



Installation & Operators Manual

HiQ Solar TSXL480-10k-ES Energy Storage Inverter

April 2019
770-00012

Model: TSXL480-10k-ES



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HiQ Solar Inc.
 Tel: 408-970-9580
 www.hiqsolar.com
 info@hiqsolar.com

1. Safety




IMPORTANT SAFETY INSTRUCTIONS – Please read

SAVE THESE INSTRUCTIONS



This manual contains important safety instructions for the HiQ Solar TSXL480-10k-ES inverter system – comprised of the TSXL480-10k-ES inverter, and Communications Gateway that shall be followed during installation and maintenance of the inverter system. The TSXL480-10k-ES inverter system is designed according to North America safety requirements. As with any electrical equipment, certain precautions must be observed when installing this equipment. To reduce the risk of personal injury and to ensure safe installation and operation, carefully read and follow all instructions, cautions and warnings in this Installation Guide.

1.1. Warnings Used















The following Warnings describe situations or procedures or practices which if not correctly performed or followed could result in damage or destruction of the described equipment or other components attached to the described equipment, or personal injury.

Symbol	Description
	<p>WARNING: Hazard to Human Life</p> <p>Indicates a situation which could result in death or serious injury</p>
	<p>CAUTION: Hazard to Equipment</p> <p>This type of notation indicates that the hazard may cause damage to the equipment.</p>
	<p>NOTE:</p> <p>This type of notation indicates that the information provided is important to understanding the operation and limits of the equipment. Failure to follow the recommendations in such a notation could result in improper or failed operation.</p>

The following symbols are used as markings on this product with the following explanations:

Symbol	Description
	<p>WARNING: DANGEROUS VOLTAGE</p> <p>This product incorporates high voltages. All handling of and operation of this product should closely follow the instructions included.</p>
	<p>CAUTION: BEWARE OF HOT SURFACE</p> <p>This product may become hot during operation. Contact should be avoided.</p>

1.2. General Safety Provisions, Warnings, and Precautions

	Connection of the system must be to 480V L-L nominal, 3-phase AC with neutral and earth ground only. This is a 5-wire connection.
	All electrical installations must be performed in accordance with all applicable local, state and national requirements, including ANSI/NFPA 70.
	TSXL480-10k-ES inverters must be provided with an equipment ground per NEC 690.43.
	All 5 ac conductor circuits (L1, L2, L3, Neutral, Ground) must be connected and Neutral must be bonded to earth ground. Failure to do so can damage the unit and void the warranty.
	The HiQ Solar components contain no user serviceable parts. For all repair and maintenance always contact your authorized dealer or installation partner.
	Before disconnecting DC cables, use a current clamp meter to measure the presence of current. If current is present, open DC disconnect switch prior to un-mating the MC4 compatible connectors.
	The TSXL480-10k-ES inverter system is a utility-interactive system. Before connecting any power system to the grid, contact your local utility company. This connection should only be made by qualified personnel.
	DC sources produce voltages that can present an electrical shock hazard. Wiring of DC sources should be performed by qualified personnel following all manufacturer's guidelines.
	Be aware that the body of the TSXL480-10k-ES inverter acts as a heat sink. Under normal operating conditions, the temperature of the exterior of the enclosure can reach more than 15 °C above ambient. Under extreme conditions the exterior of the enclosures can reach a temperature of 80 °C. To reduce risk of burns, use caution when working with the TSXL480-10k-ES inverter system.
	<p>Communication Gateway AC Connection Procedures</p> <ul style="list-style-type: none"> • To connect - Plug the AC cable into the Gateway FIRST, then plug the other end into the wall outlet. • To disconnect - Unplug the cable from the AC wall outlet FIRST, then proceed to disconnect the cable from the Gateway device.
	In order to maintain the integrity of the watertight enclosures, all connectors must be properly and fully engaged.
	Do not allow water to enter the AC or DC connectors or warranty will be void.
	Depending on physical location, atmospheric effects, utility abnormalities, and local loads the utility connection can suffer from repeated disturbances, which can damage equipment. It is recommended that an appropriate surge suppressor be installed near the Point of Common Connection with the utility.
	Before installation, carefully read all instructions, cautions, and warnings in this guide.

2. Introduction

This instruction manual covers the TSXL480-10k-ES inverter system. A summary of features is shown in the table.

Feature	TSXL480-10k-ES
Grid voltage	480 V, Wye configuration with neutral and ground
Nominal power	9.975 kW
Two Paralleled DC ports	24A Maximum Total Current
Type 6 Ingress Protection per UL50, watertight	✓
Hand-holdable	30.6 lb.
Mounting orientation	Any
No electrolytic capacitors	✓

2.1. System Overview

A typical layout is shown in Figure 1.

The HiQ Solar TSXL480-10k-ES system is an easy to install, modular system optimized specifically for commercial battery applications. The DC ports are connected in parallel and individually monitored and managed by the inverter.

The main components of the HiQ Solar TSXL480-10k-ES inverter system are described in the next section.

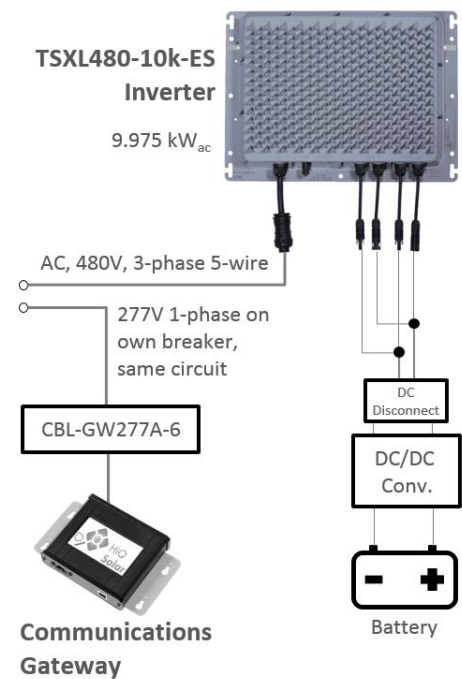


Figure 1: System overview showing dc ports connected in parallel to one battery source supplying a single TSXL480-10k-ES inverter. A Communication Gateway is shown connected through CBL-GW277A-6 to one 277V phase.

2.1.1. TSXL480-10k-ES Inverter

One TSXL480-10k-ES inverter interfaces up to 2 DC sources to the installation site 3-phase, 480V compatible utility connection. The TSXL480-10k-ES inverter is shown in Figure 2. It is a non-isolated inverter for use with ungrounded DC systems.

Multiple inverter outputs may be connected in parallel by a qualified electrician, for example using the HiQ Solar AC Splice.

Figure 2:
TSXL480-10k-ES
Inverter



2.1.2. Communication Gateway

One Gateway module connects to a 277V/60Hz branch that is connected to the same 3-phase, 480V compatible utility connection supplied by the TrueString XL inverter(s). A CBL-GW277A-6 AC power cable must be used. The Gateway module provides for system monitoring, logging and control. The Gateway is shown in Figure 3 and is designed for indoor use only.

Figure 3:
Communications
Gateway



Internet access should be provided for the Gateway to enable HiQ to supply firmware updates and to provide customer support functions.

