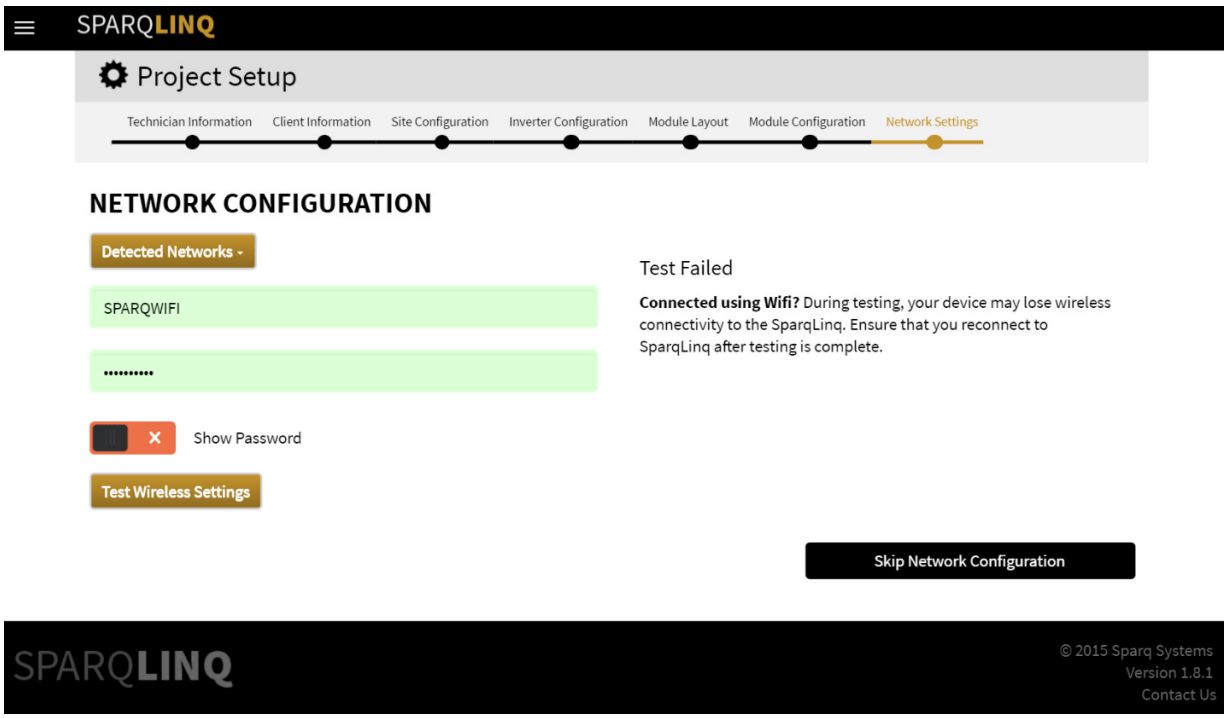


Figure 18: Failed wifi detection.

3.2. Microinverter Placement and Installation

Once your racking is in place, the next step is to place the microinverters on the racking so that the cabling and ultimately modules can be built on top. Refer to your system layout to plan these out.

The Q3-2000 has two slots on the top for mounting. These are both required to ensure a strong connection to the rail. There is a handle in between these mounting slots for ease of carrying and placement of the Q3-2000s around the job site. Use two fasteners to mount the Q3-2000 to the rail and torqued to 10 ft-lbs / 13.5 N-m.

Note: the Q3-2000 has DC connectors on the sides, an AC connector and a Wireless Window on the bottom. Weight should NEVER be placed on these plastic components to ensure they are not damaged during the installation process. The Q3-2000 should always be carried and supported using the handle and placed down by leaning on the edges of the body of the unit. Never carry or pull the microinverter using any of the connected cables. No weight should be applied on the connectors as they can be damaged.

3.3. Cabling

Once your microinverters are mounted on the racking, the next step will be to lay out the AC Cable on the site and connect it to the rails. Some basic tips will ensure an easy installation:

- Add any expected DC extensions if required to the modules as you place them, preinstalled as appropriate to enable easy connection of modules.

SPARQ has partnered with Ti-Lane to bring you a complete cabling solution that makes installing the SPARQ microinverters snap. This mature and robust solution ensures an easy and cost-effective deployment of your SPARQ system. These cables come with the AC connector ready to be plugged into the SPARQ microinverter.

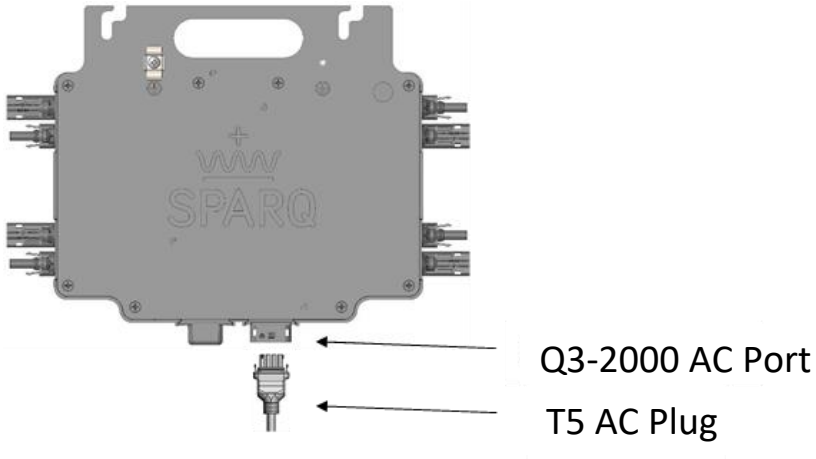


Figure 19: SPARQ microinverter connection with T5 AC plug.

3.4. Cabling System

The SPARQ's AC Cable microinverter solution is very cost-effective compared with daisy chain or other

proprietary cabling systems, reducing installation cost and cost of ownership. The AC cabling system enables the solar installer to cost-effectively match the cabling needs to each site. The cable consists of an individual molded T5 plug and a 0.7-meter, or 3-meter cable assembly. This cable terminates in either bare wires allowing it to be connected in parallel with other microinverter outputs in a Junction Box to a homerun cable, or to a T6 plug. The T5 female plug connects to the male bulkhead port installed in the SPARQ Q3-2000 Microinverter that serves as its AC output.

Types of cables:

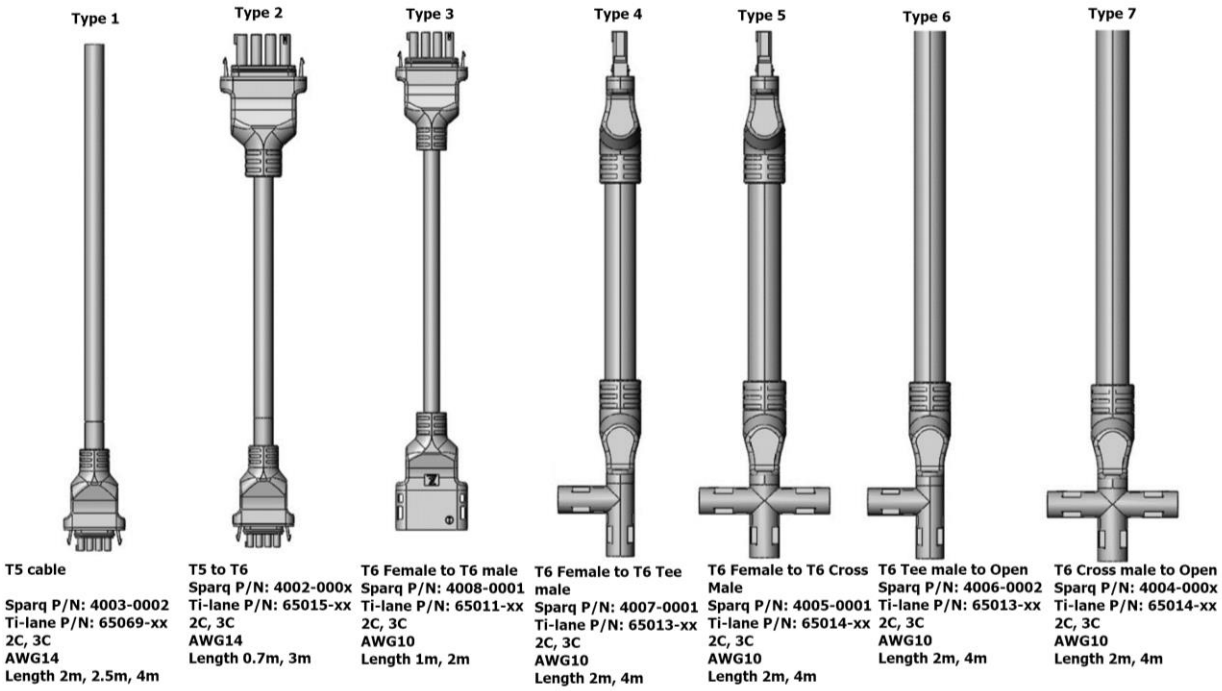


Figure 20: Ti-Lane cabling solutions.

Most installations will only need 2 meters of cable between inverters if modules are mounted in portrait orientation. If modules are mounted 4 in a row, or landscape orientation, they will need 4 meters of cable to bridge between inverters.

The American NEC (National Electric Code) and European IEC (International Electrotechnical Commission) specify the maximum current carrying capacity of the various standard wire sizes including the American Wire Gauge (AWG) and the European square millimeter (mm^2). Based on these tables, a 10 AWG ($6mm^2$) cable should be limited to ten Q3-2000 microinverters and protected using a three-phase (three-pole) 30A, 230V/400V breaker. It should be noted that the selection of the appropriate circuit breaker depends on the grid voltage, wire gauge of the AC trunk, and the number of the Q3-2000 inverters. A 10 AWG ($6mm^2$) cable will have a lower overall cable resistance resulting in less voltage drop along the cable, so it may also be used in long cables with less than ten Q3-2000 microinverters installed. Do not exceed the recommended number of microinverters per trunk cable as noted above.

⚠ If the AC cable has any damage to the connectors and/or jacket, ***DO NOT*** install the cabling and get some undamaged cable.

WARNING: When stripping the sheath from the cable, make sure that the cable and/or conductors are not damaged. If the exposed wires are damaged, the system may not function properly and could cause issues with the microinverter.

3.5. Cable Accessories

AC Protection Caps female version

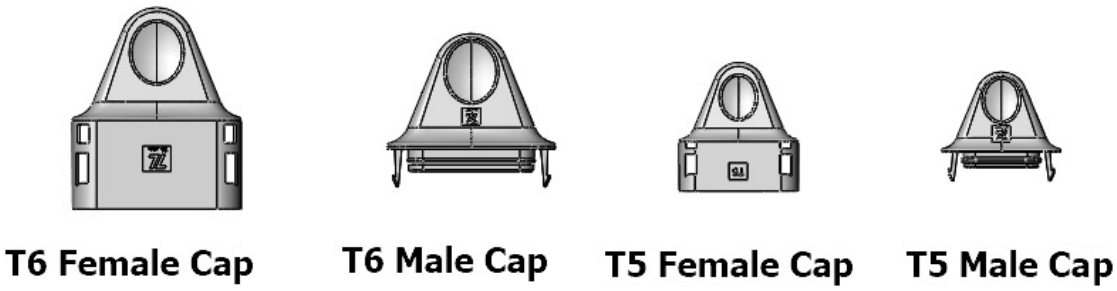


Figure 21: Waterproof Ti-Lane cable caps.

Waterproof T5 and T6 Caps - used when complete sealing from water and dust are needed. The waterproof cap is IP67 rated and can protect from water ingress if submerged at the depth of 1m for 30 minutes. To unlock waterproof caps, the unlocking tool is required. Make sure these waterproof caps have been installed on all unused AC connectors. Unused AC connectors are live when the system is energized by the grid.

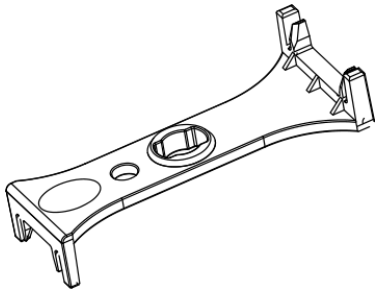


Figure 22: AC unlocking tool.

AC Unlocking Tool – used to disassemble mated connectors with T6 and T5 cable plugs and T5 bulkhead connectors in the microinverter. This tool is also used to unlock waterproof caps.

Cable Assembly Instructions

Step 1:
Determine the cable wire gauge and the cable length required for installation based on the number of microinverters to be installed in a single AC cable.

Step 2:

Measure where the modules will be placed on the mounting rail. Position of the inverters and T5 cables

so DC extension cables and T5 cables are minimized.

Step 3:
Secure Junction Boxes with cable ties or other reliable method.

Step 4:
Align the mating AC connectors and join mating parts together as shown below and connect the AC plugs.

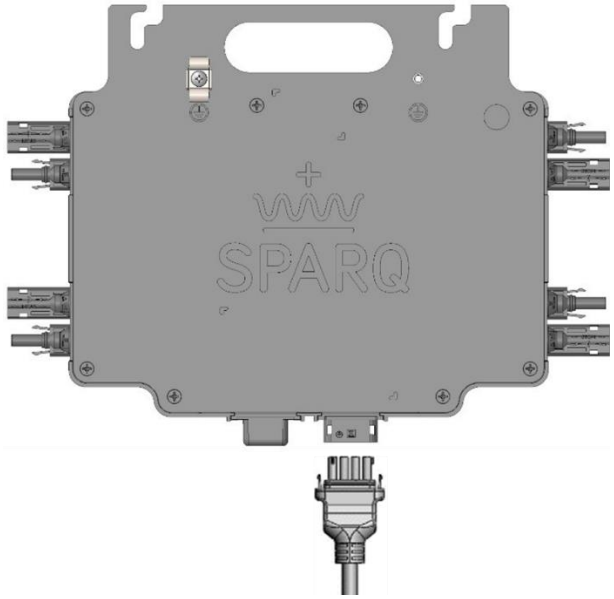
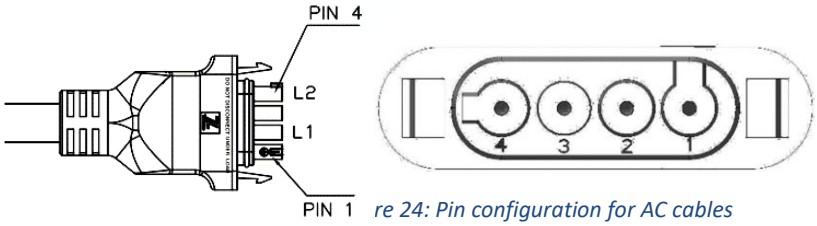


Figure 23:Aligning the mating AC connectors with the inverter.

NOTE: Do not apply excessive force when mating the connectors. Please check if the key is aligned properly before assembly. Wrong key alignment will result in connectors not properly joining.



re 24: Pin configuration for AC cables

Join all Red wires together with the Red trunk wire, all Black wires together with the Black trunk wire, and all the White wires together with the White trunk wire using the terminal block in the junction box when using unterminated wires. The Red wire is connected to T5 Pin 4, the White wire is connected to T5 Pin 3, and the Black wire is connected to Pin2 of the T5 plug. NOTE: When connectors are properly locked a “click” sound will be heard and the locking hooks on the connector will align and lock in place.

Step 5:
Secure any unused T5 plugs with a waterproof cap. Waterproof caps must cover all unconnected connectors and will provide IP67 sealing to avoid risks of electrical shock and short circuits when the system is energized.

Cable Disassembly Instructions

To unlock the T5 cable connectors from the inverter bulkhead, use the AC unlocking tool. The unlocking tool must be inserted in the correct direction and into the opening of the connectors to unlock. The tool has sloped edges that push the locking barbs into the unlock position and allow the connectors to be separated. Once the hooks of the connector disengage, separate the connectors.

WARNING: Do not leave AC connectors on the AC Cable uncovered for an extended period. If you do not plan to connect the microinverter immediately, you must cover any unused connector with a Waterproof cap.

3.6. Ti-Lane Cable Part Number Information

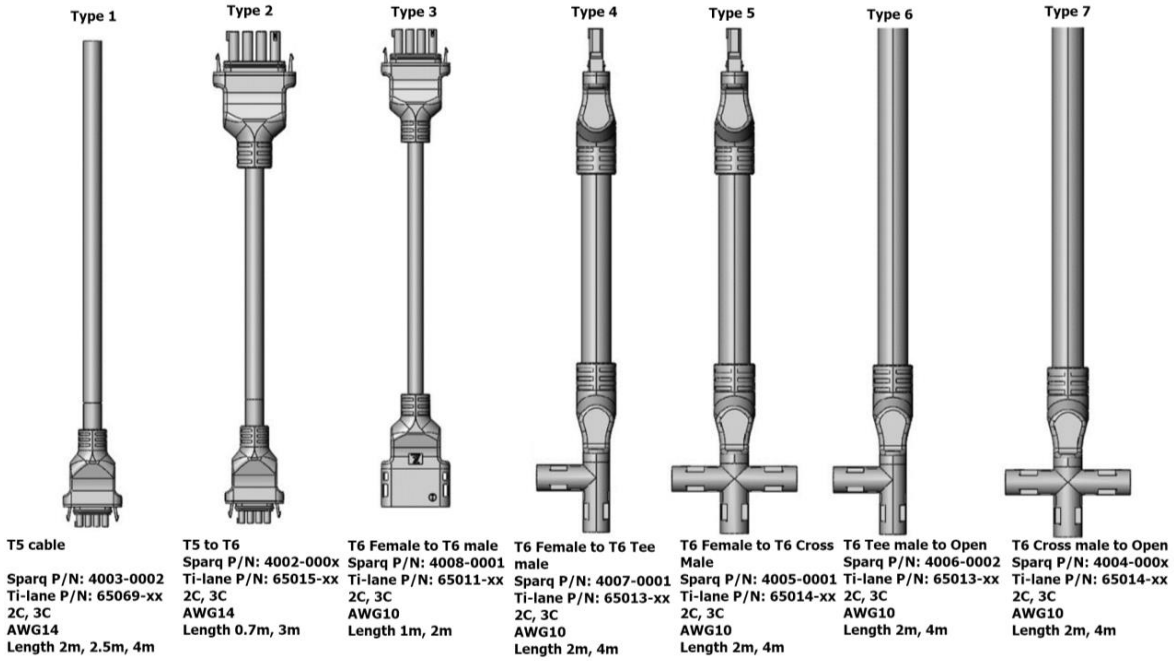


Table 2: Ti-Lane cable specifications

	Cable Gauge	Cable Length (M)		
T5 female to open		2	2.5	4
Part Number	3C/14AWG	65069-17	65069-19	65069-18
T6 female to t5 female		0.7	3	
Part Number	3C/14AWG	65015-09	65015-10	
T6 female to t6 male		1	2	
Part Number	3C/10AWG	65011-10	65011-11	
T6 female to t6 tee male		2	4	
Part number	3C/10AWG	65013-16	65013-17	
T6 female to t6 cross male		2	4	
Part Number	3C/10AWG	65014-25	65014-26	
T6 tee male to open		2	4	
Part Number	3C/10AWG	65012-14	65012-15	
T6 cross male to open		2	4	
Part number	3C/10AWG	65014-19	65014-20	

3.7. Mounting the SPARQ Microinverter

1. Mount the microinverter onto the racking using two fasteners and ensure the microinverter is fully covered by the module or other means.
2. Install the grounding hardware and attach grounding wire. If using WEEBs, place them between the rail top and microinverter flange bottom.
3. Connect the AC cable and ensure that the system is not connected to AC power
4. Connect the modules to the inverter one at a time.