3. Design Guidelines

3.1. Notes on Siting

The HiQ Solar TSXL480-10k-ES inverter is suitable for flat, commercial rooftops, carports, ground mounts and other commercial installations.

A line diagram is shown in Figure 4. Note that the inverter requires a 480V Wye grid configuration.

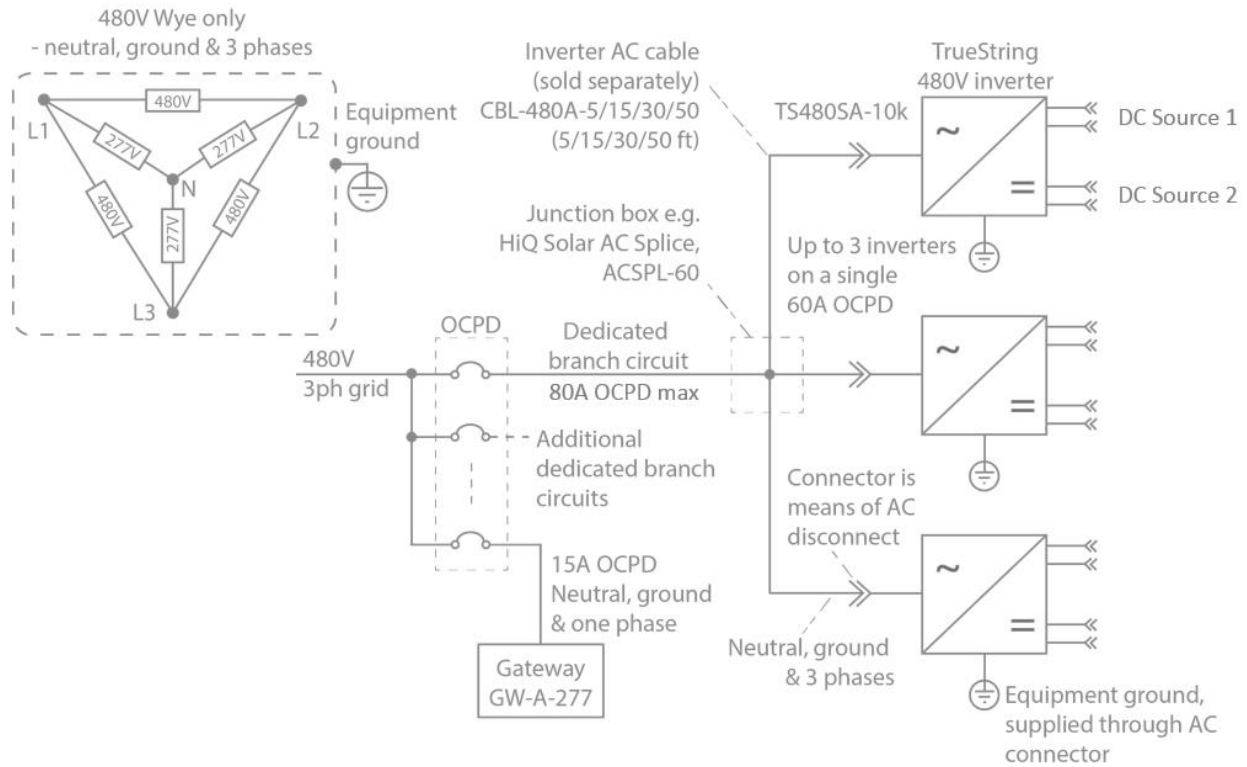


Figure 4: Example line diagram

- Note that up to 5 inverters may be connected to the same branch on one 80A max OCPD if desired.
- HiQ Solar offers a NEMA4 AC Splice junction box suitable for use with 2 or 3 HiQ inverters if desired.

The following sections provide details on individual component placement guidelines and requirements.

3.1.1. Inverter Placement/Mounting Hardware

The TSXL480-10k-ES inverter is Type 6 rated per UL50 and may be placed almost anywhere. Cooling is most efficient if the unit is mounted vertically in the shade, bolted to racking and with the connectors pointing downwards. However, any orientation is acceptable. Ideally the unit would be at least 1” above the horizontal surface, and with 4-5” clearance above the cooling fins to allow air to circulate.

At least two fasteners with a minimum size of #10 or M5, are required to mount the TSXL480-10k-ES inverter. Using washers with a minimum outer diameter of 7/16" is suggested. The baseplate mounting holes/slots will accept fasteners up to 3/8" or M8.



Figure 5: Ideal placement of the TSXL480-10k-ES inverter

3.1.2. Gateway Placement

Internet access should be provided for the Gateway to enable HiQ to supply firmware updates and to provide customer support and monitoring functions.

- The Gateway is rated for indoor installation only. Do not expose it to rain, extreme temperatures, or excessive dust. It must be mounted indoors. A utility closet or similar location physically close to the inverter system is ideal. It must be electrically connected to one of the three phases that are connected to the inverter. Note that in large utility closets it is often easy to end up on an unrelated AC circuit accidentally, in which case communications are unlikely to be successful.



WARNING!

The Gateway Device and power supply cable are rated for indoor installation only.

- Recommended: Add a 277 V_{ac} outlet at the earliest entry point in the building to provide the best power line communication (PLC) signal possible. Ideally a 277 V_{ac} outlet next to the breaker.
- Gateway ac power supply (CBL-GW277A-6) shall be protected by a 15A OCPD.
- A wired Ethernet network connection must be provided to the Gateway for proper data retrieval.
- If outdoor placement is required, the Gateway and ac power supply (CBL-GW277A-6) must be housed in a weatherproof enclosure.
- The Gateway has 'keyhole' mountings on its baseplate. Each hole has a guide-hole above – a center punch can be inserted through these four holes leaving marks on the wall to help accurate drilling of holes. Mounting can be achieved using #8-sized screws.



Figure 6: Gateway baseplate showing keyhole mounting and drilling guide hole.

3.2. Notes on Wiring

3.2.1. AC Cable

The inverter AC cable has a TC-ER rating. The “-ER” signifies that the cable is sufficiently rugged to permit its use as exposed wiring, by the NEC (section 336.10). Exposed wiring is wiring that is not installed in a tray, conduit or other raceway. It must be secured every 6 feet or less, and protected from physical damage.

The TSXL480-10k comes in a connector-less version for installation locations which have another form of AC disconnecting means or do not require it, per local electrical codes. For this instance, in addition to the retainment mentioned above, the AC cable must be secured within 3 feet of the unit.

Perform all electrical installations in accordance with all applicable local electrical codes.

3.2.2. Grounding

The metal enclosure of the inverter must be grounded per NEC 690.43. Equipment ground is provided through the AC connection. In Canada, grounding must be achieved through attaching an Equipment Ground Conductor (EGC) to a lay-in lug (not provided) attached to the chassis per the picture of Figure 7.

Grounding, in accordance with local electrical codes, may also be achieved using the mounting bolts to any properly grounded metallic structure provided a paint-cutting washer is employed, such as a stainless steel star washer.

Note: Grounding of the DC Sources shall NOT be provided thru the TSXL480-10k-ES enclosure.