WARNING: Do not exceed the maximum number of microinverters in series in one branch.

IMPORTANT: Ensure that there is a gap (at least 10mm) on both the top and bottom of the microinverter.

3.8. DC Connection (Connecting the Microinverter PV Module)

To connect the mounted microinverter to the PV module, please follow these steps:

1. Before placing modules, clip the DC wires to the module frame. This will secure them off the roof and make them the right length to connect them to the Q3-2000.

   NOTE: When placing the modules, please ensure that the module is supported (either by a second person or a suitable fixture or support) while you make the final connection.

   For the 4th module that will cover the Q3-2000, rail clips should be used to hold the excess cable from the module to the Q3-2000 (as opposed to module frame clips).

2. With one person or suitable fixture/support holding the module up, connect the module's MC4- compatible connectors to the microinverter DC input connectors.

3. Install the PV modules on the racking (follow the PV module installation guide and make sure that the cable is not on the rail where the edge of the module will be placed).

WARNING:

Before disconnecting any of the wires, the AC system circuit breaker must be disconnected. NEVER disconnect any DC cables under load!

3.9. AC Connection

1. Connect the male AC T5 bulk head of each microinverter to the female plug on the AC cable.

WARNING:
Make sure any unused AC connectors are covered by the protective caps.

2. Ensure the junction box is not live then connect the end of the AC cable to the junction box.

3.10. Grounding

Grounding the microinverter can be done with a 6 AWG (16mm²) or 8 (10mm²) AWG solid copper wire or Washer Electrical Equipment Bonding (WEEB) method. The grounding must be done in accordance with the IEC or equivalent regulatory requirements by the trained personnel.

WARNING:
Failure to comply with the NEC grounding requirements will null and void the product warranty.

3.10.1. Copper Cable Grounding

The illustration below shows how to make the grounding bond to the microinverter using microinverter ground lug. This is a side view of the grounding clip installed on the Q3-2000. This grounding lug is internally bonded to the microinverter ground screw and provides a high-level of ground bond between the microinverter enclosure and the system ground.

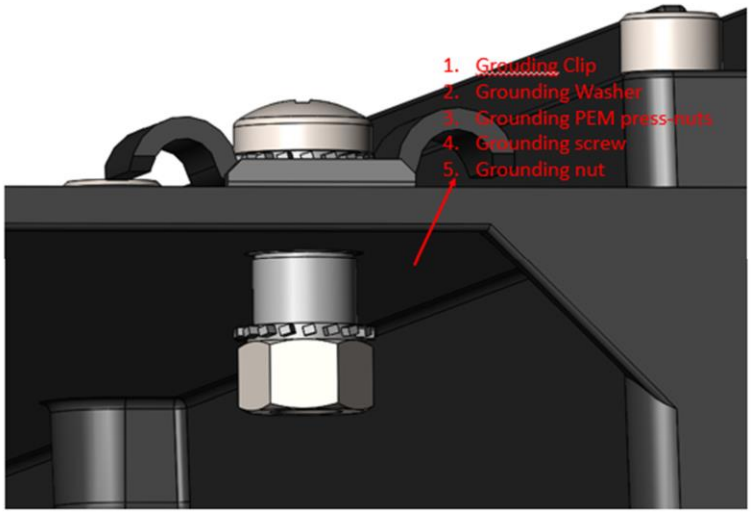


Figure 26: Grounding lug of the microinverter.

3.10.2. WEEB Grounding

Another grounding method for SPARQ microinverters is to bond the microinverter metal enclosure to

the PV mounting rack using proper outdoor-rated WEEBs. This method is a cheap, solid, and quick solution for bonding the microinverter to the mounting rack. SPARQ Systems highly recommend using quality serrated lock washers and blot-nuts combination for making a solid bond between the microinverter enclosure and the metal rack.

Figure 27 shows the Q3-2000 attached to a mounting rail with a solid copper conductor attached to the grounding clip as well as the WEEB grounding method.

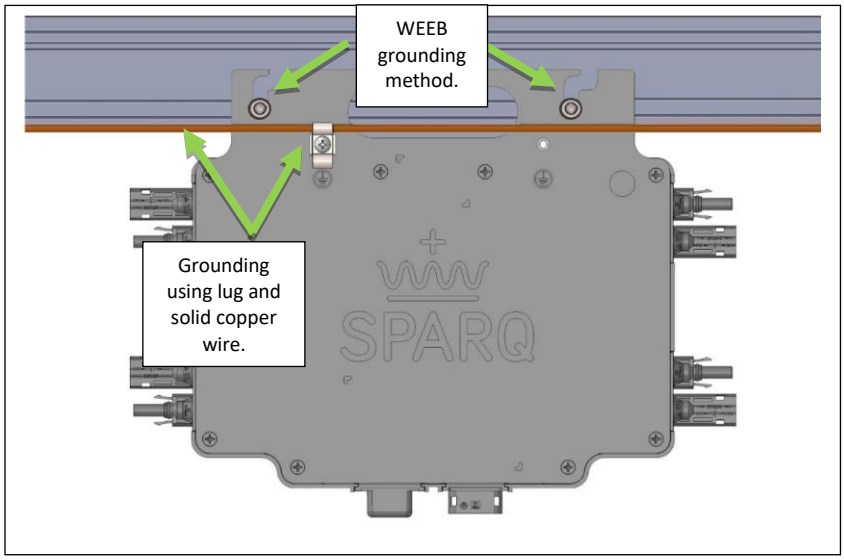


Figure 27: Microinverter grounding using WEEB and grounding lug.

WARNING:

At least one of the introduced grounding methods MUST be incorporated for safe operation of the microinverter.

3.11. Protection Against Lightning Surges

Voltage and current 'surges' may result in the destruction of electronics equipment in an electrical power system. As per ANSI/IEEE 62.41 'Recommended practice on surge voltages in low voltage AC power circuits', SPARQ microinverter is equipped with surge protection devices suitable for installation in Category A sites. Before using the Q3-2000 microinverter in a PV system, the users are advised to correctly identify the location of its use, and connect external Surge Protection Devices (SPD) as per their need. We recommend installation of surge protection devices on the AC lines by trained personnel. SPARQ recommends the Citel (https://citel.us/en) DS70U Series SPDs (or equivalent as deemed suitable by a trained personnel in accordance with NEC or equivalent regulatory requirements) for protecting the microinverters. See the link https://citel.us/en/news/renewable-energy-systems for details on how to install the SPDs.

3.12. Electrical Wiring Diagram

The Q3-2000 microinverter can work with various three-phase AC grid voltage levels, including 380V/50Hz, 400V/50Hz, and 480V/60Hz. The microinverter will autosense the line voltages and calculates the frequency to adjust its internal settings to match the appropriate service voltage.

Here is a typical electrical wiring diagram showing the main parts of a SPARQ Q3-2000 system for use with a 230V/400V three-phase electrical service. Because of the NEC requirements it is recommended that a 10 AWG Trunk cable have a maximum of nine Q3-2000 inverters with a 30A three-pole breaker.

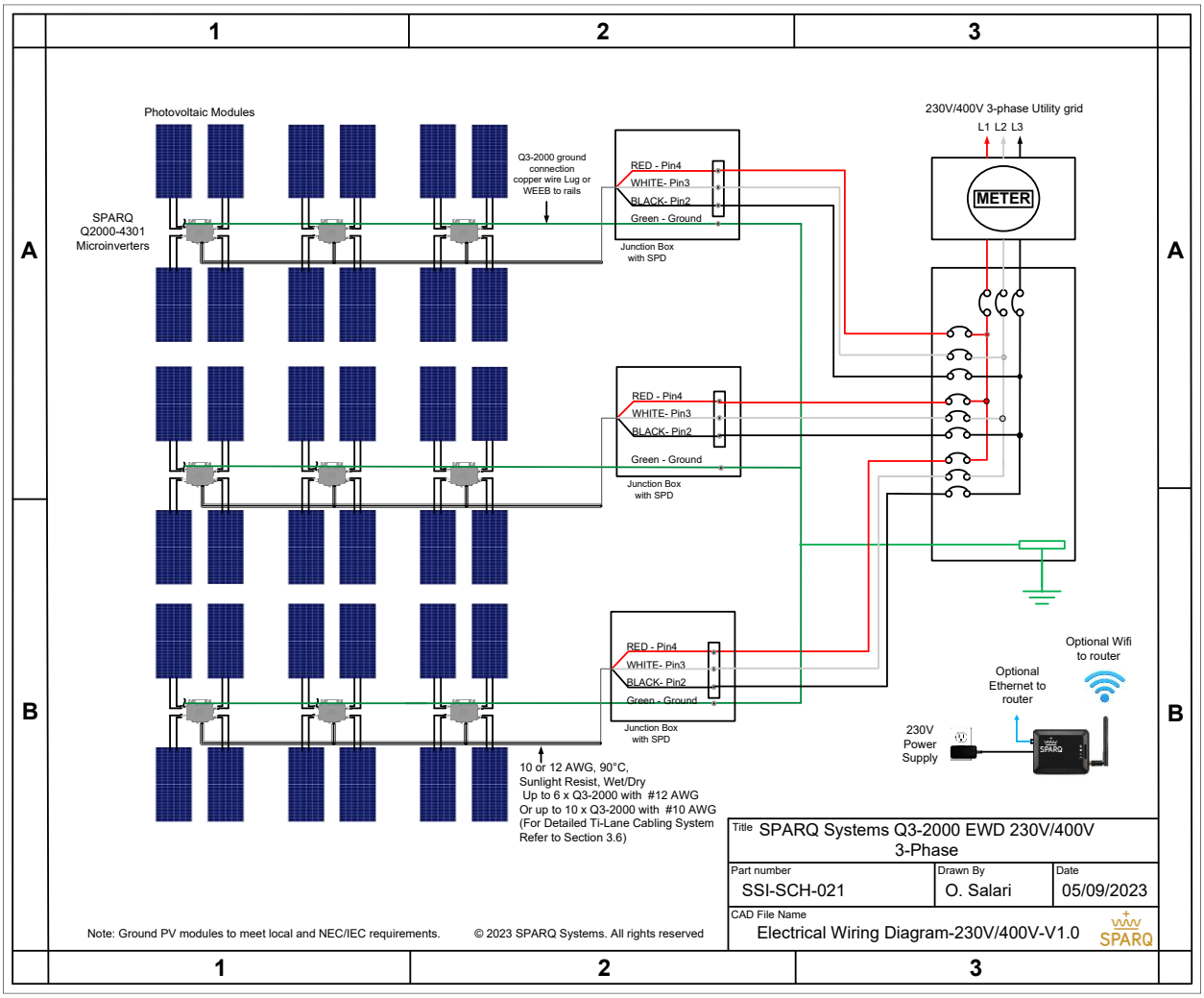


Figure 28: Single line diagram for three phase system.

4. SparqVu

SPARQ offers complete system management for initial installation as well as ongoing monitoring of the SPARQ System production and performance. Named “SparqVu”, it offers a mobile friendly, easy to use solution for installers and end customers. The first step is to create your SparqVu account.

4.1. Creating a new SparqVu account

To create an account:

1. Go to http://sparqvu.com and click on the Register tab

2. Enter an email address and password then click Register
3. Click on the link sent by SparqVu to your email account to verify your account

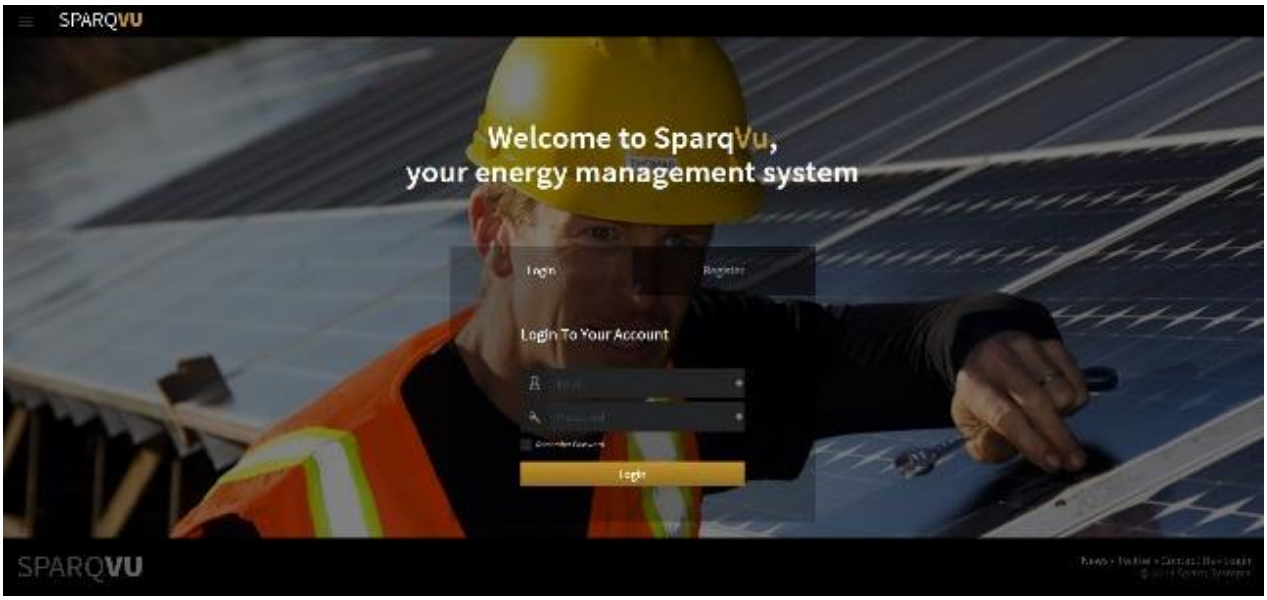


Figure 29: SparqVu login page.

4.2. Adding a new SparqLinq site to your SparqVu account

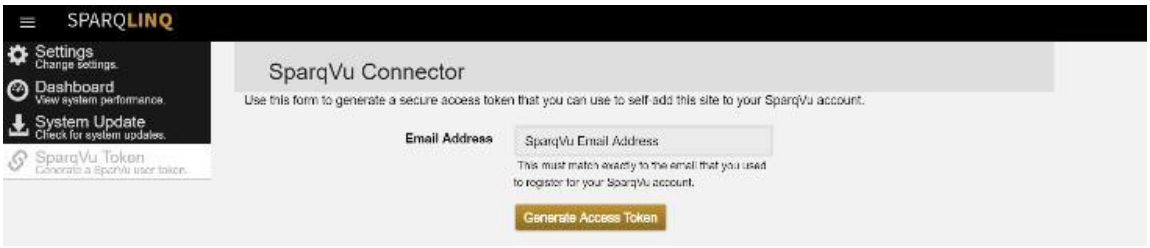


Figure 30: Adding a SparqLinq Site.

1. On the **SparqLinq** dashboard, click on the menu icon (three horizontal bars) in the top left corner of the dashboard page and then select the SparqVu Token option.
2. Enter the full email address that was used to create the SparqVu account and click “Generate Access Token” and copy the Token value.
3. Click on the “Activate on SparqVu” button and login to your account.

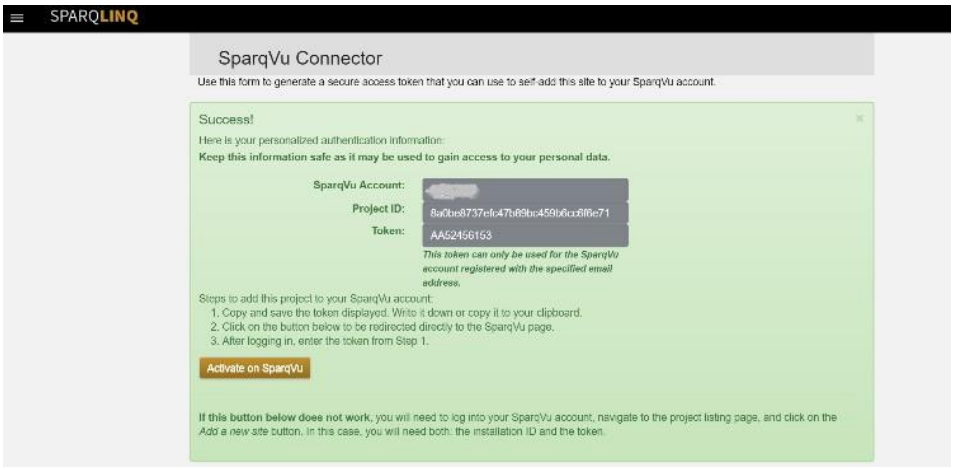


Figure 31: Setting-up access to the SparqVu.

4. Enter the Token copied from the SparqLinq and click Check Access Token.

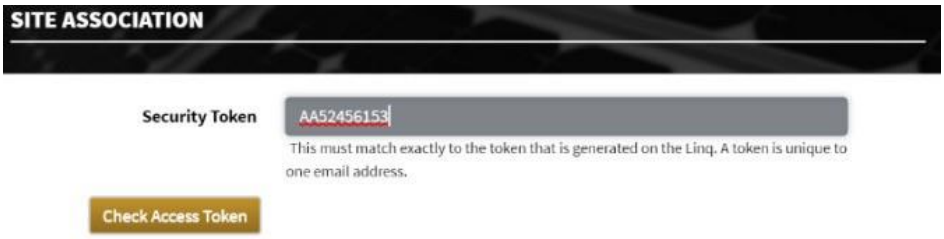


Figure 32: Entering SparqLinq token.

The SparqLinq should now be added to this SparqVu account. Additional SparqLinqs can be added to a SparqVu account by repeating these steps for each additional Linq.

4.3. Accessing a SparqVu project's /System page

In the upper right of the SparqVu dashboard in a small gear icon that can be used to view additional system information about the project site. Clicking on the gear icon see the page.

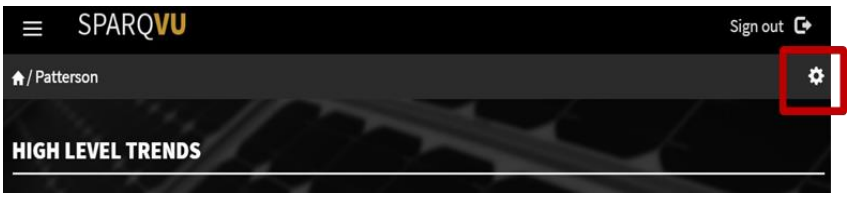


Figure 33: Navigating SparqVu additional settings.

The /System page can allow installers to view customer and installation information. It also provides a way to remotely initiate a GFDI reset by clicking the [Clear GFDI] action.