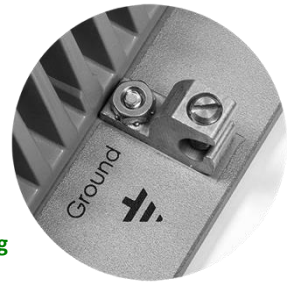


Figure 7: Example ground lug

3.2.3. Neutral

All 5 circuits (L1, L2, L3, Neutral, Ground) must be connected and Neutral must be bonded to earth ground. Failure to do so can damage the unit and void the warranty. Note that particular care is required to ensure that an effective neutral is maintained when a transformer forms part of the installation.

The HiQ inverter exports power only on the L1, L2, and L3 conductors. The neutral conductor is used solely for voltage sensing and Power Line Communications.

3.2.4. Use with a Transformer

While TrueString XL inverters may be used with a transformer, care must be taken to ensure proper wiring.

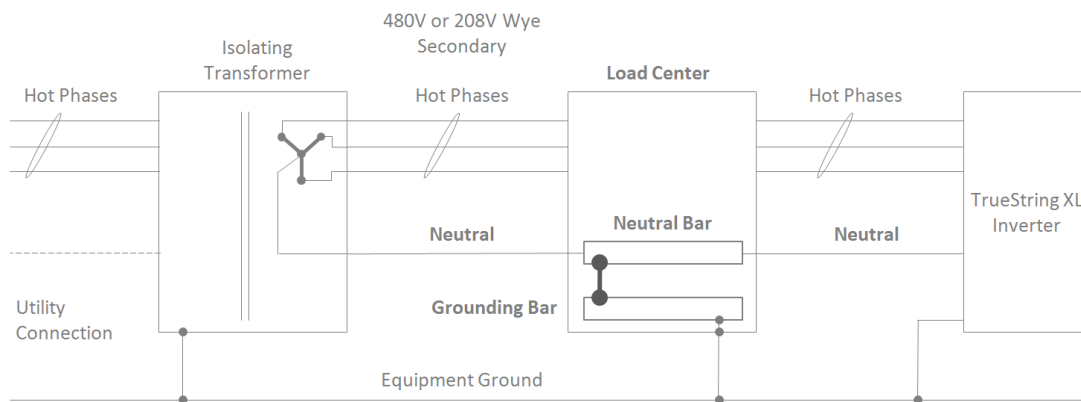


Figure 8: Use of the TrueString XL with an isolating transformer

- Inverter must have wye grid connection (3 hot phases, neutral & equipment ground)
- Neutral **MUST** be bonded to equipment ground or damage to the inverter may result.
- Transformers are often isolating – so the neutral may lose any path to equipment ground that was provided elsewhere. Once the transformer is inserted into the circuit, the neutral connection on the inverter side of the transformer must be grounded.
- **Example is shown** where neutral is bonded to equipment ground in the load center, but many other system configurations and methods are possible.

3.2.5. Site Surge Suppression









Depending on physical location, atmospheric effects, utility abnormalities, and local loads the utility connection can suffer from repeated disturbances which can damage equipment. It is recommended that an appropriate **surge suppressor** be installed near the Point of Common Connection with the utility.

4. Installation

The HiQ Solar TSXL480-10k-ES inverter employs industry standard connection methods, including locking interconnects for DC source attachment, and standard 5 lead, 3-phase AC wiring compatibility. Careful adherence to these instructions is required.

4.1. Cautions


	The system must be connected to 480V 3-phase Wye 5-wire only
	TSXL480-10k-ES inverters must be provided with an equipment ground per NEC 690.43. This equipment ground may be provided thru the ac cable connection, which provides proper timing of make first and break last for the equipment ground terminal.
	All 5 circuits (L1, L2, L3, Neutral, Ground) must be connected and Neutral must be bonded to earth ground. Failure to do so can damage the unit and void the warranty.
	The Communications Gateway and ac power supply is for indoor use only
	In order to maintain the integrity of the watertight enclosures: <ul style="list-style-type: none"> • All connectors must be properly and fully engaged • Unused connectors must be sealed using appropriate weatherproof caps
	Do not allow water to enter the AC or DC connectors or damage may occur and warranty will be void.

4.2. Connection Outline

Connection occurs in the following order:

1. Connect an equipment ground to the inverter. This should always be done first.
2. Connect the inverter to the grid.
3. Connect the Communication Gateway to one L-N of the same 480V circuit as the inverter and the network.
4. Connect the DC sources to the inverter inputs.
5. Lastly, close the DC disconnect switch and close the AC disconnect switch.

Disconnection uses these steps in reverse, with system ground being the last item to be disconnected.

	Before disconnecting DC cables, use a current clamp meter to measure the presence of current. If current is present, open DC disconnect switch prior to un-mating the MC4 compatible connectors.
---	--

4.3. Basic Connection Procedure

1. **Ground the inverter.**

The inverters must be grounded.

Equipment ground is provided through the AC connection. For installations in Canada, a grounding lay-in lug (not supplied) must be used (Figure 9), or the mounting method may be used if employing a paint-cutting washer such as a stainless steel star washer (provided it's acceptable per local electric codes).



Figure 9: Example ground lug

2. **Connect the inverter to the grid.**

(a) Connect the inverter AC cable to the AC system in the usual way using the HiQ Solar inverter AC cable (supplied separately) – see Figure 10.

This should only be carried out by qualified personnel.

Note that the unit is only watertight when connectors are fully engaged.

Note that the inverter AC cables are TC-ER rated¹.

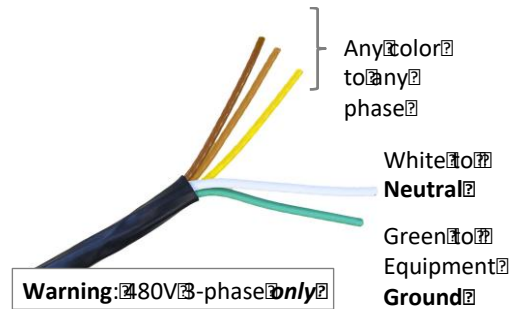


Figure 10: Wiring identification on the Inverter AC cable

	<p>WARNING - DANGEROUS VOLTAGE This product incorporates high voltages.</p>
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(b) Mate the male and female AC connector to connect the inverter to the AC system.

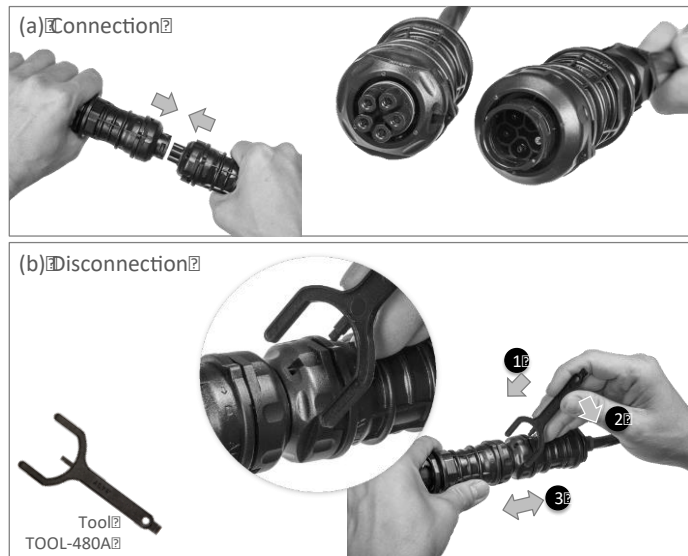



Figure 11: Connecting and disconnecting of the TSXL480-10k-ES inverter AC connection

¹ The “-ER” signifies that the cable is sufficiently rugged to permit its use as exposed wiring, by the National Electrical Code. Exposed wiring is wiring that is not installed in a tray, conduit or other raceway.