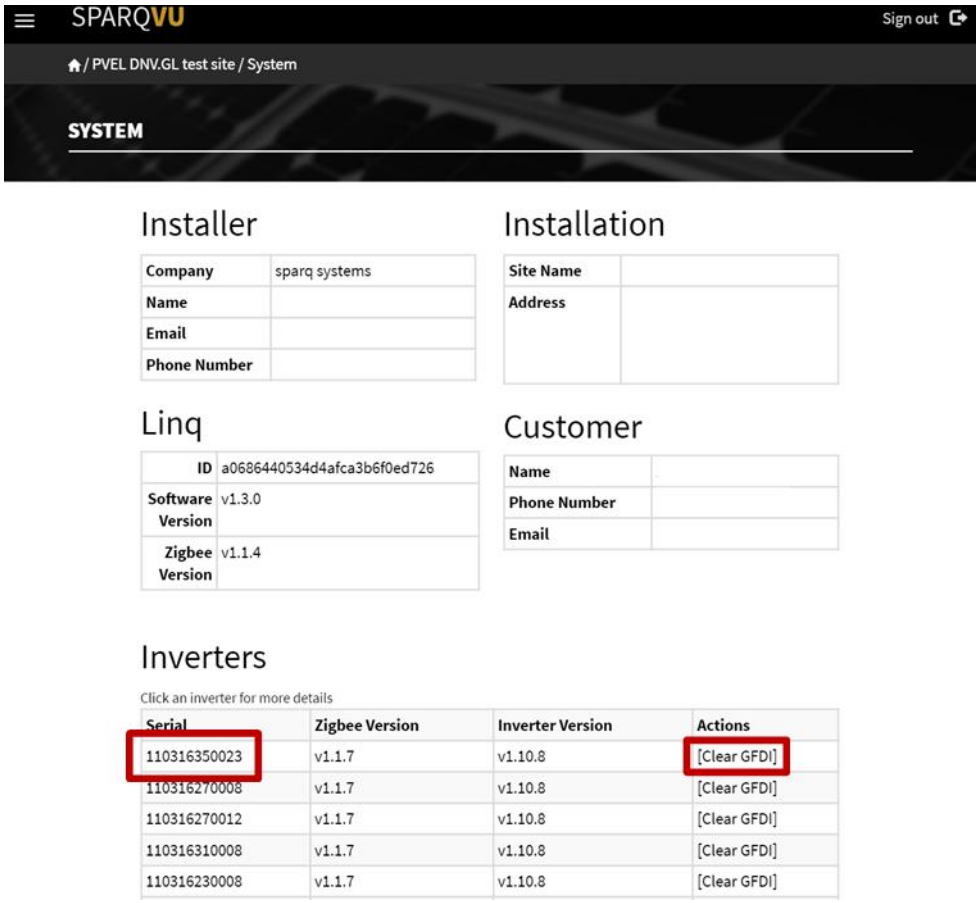


Figure 34: SparqLinq system page.

Clicking on an inverter serial number allows additional information to be displayed regarding that specific inverter and its modules.

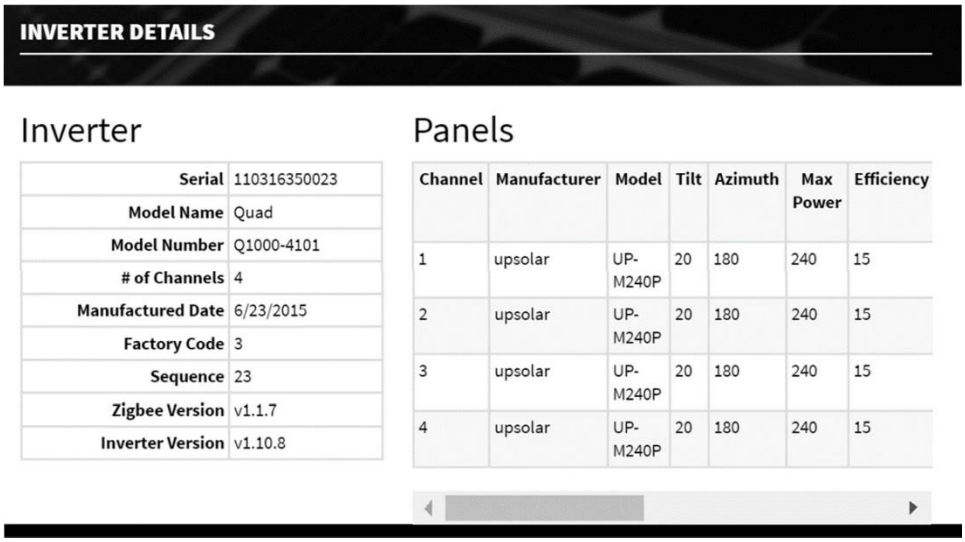


Figure 35: Inverter detailed information.

4.4. Documenting the module inverter connections during installation

As you design the system, SPARQ has included easy stickers to be mapped into your design. They allow the ability to identify which module is connected to which port, and which module has the QIII2000 underneath it should any troubleshooting need to take place in the future.

Note the port numbering depicted below:

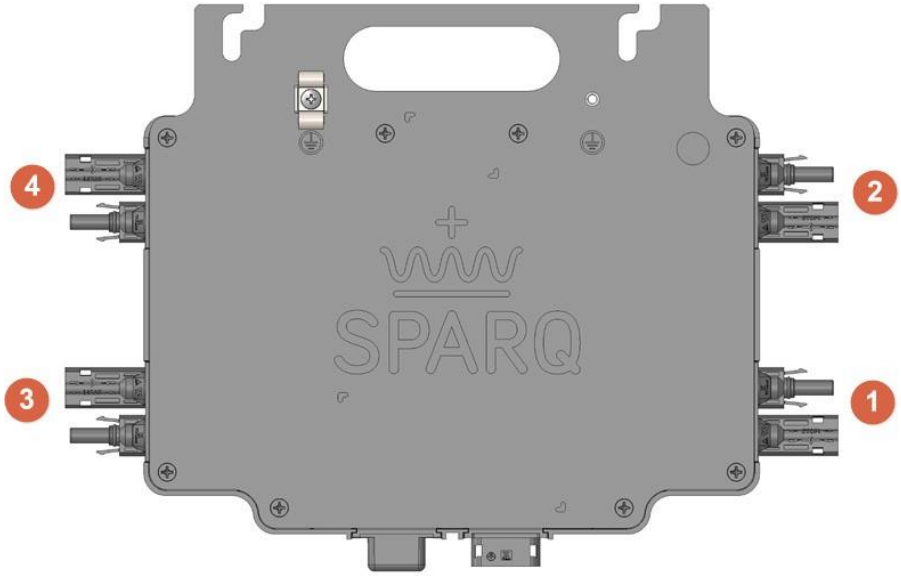


Figure 36: SPARQ microinverter DC port numbering.

A typical sticker map is shown below:

SPARQ QIII2000 Panel

N / E W / S

Tilt:_____ Azimuth:_____

1-4	1-2	2-4	2-2	3-4	3-2	4-4	4-2	5-4	5-2
1-3	1-1	2-3	2-1	3-3	3-1	4-3	4-1	5-3	5-1
6-4	6-2	7-4	7-2	8-4	8-2	9-4	9-2	10-4	10-2
6-3	6-1	7-3	7-1	8-3	8-1	9-3	9-1	10-3	10-1
11-4	11-2	12-4	12-2	13-4	13-2	14-4	14-2	15-4	15-2
11-3	11-1	12-3	12-1	13-3	13-1	14-3	14-1	15-3	15-1

Street

Customer Name & Address_____ Street_____

Figure 37: Panel map.

Once logged in, the installer will be able to see all the sites they are registered to manage. This is called the Project Selection page and is designed for when you are managing the 2nd customer and beyond:

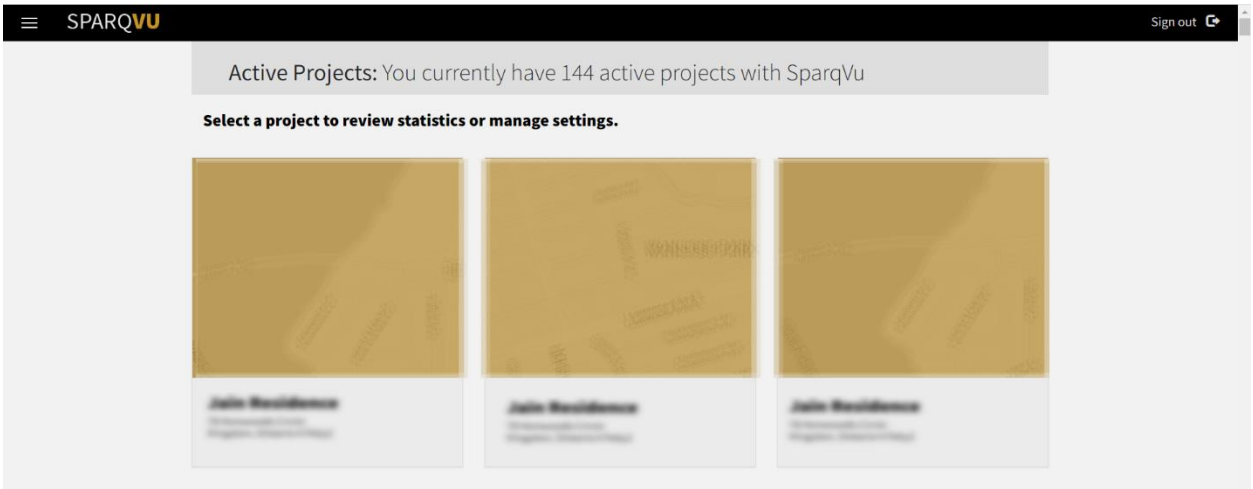


Figure 38: Navigating sites.

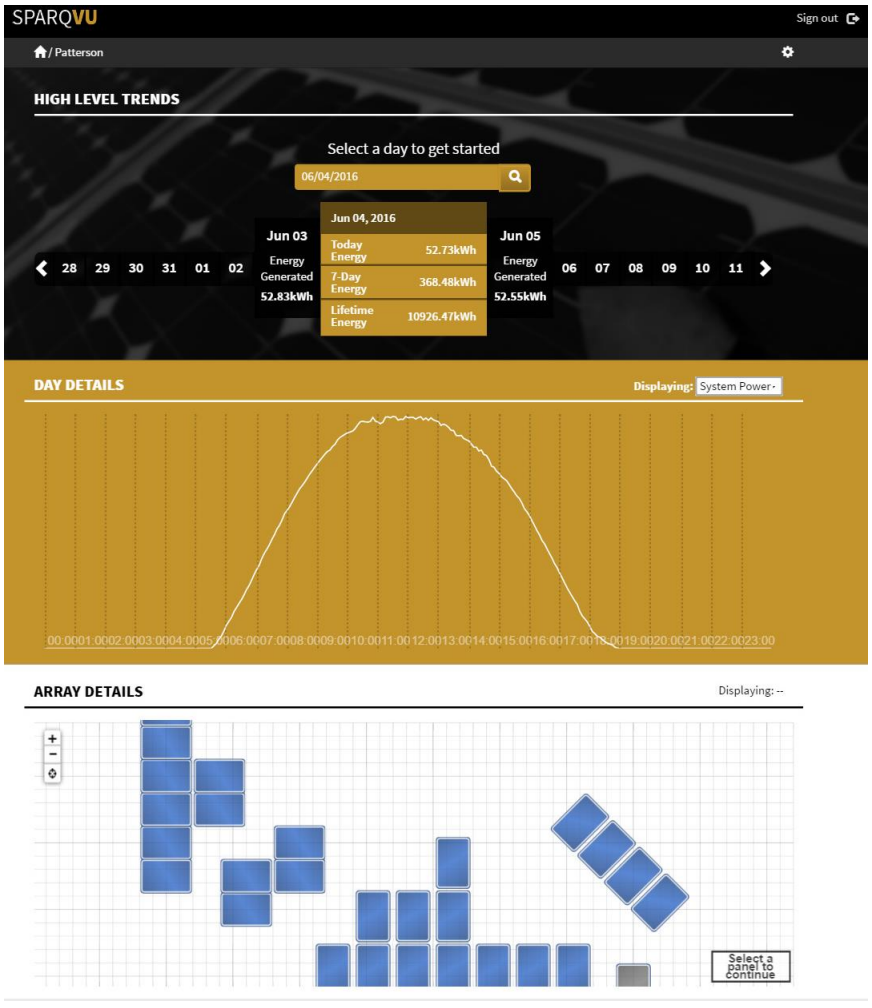


Figure 39: Navigating the dashboard.

Once logged in to a given site, the user will see a dashboard of their daily performance, as well as details

on the array and module performance information by clicking on each module. Some of the key statistics include AC Output power, DC Input power per module, AC Grid Voltage, DC input voltage by module, and temperature, etc.

4.5. Generating Power

For your safety, please review the following checklist and ensure that all the steps have been properly completed before turning on your SPARQ energy system.

Checklist:

☐ Ensure any unused AC connections have been covered with the recommended waterproof cap.

☐ Check all connections to make sure they are fully connected, and no wires are damaged or pinched.

☐ Confirm all microinverters are grounded using a grounding wire or by using the appropriate grounding washer for your racking.

☐ Ensure that all PV modules and microinverters are securely fastened to the racking.

☐ Make sure you comply with IEC (International Electrotechnical Commission), ANSI/NFPA 70, and the local electrical code during installation—such as including main AC system circuit breaker, if required.

Turning on the SPARQ Energy System:

Turn on the main AC circuit breaker to connect your system to the grid.

WARNING:

- Connection of your system to the utility grid **MUST** be completed by a certified installer or electrician.
- Before connecting the SPARQ Microinverter to the utility grid, confirmation from the utility company is required.
- It is the responsibility of the installer to install all relevant apparatus to connect to the utility grid and to comply with relevant electrical codes. The installer must also complete all safety checks required before connecting the system.

5. TROUBLESHOOTING

5.1. LED Indicators

There are two LED indicators in the Q3-2000. The power status LED mounted next to the AC power port indicates power related conditions. The communications status LED is the one furthest from the AC power port and indicates the SparqLinq communication related conditions. There is also a magnetic field sensor that allows the QIII2000 to be manually released by placing a magnet next to the plastic LED bezel. The LEDs and the magnetic sensor spot are shown in the diagram below.

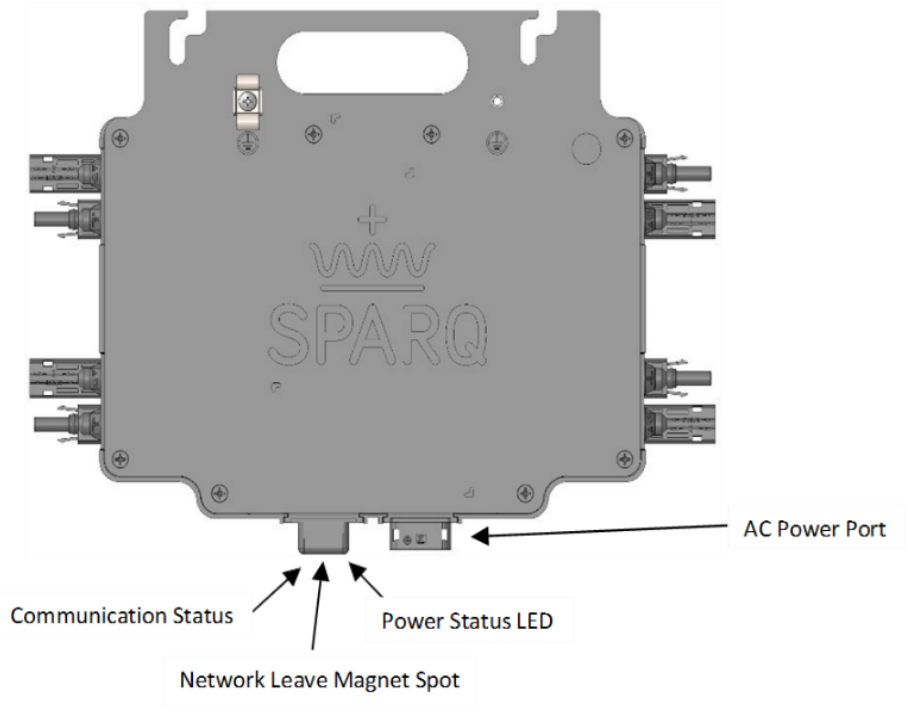


Figure 40: LED indicators of the SPARQ microinverter.

5.1.1. Communication Status LED Indication Table

Table 3: communication LED status indication

Communication Status LED Indicators			Possible Solution
Interval	LED Status	Meaning	
Normal operation	Solid GREEN	Communication is established with SparqLinq	Signal strength is suitable for reliable communications.
Normal operation	Solid AMBER	Network signal strength is too weak to communicate, or network is missing.	Check SparqLinq is powered on. Move the SparqLinq closer to the inverter
Normal operation	Flashing RED/AMBER	Ready to join Network	Run the SparqLinq setup wizard to join the inverter to the SparqLinq

5.1.2. Power Status LED Indication Table

Table 4: Power LED status indication

Power Status LED Indicators			Possible Solution
Interval	LED Status	Meaning	
Start-up	Solid GREEN	Startup process (normal). Performing 1-minute delay.	Check for abnormal AC conditions if this persists for more than 1 minute.
Start-up	LED OFF	If LED is OFF after applying DC and AC power, this indicates a failure in the microinverter startup.	Check: The DC connection to the solar panel Any possible shading of solar panel
Post-Start-up	Flashing GREEN	Operational and is producing power (normal).	N/A
Post-Start-up	Flashing RED	Not producing power due to abnormal grid voltage or frequency condition.	Please check for tripped AC breaker and turn back on. Confirm the grid voltage and frequency at the point of connection is within the ranges: 400Vgrid: 350V to 457V Grid Frequency: 50Hz $\pm$ 2.5 Hz.
Post-Start-up	Solid RED	Not producing power due to protection and caused by: Under/over voltage protection Over current protection	Check DC input voltage is less than 59Vdc and more than 20Vdc. Please contact SPARQ for support if condition persists
Post-Start-up	Amber	Ground fault detector	Please contact SPARQ for support

WARNING: No attempt should be made to repair the SPARQ Microinverter; there are no user serviceable parts. By opening the microinverter you risk voiding your warranty. If the device fails please contact SPARQ customer service.

5.2. Inverter Management

5.2.1. Access Inverter Management Page

The settings page becomes available accessible after the configuration wizard completes. Connect to the SparqLinq and select the settings page from the menu:

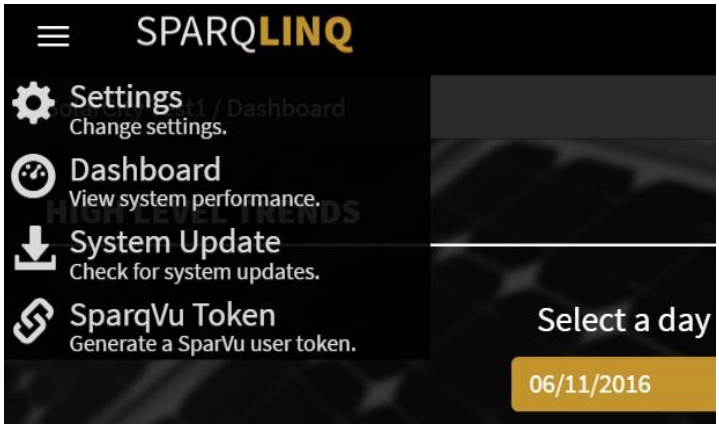


Figure 41: SparqLinq Menu.