3. Connect the Communications Gateway.

	<p>WARNING! The Gateway Device and power supply cable are rated for indoor installation only.</p>
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(a) The Gateway should be **sited indoors**, as near to the inverter(s) as possible for reliable communications (Figure 12).

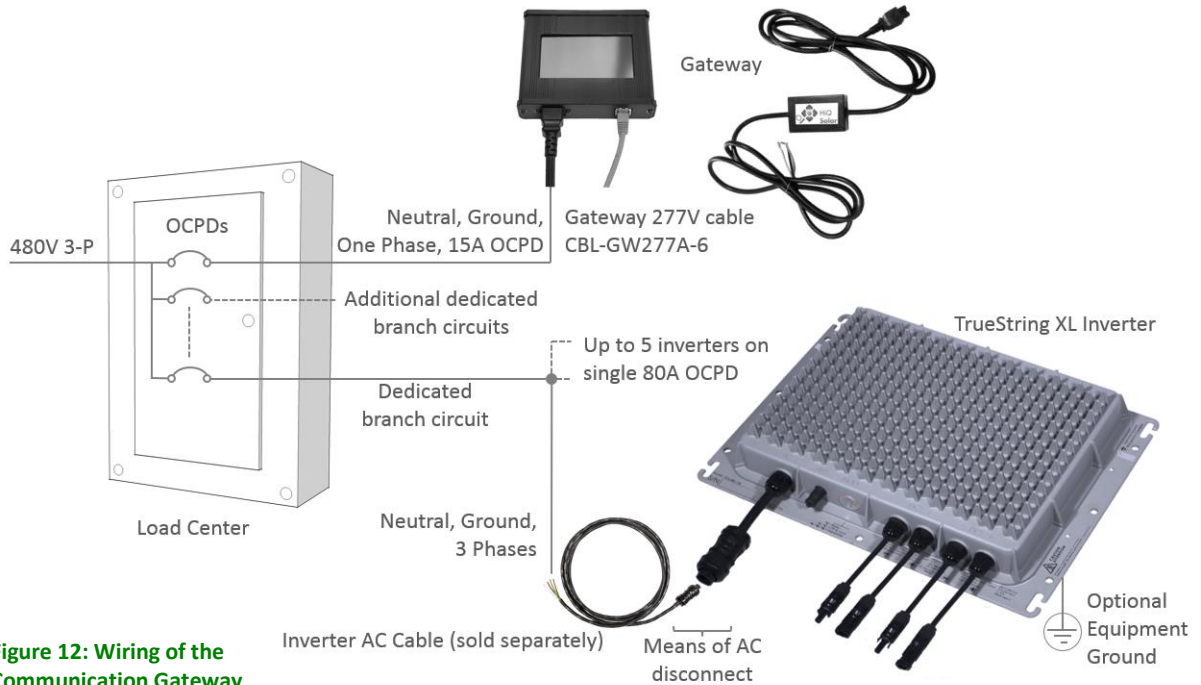


Figure 12: Wiring of the Communication Gateway

(b) Connect power to the Gateway using the appropriate AC cable (Figure 13). Ethernet may also be connected at this stage.

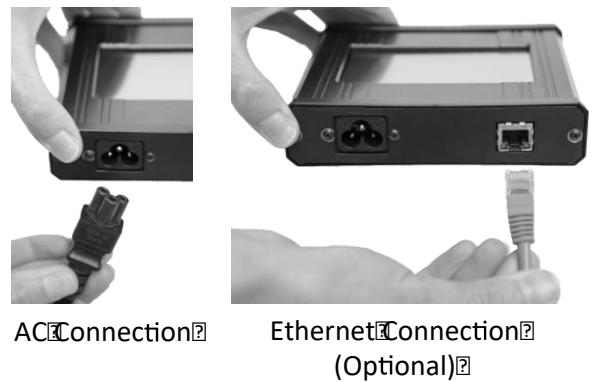


Figure 13: Making Gateway connections

(c) Switch on power to the inverter.
 On the Gateway screen, press the 'Inverters' button at the top of the screen if the unit is not already on that tab. Press 'Setup', then the 'Discover' button.

The Gateway will search for any/all inverters and check that they are healthy.

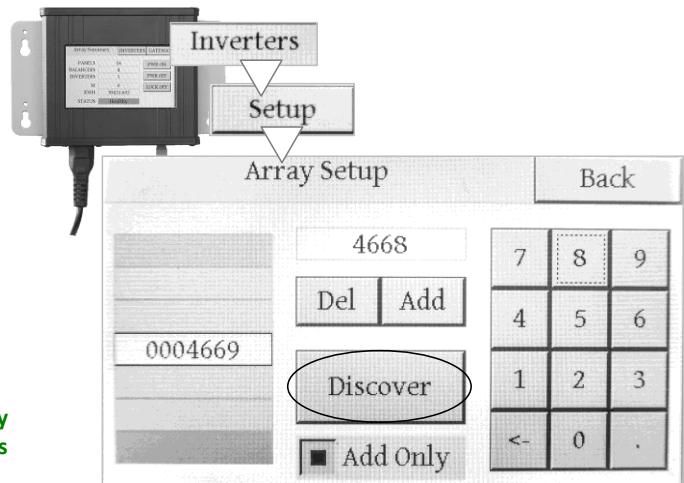


Figure 14: Having the Gateway auto-discover added inverters

4. Connect the DC sources.

This may be done with the AC on or off; this section assumes the AC is off.

Take care not to reverse the polarity of the DC string inputs. The markings on the baseplate below the DC cable indicate the correct polarity.

All connectors must be fully mated to ensure weatherproofing.

Close DC Disconnect switch.

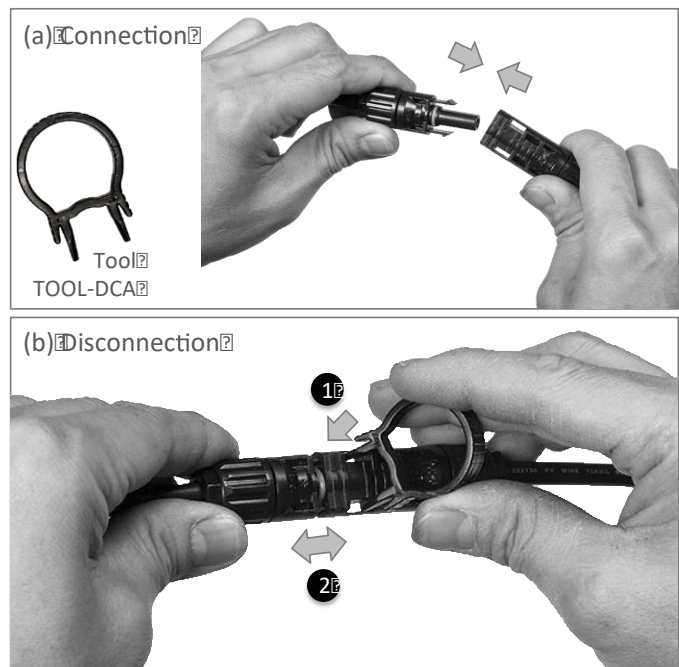


Figure 15: Connecting and disconnecting MC4-compatible module connectors

With the AC off but DC port voltage present, the inverter button will flash red. This is normal when no grid is present.

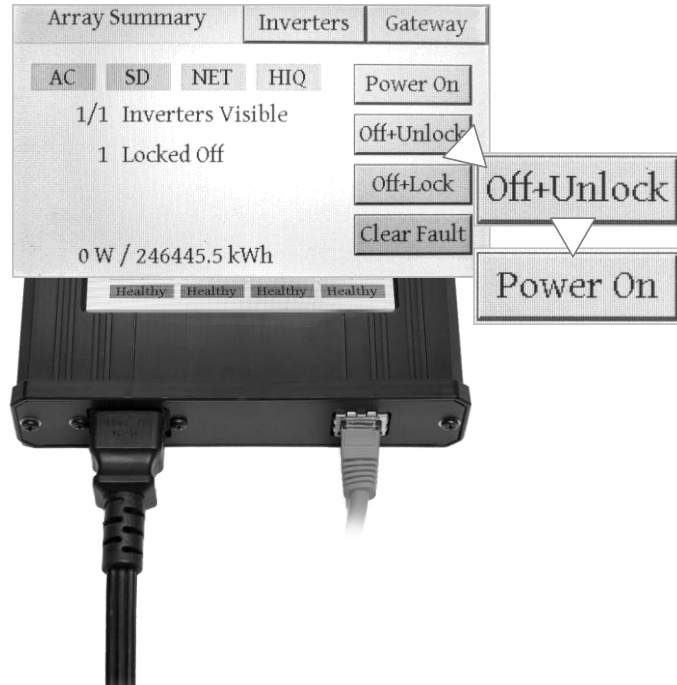


5. **Switch on the AC.**

Application of AC voltage will start a 5-minute timer (default duration). At the completion of this timer, the inverter will enter the active state. Active state is when the inverter is connected internally to the grid and providing voltage to the DC port--this will be shown by a green chaser light. The inverter will not sink or source DC current until commanded.

In case any inverters are locked, "Off + Unlock" on the Gateway touchscreen will unlock all inverters in the array, or an individual inverter may be unlocked by pressing the inverter button three times—entering the active state.

To skip the 5-minute wait, press "Power On" on the gateway – the units will enter the active state.



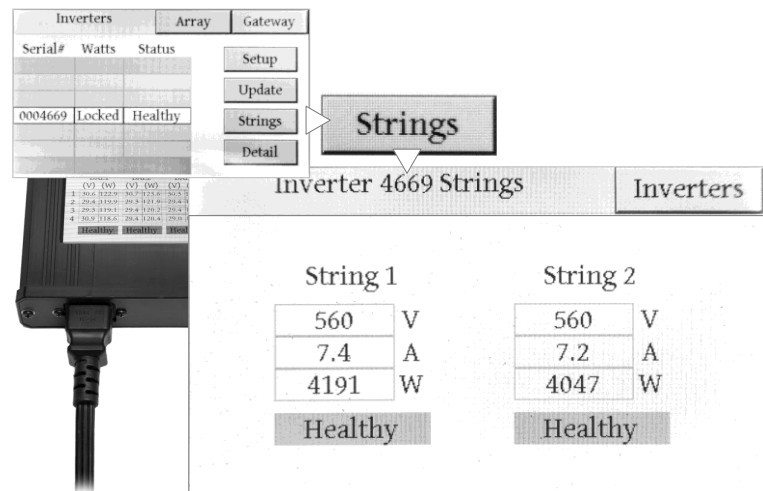
➔ Once 5-minute timer has successfully completed, inverter enters active state.



Rotating green chaser light

For individual inverters, check the Gateway 'Strings' screen to verify everything is healthy.

Figure 16: Verifying that all modules are healthy using the Gateway



Connection is complete.

4.4. More Detailed Installation Information

4.4.1. Meanings of Buttons & Indicators

While most installations will use a Communication Gateway to control and report, it is not mandatory – the inverter can be controlled using the button, as illustrated in Figure 17. A brief press-and-release of the button counts as a button-push in the guide below. Indications given by the button illumination are shown in Figure 18.













Inverter Button Push	Button Indication	Result
1 press 		<ul style="list-style-type: none"> • Make inverter beep (“are you alive?”)
2 presses 		<ul style="list-style-type: none"> • ‘Off & Locked’ - disabled • Do not 5-minute self-start
3 presses 		<ul style="list-style-type: none"> • Enter active state immediately • If locked, unlock & enter active state immediately • (If system is faulted, will unlock but won’t enter active state)
Long press (>2 seconds) 	 (Brief flash)	<ul style="list-style-type: none"> • Alternate functions mode, ready to accept further button pushes. Times out after 10 seconds
1 press (after long press) 		<ul style="list-style-type: none"> • Clear latched faults, for example after RCD or arc-fault test has initiated a fault condition

Figure 17: Inverter pushbutton actions and results


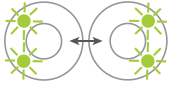




Inverter Indicator State	Meaning
 Solid	<ul style="list-style-type: none"> Powered up Not in enter active state No faults
 Left-right flash	<ul style="list-style-type: none"> Power-on self-test (will take <1 minute)
 Green Chaser	<ul style="list-style-type: none"> Powered up In active state, no faults
 Rapid Flash	<ul style="list-style-type: none"> Faulted, e.g. arc detected
 Mostly On	<ul style="list-style-type: none"> 'Off & Locked' - disabled
 Mostly Off	<ul style="list-style-type: none"> Sleeping – not in active state

Figure 18: Inverter indicator states and meanings

4.4.2. Manufacturing Date

The TSXL480-10k-ES inverter, and Gateway each have an individualized serial number label, with an example shown in Figure 19. The first 6 letters are for device model code (TEJBFA for TSXL480-10k-ES); this is followed by the 6-digit serial number (for example 001003). The manufacturing date code is available in the QR code, readable with common smartphone applications. The QR code will give the same information, appended with the date of manufacture, for example TSBB001003 1341, where 13 is the year (2013), and 41 the calendar week number.