Click the Inverter Management Tab:

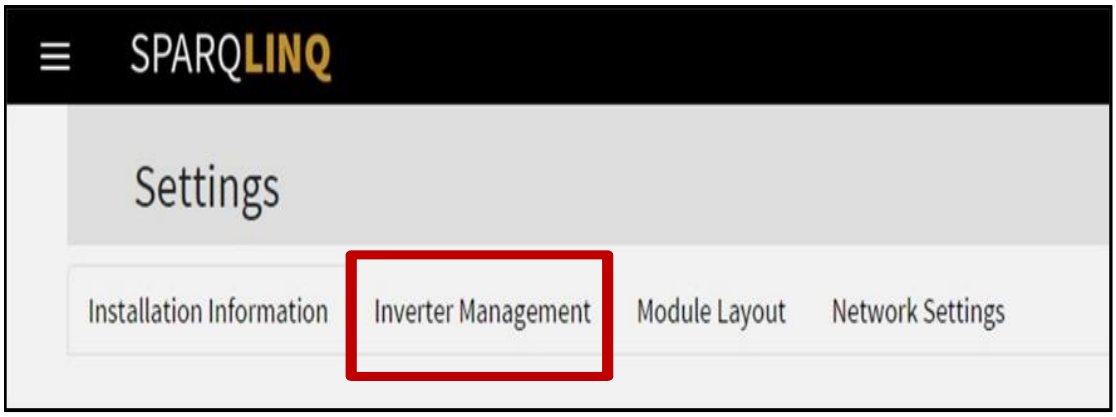


Figure 42: SparqLinq Settings tab.

5.2.2. Releasing an Inverter

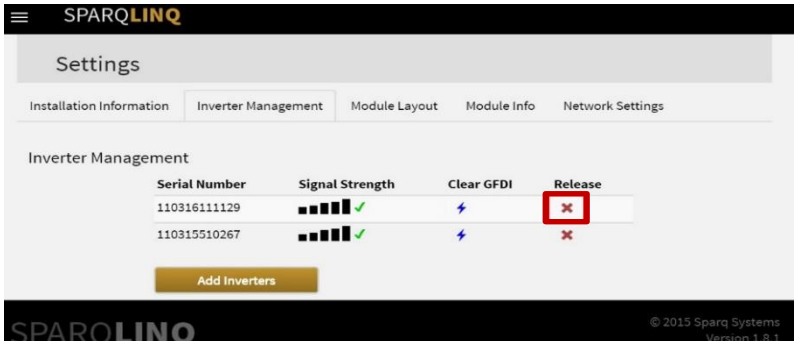


Figure 43: Inverter Management tab.

Identify the inverter to release. Click on the 'X' next to the serial number for that inverter. The inverter will Ask to confirm or cancel this action.

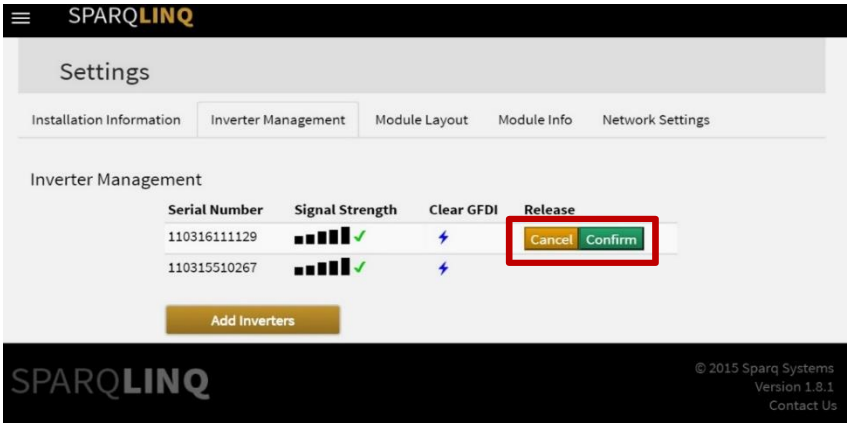


Figure 44: GFDI release.

After the inverter has been released, it will be removed from the list:

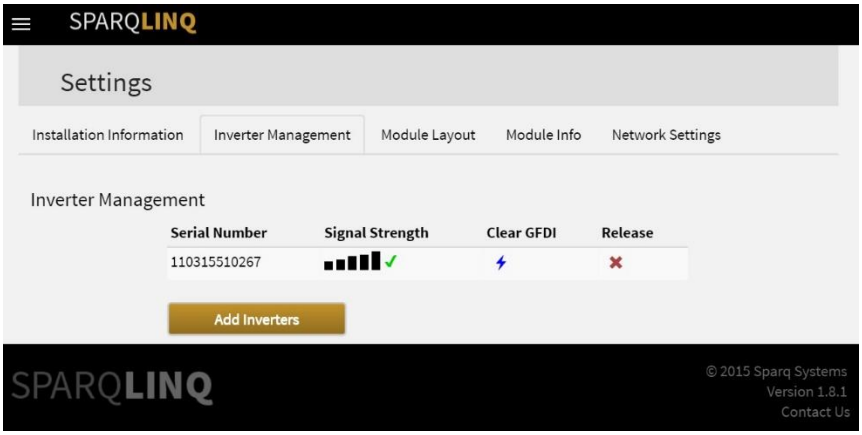


Figure 45: Removing an Inverter.

If a Q3-2000 has been joined to a SparqLinq, it can be manually released by placing a magnet next to the plastic LED bezel. This will allow it to be joined to a new SparqLinq.

5.2.3. Adding an Inverter

From the inverter management tab, click on the 'Add Inverters' button:

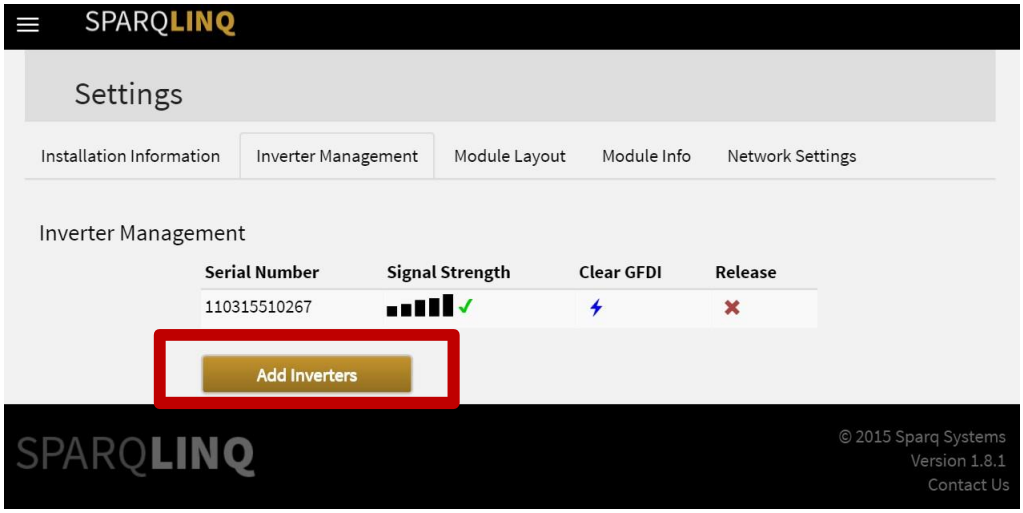


Figure 46: Adding an Inverter.

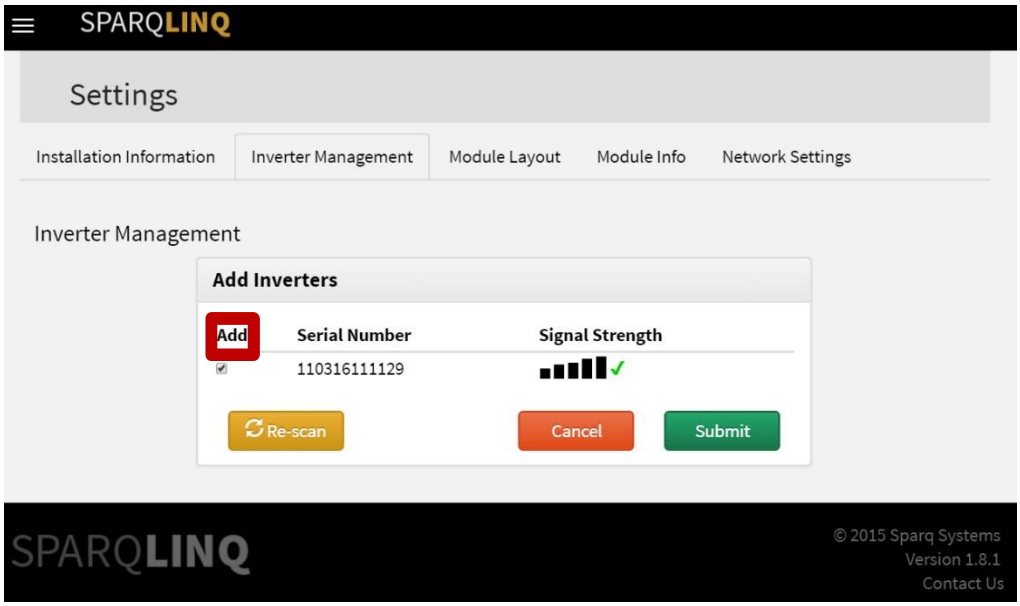


Figure 47: Scanning for an Inverter.

The SparqLinq will permit inverters to join for one minute. As inverters join with the SparqLinq, they will be displayed in the list. Use the Add check box to select the inverters to be added to this SparqLinq.

After scanning is complete, three actions are possible:

- Re-scan for inverters. The SparqLinq will turn on joining for one minute and scan for new inverters.
- Click ‘Cancel’ to reject all the found inverters. This will release them from the SparqLinq.
- Select inverters to add by checking the checkboxes next to the serial numbers. Hit ‘submit’ to register the inverters with the SparqLinq. All unchecked inverters will be released from the SparqLinq.

Note: If you fail to click either ‘Cancel’ or ‘Submit’ and leave the page, then any found inverters will remain associated with the SparqLinq. However, their data will not be collected. To release these inverters, click the ‘Add Inverter’ button on the inverter management page and then click ‘Cancel’ to release them.

Figure 48: Canceling an action.