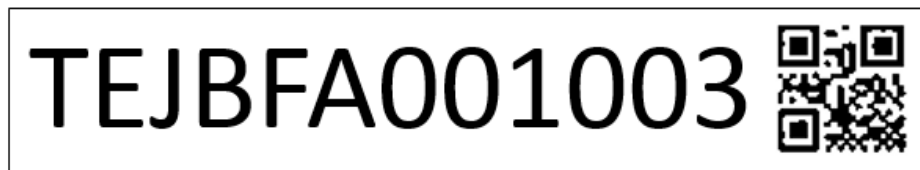


Figure 19: Example serial number label with QR code containing the manufacturing date

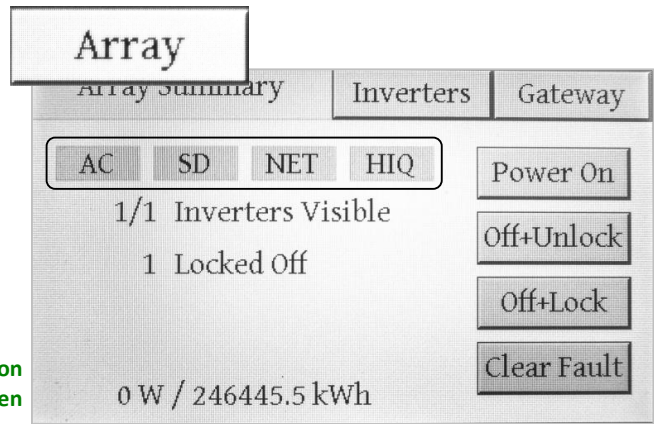
4.5. Gateway Information

This section covers common tasks and features associated with the Gateway.

4.5.1. The Array Summary Screen Diagnostics

Pressing 'Array' brings up the Array Summary screen. This has helpful diagnostic indicators that will be shaded red if the Gateway detects an issue, as follows.

Figure 20: Status indicators on the Array Summary screen



Indication	Meaning
	The Gateway's AC wiring is correct. For example the Neutral is connected, voltage is within tolerance, no dangerous spikes are present.
	The SD card is inserted and the file system is OK.
	The network is connected. The cable is OK and the Gateway has acquired an IP address.
	The Gateway was able to contact the HiQ server and upload data. Indicator will be yellow while the Gateway attempts to make contact.

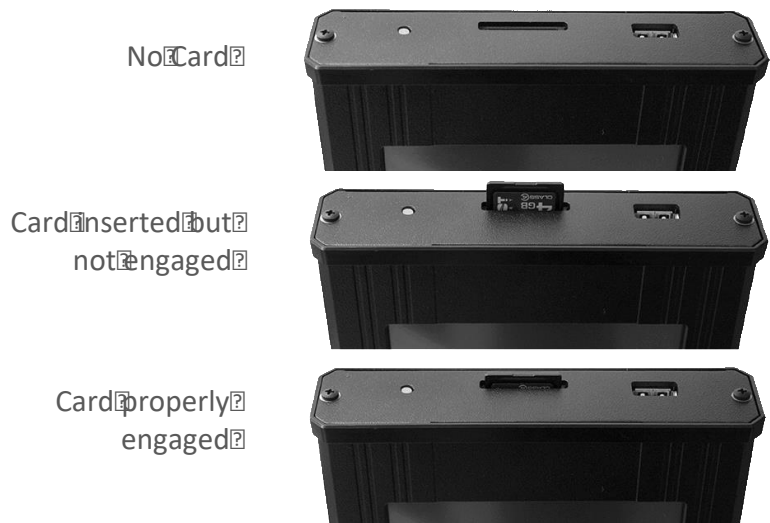
Table 1: Meaning of green indications on the Array Summary screen

4.5.2. The Memory Card

The Gateway is supplied with a memory card to allow long-term storage and retrieval of performance history. Care should be taken to ensure that it is fully inserted, as some functions are not available with the card not fully engaged. The card is pre-formatted with the FAT32 file system and is ready to be inserted into the Gateway as shown in Figure 21.

The 'Array Summary' screen has an indication of the SD card status, which will be red if the card is not fully engaged, and green if all is ok.

Figure 21: Insertion of the memory card.



4.5.3. Methods of Accessing System Information

An overview of ways to access data is shown in Figure 22. The Gateway gathers data from inverters over a connected power line. The Gateway displays information on its touchscreen. With a suitable Ethernet network connection, it is capable of acting as a webserver, allowing a local computer or a remote computer with firewall access to see system performance as it is happening, displayed on a web page. Data is also transferred to HiQ servers to gather history, which can be accessed remotely. More details are given below.

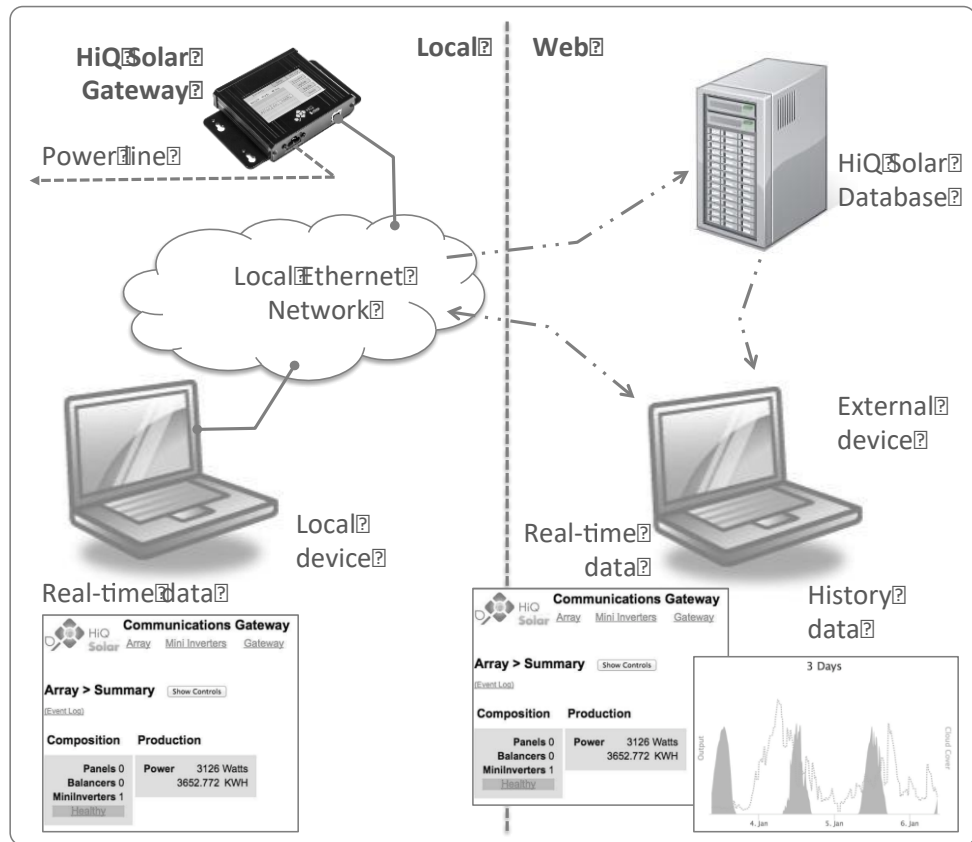


Figure 22: Methods of accessing data from HiQ inverters

4.5.4. Registering Inverters

The Communication Gateway is intelligent, and when required to discover TSXL480-10k-ES inverters nearby, will do so easily with just the press of a button. Occasionally it may be desirable to manually register inverters, and this is also easy to achieve. Both procedures are described below.