In the above screenshot, inverter number ‘110315510267’ has been unchecked. When the ‘Submit’ button is clicked, only one inverter will be added and the unchecked inverter will be released. After clicking ‘Submit’ the SparqLinq will return to the inverter management screen.

5.3. Clearing the GFDI (Ground Fault Detection Interruption) condition

If an inverter experiences a GFDI condition on one input, it will shut down that input until the fault is removed and the installer will need to clear the inverter GFDI flag. This is done through the inverter management screen. Click on the blue lightning bolt to initiate clearing the GFDI flag.

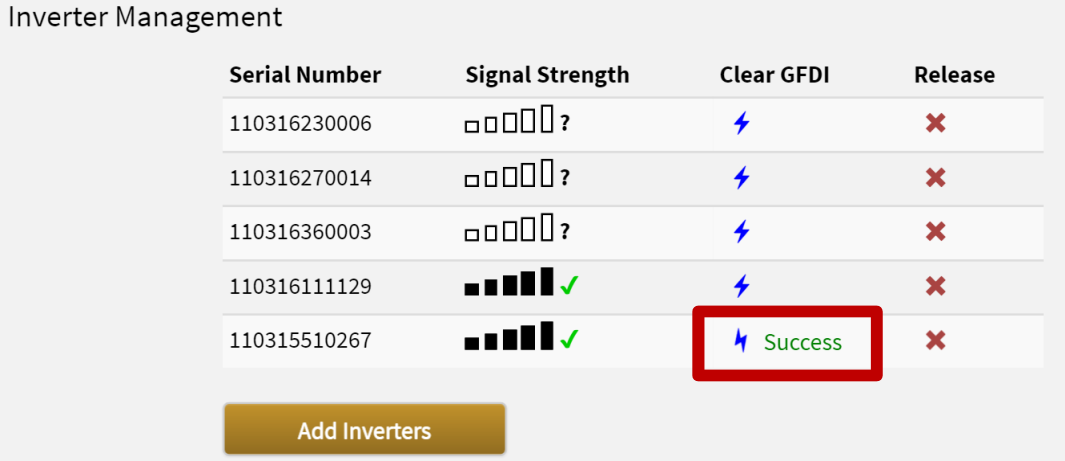


Figure 49: GFDI clearance verification.

5.4. Connecting to the SparqLinq using a wired Ethernet connection

Use a browser on a device connected to the customer's home network to access the Routers administration page. On some Comcast routers you enter http://10.0.0.1/ and on the Netgear router shown below you enter http://192.168.0.1/ or www.routerlogin.net in the browser address bar.

You will then be asked for the administrator ID and password. Many devices use the ID "admin" and password set to "password" or left blank. Contact the system owner or look at the label on the router for more information.

After connecting to the router go to the router's "Attached Devices" table to determine the local IP address of the SparqLinq (circled in red in image below). The illustration below is an example of a Netgear router. The router you actually access maybe different.

Once you have determined the SparqLinq's local IP address, type it in the browser's address bar to connect to the Dashboard or Wizard. In the example below you would type in the following: http://192.168.0.5/ .

Figure 50: Netgear router setup.

6. DISCONNECTING THE SYSTEM

1. Turn OFF the AC circuit breaker for each of the branch circuits.
2. Disconnect the AC connectors for each microinverter.
3. Disconnect the DC connectors.
4. Disconnect ground wiring.
5. Remove each microinverter from the racking.

WARNING:
Before disconnecting any of the wires, the appropriate AC circuit breaker *must* be turned off.
Do not disconnect DC wires under load.

7. WARRANTY INFORMATION

For Warranty Information, please see www.sparqsys.com

8. TERMS AND DEFINITIONS

T5 Cable — Cable assembly consisting of UL TC-ER cable extending to a molded T5 connector for attaching to the microinverter AC output.

Bulkhead Connector — Waterproof panel mount connector attached to the microinverter housing. Bulkhead connectors are used for DC inputs and AC output.

Landscape and Portrait Installation — Indicates whether the long side of the PV modules are oriented horizontally (landscape) or vertically (portrait) in the array.

Microinverter — Small inverter rated to handle the output of four solar panels and converts direct current (DC) from each solar panel to alternating current (AC).

9. TI-LANE CABLE SPECIFICATION

- Cable Type: TC-ER Type, reference standards: UL1277, UL1581, UL83 and UL2277
- Rated Voltage: 600V
- Flammability Test: FT4
- Rated Temperature: -40°C ~ 90°C static applications
- Outer Insulation Material: Nylon
- 90°C dry or 90°C wet
- Sun resistant, oil resistant
- Conductor gauge & Current carrying capacity (T5 cable): 18AWG (0.75mm²) (7A)

10. CONNECTOR SPECIFICATION

Connector Material:

- Housing Material: M-PPE 540Z, black
- Outer Mold Material PVC-1018, black
- Rated Temperature: -40°C ~ 90°C
- Waterproof Rating: IP67
- Current Rating: 5 Amp
- Working Voltage: 600V

11. ADDENDA

11.1. Transformers and isolation

The SPARQ QIII2000 inverter contains internal transformers that isolate the PV array from the AC grid. These transformers have double insulation capability. The inverter is provided with internal GFDI protection circuit so that in case of any ground faults the micro inverter will shut down. The GFDI circuit compares the insulation resistance of the earth ground with respect to the PV array. Moreover, it is mandatory to make sure that the inverter grounding is done as guided in section 3.10 for safety purposes.

12. Datasheet

Input (DC) Specifications				
DC Input Power (Module STC)	W	2200		
Number of channels		4		
PV Panel Rating (Module STC)	W	680 W_p per channel		
Input Power Clipping		None		
Maximum Input DC Current	A	16 per channel		
Full Power MPPT Voltage Range	V	34 - 45 per channel		
Extended MPPT Voltage Range	V	20 - 50 per channel		
Start-up Voltage	V	19 per channel		
DC Connection Type		MC4 compatible panel receptacles		
Output (AC) Specifications				
Grid Connection Type		380V L-L from 3-φ	400V L-L from 3-φ	480V L-L from 3-φ
Operational Voltage Range	V	315 - 450	315- 450	422 - 528
Maximum Continuous Power [1]	W	2000 @ 52°C	2000 @ 60°C	2000 @ 60°C
Nominal Output Frequency	Hz	50		60
Operational Frequency Range	Hz	47.5 – 50.5 default		59.3 – 60.5 default
		Extendable according to various standards		
Power Factor		>0.99 default. Programmable from 0-0.99 leading/lagging		
Output THD	%	<2, default		
Inrush Current	A	<8		
Output Wiring Type		14 AWG		
Output Connection Type		T5 AC micro male connector 98053		
Safety and Protection				
Input Reverse Voltage Polarity Protection		Yes, Polarized PV Connectors		
Anti-Islanding Protection		Yes, programmable to meet various standards UL1741, UL1741 SA, Rule 21, IEC		
Integrated GFDI		Yes		
Isolation		Galvanic isolation		
Abnormal Voltage/ Frequency Trip Time		Less than 200ms		
Regulatory				
Regulatory Certifications		IEC62109-1:2010 IEC 62109-2:2011 IEC 61000-6-3:2007 IEC 61000-6-1:2007 IEC 61000-3-2:2007 IEC 61000-3-3:2007 FCC Part 15-Class B. EN50549-1:2019		

Efficiency and Operating Performance	Unit	
Maximum Efficiency	%	97.5
CEC Efficiency	%	97
MPPT Efficiency	%	Static: 99.85 – Dynamic: 99.8
Stand-by Consumption	mW	< 30
Communication		
Monitoring System		Wireless, Web-based monitoring through SparqLinq and SparqVu
Environmental		
Ambient Operating Temperature Range	°C (°F)	-40 to +65 (-40 to +149)
Relative Humidity	%RH	0 – 100 condensing
Mechanical		
Enclosure Rating		NEMA 6, IP-67
Cooling		Natural Convection
Dimensions (H x W x D)	mm (in)	41 x 217 x 300 (1.6 x 8.5 x 11.8)
Weight	kg (lb)	4 (10)
Recommended Mounting		Rack mount with two M8, 1/4", or 5/16" bolts
Warranty		
Standard Limited Warranty		12 Years
Extended Warranty		25 Years
Programmable Parameters for Smart Grid		
Voltage Ride-through	Under Voltage	Maximum 4 levels with programmable ride-through time
	Over Voltage	Maximum 3 levels with programmable ride-through time
Frequency Ride-through	Under Frequency	Maximum 6 levels with programmable ride-through time
	Over Frequency	Maximum 4 levels with programmable ride-through time
Reconnect Time		Programmable wait time of 0-5 minutes
Power Ramp Rate		Programmable on both active and reactive power
Volt-VAR		Programmable VAR injection and power factor limit
Frequency-Watt		Programmable active power curtailment with an adjustable rate of Watt per Hz
Power- Cos(φ)		Programmable active power as a function of power factor.

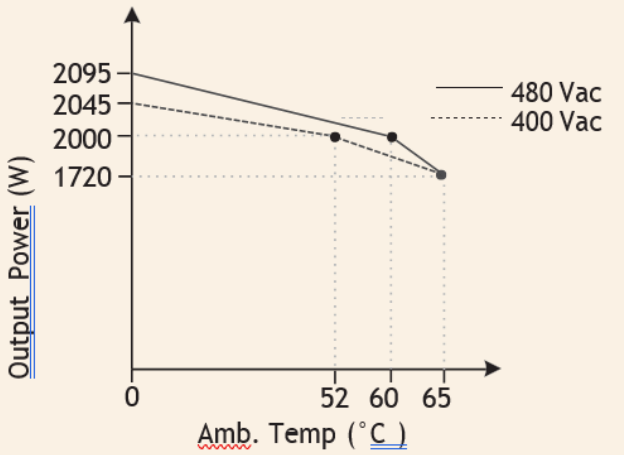


Fig. 1: Q2000-4301 AC Output Power vs Temperature Profile.