4.5.4.1. Automatic Discovery of TSXL480-10k-ES Inverters

On the [Inverters] tab the 'Discover' button will search for any inverters in the local area. In most cases this is all that will be required, with all available inverters appearing on the list shown on the screen in Figure 23. Note that for an installation where the discovery process was carried out previously, 'Add Only' is checked by default, speeding up the process. Unchecking this will force discovery to occur from scratch.

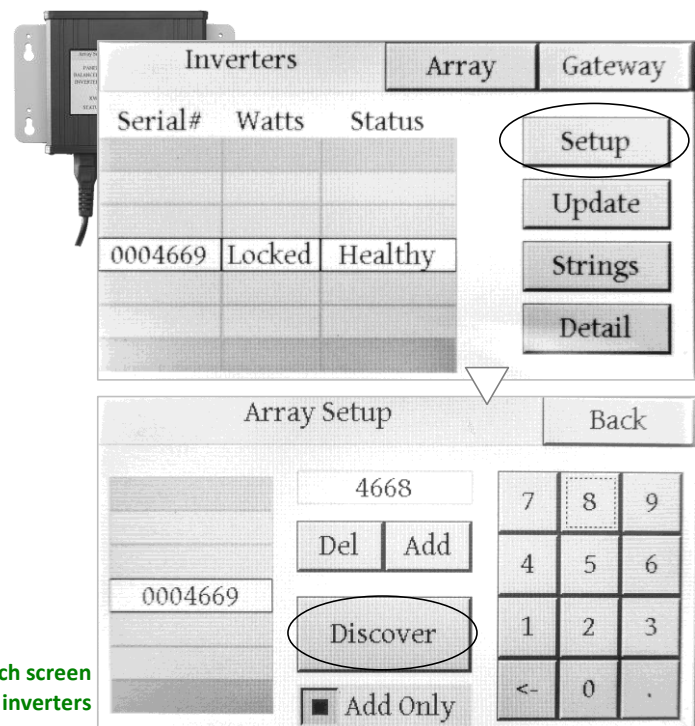


Figure 23: Using the touch screen to auto-discover inverters





Button State	Meaning
	<ul style="list-style-type: none"> Initial state
	<ul style="list-style-type: none"> Once pressed, in process of discovering TSXL480-10k-ES inverters. Will return to initial state with empty serial number list if no inverters found
	<ul style="list-style-type: none"> Error found, for example signal strength is too low, too much background noise on circuit. Red color only clears when user re-tries & the fault condition no longer applies
	<ul style="list-style-type: none"> Once discovery has successfully occurred, button returns to original state

Figure 24: States of the 'Discover' button with meanings

This may also be achieved from the web interface, see Figure 25 (c).

4.5.4.2. Manual Registration of Inverters

Manual registration of inverters may be achieved either using the touch screen, or the web interface. This gives the ability to add and delete inverters as desired, and is particularly useful if an inverter is being replaced on a site where repeating auto-discovery would take a long time. Figure 25 shows the web interface, where this functionality may be found under the top level of the [Mini Inverters] tab.

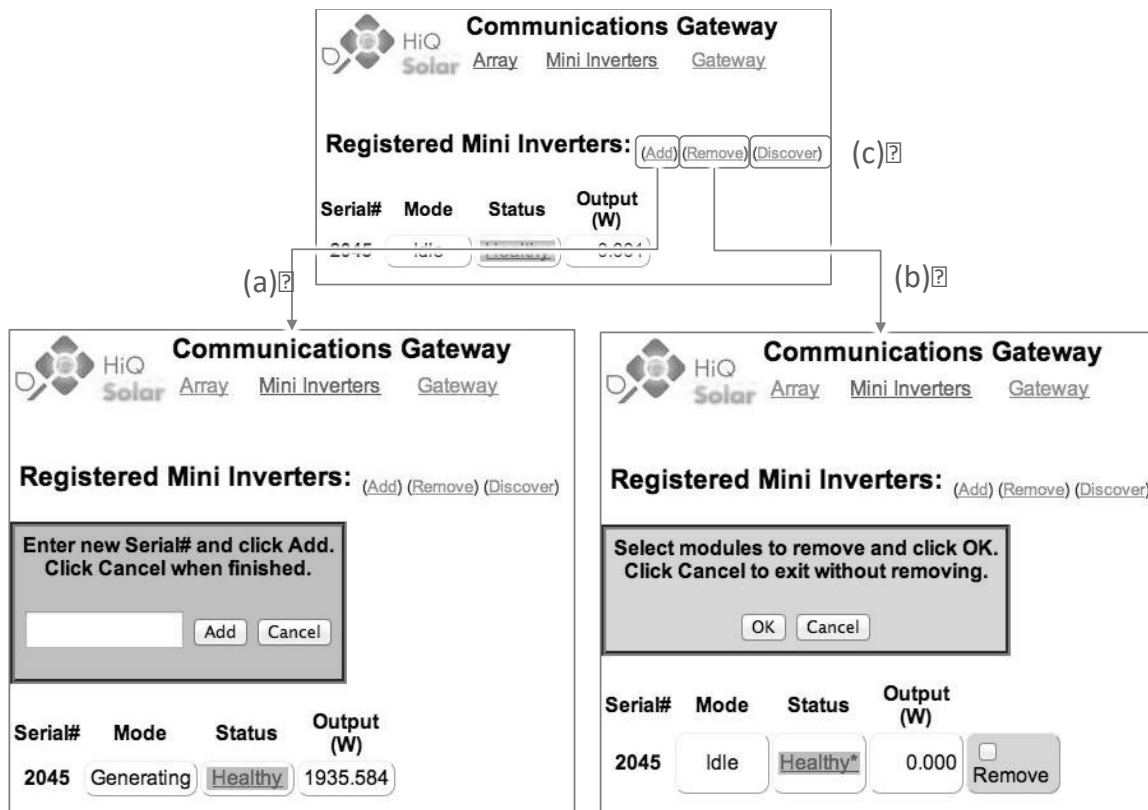


Figure 25: Adding and removing inverters manually using the web interface

4.5.5. Gateway Touch Screen Menu Structure

The following menu tree shows how different screens and functions are related and accessed.

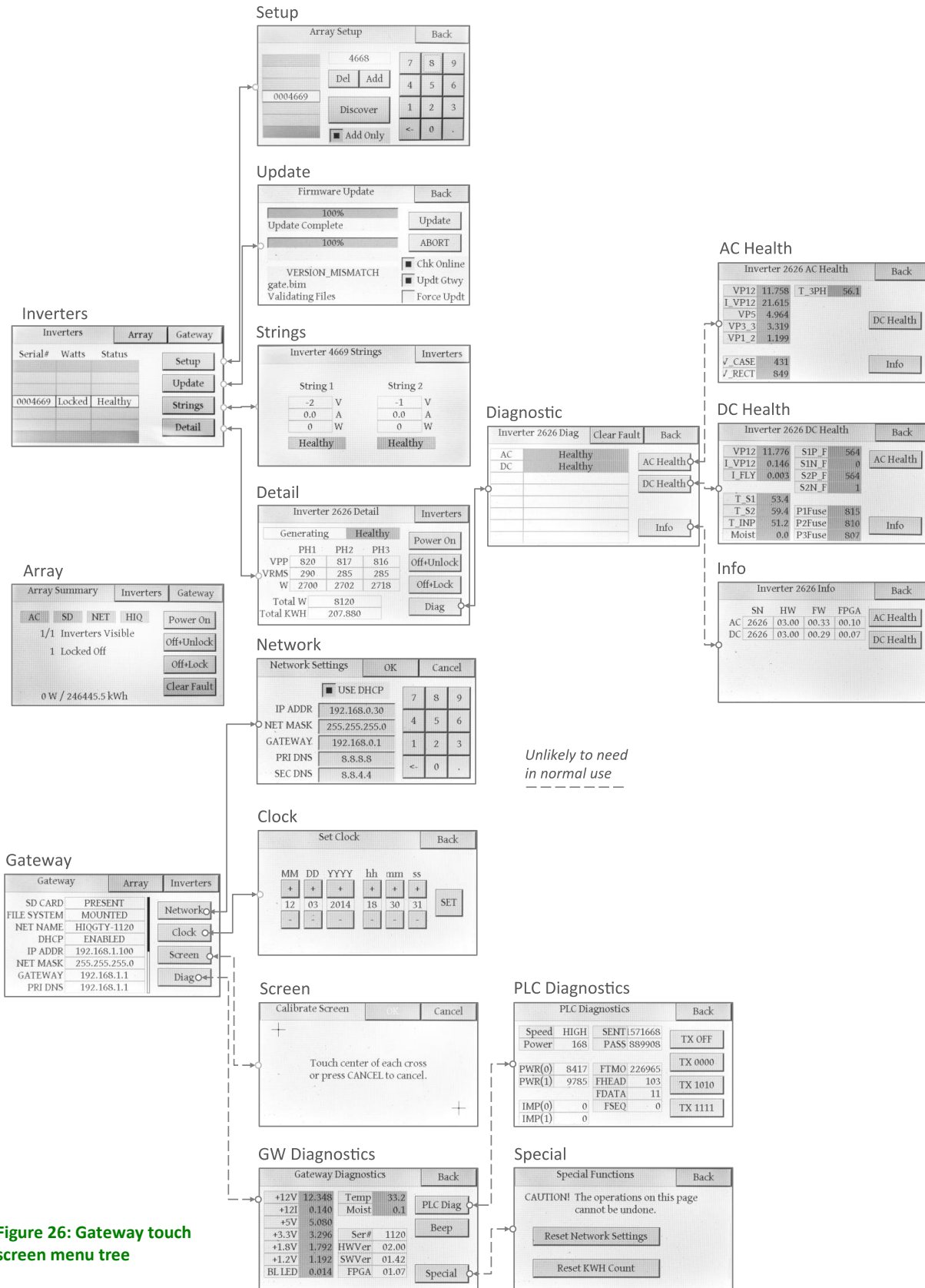


Figure 26: Gateway touch screen menu tree

4.5.6. Gateway Web Page Menu Structure

Overall
Array

Main
Navigation
Menu

Listed
Inverters

Serial#	Mode	Status	Output (W)
1001	Generating	Healthy	1046.200

Summary
for each
inverter

	String 1	String 2
Input	317.360 V	348.510 V
	419.990 W	478.940 W
	0	0
	798.020 V	
Status	Healthy	

	Phase 1	Phase 2	Phase 3
Output	795.560 Vpp	783.850 Vpp	785.000 Vpp
	278.390 Vrms	276.500 Vrms	275.880 Vrms
	290.420 W	295.580 W	303.770 W
	889.780 W	6641.311 KWH	59.975 Hz
Status	Healthy		

	PLC
Status	6650 Signal
	1110 Noise

Figure 27: Array page and main inverter navigation

Gateway?
 Summary?
 Screen?

Communications Gateway
 Array Mini Inverters Gateway

Network Settings

Name: HIQGTY-1040 HTTP Port: 80
 DHCP: ENABLED FTP Cmd Port: 21
 IP Address: 107.142.42.1 FTP Data Port: 8000
 Net Mask: 255.255.255.248 Diag Port: 1000
 Gateway: 107.142.42.6
 Primary DNS: 107.142.42.6
 Secondary DNS: 0.0.0.0
 MAC Address: 00:04:A3:51:FB:E5

- [Change Network Settings](#)
- [Change Users and Permissions](#)

Data Logging

- [Upload Status](#)
- [Upload Settings](#)
- [Polling Intervals](#)
- [Clock Settings](#)

File System

- [File System Info](#)
- [FTP File Server](#)

Gateway

- [Auto-Update Settings](#)
- [Gateway Diagnostics](#)
- [PLC Statistics](#)
- [Diagnostic Log](#)

Figure 28: Gateway summary page (primarily for service use)

4.5.7. Show/Hide Webpage Controls

A valuable feature of the system is the ability to view and control the system from a smartphone when local computer network settings allow (see Section 4.5.10, page 25, below). Because phone screens are small it might sometimes be possible to accidentally activate or disable functions inadvertently. To help avoid this the Gateway web page has a button for ‘Show Controls’ and ‘Hide Controls’ near the top of some of the screens, an example is shown in Figure 29.

Figure 29: Showing/hiding controls on the Gateway webpage

Communications Gateway
 Array Mini Inverters Gateway

Array > Summary Show Controls

Array > Summary Hide Controls

Power On Off+Unlock Off+Lock
 Clear Fault Clear Fire/Arc

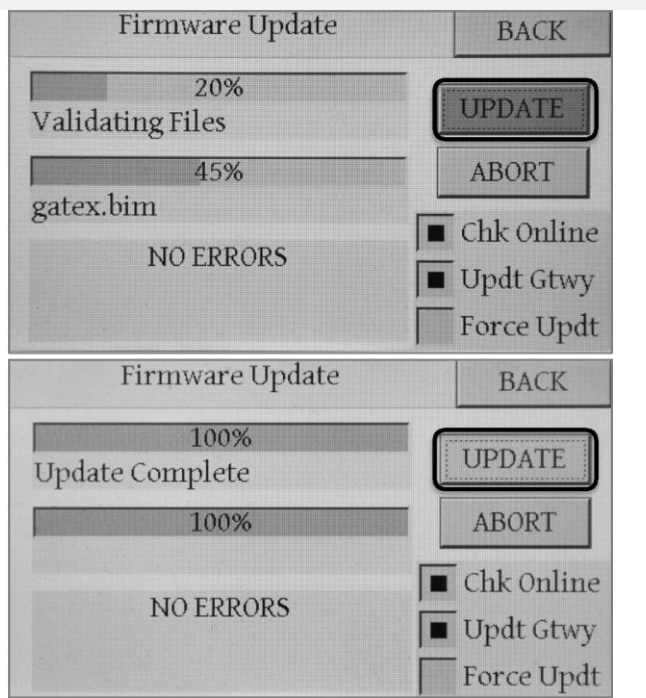
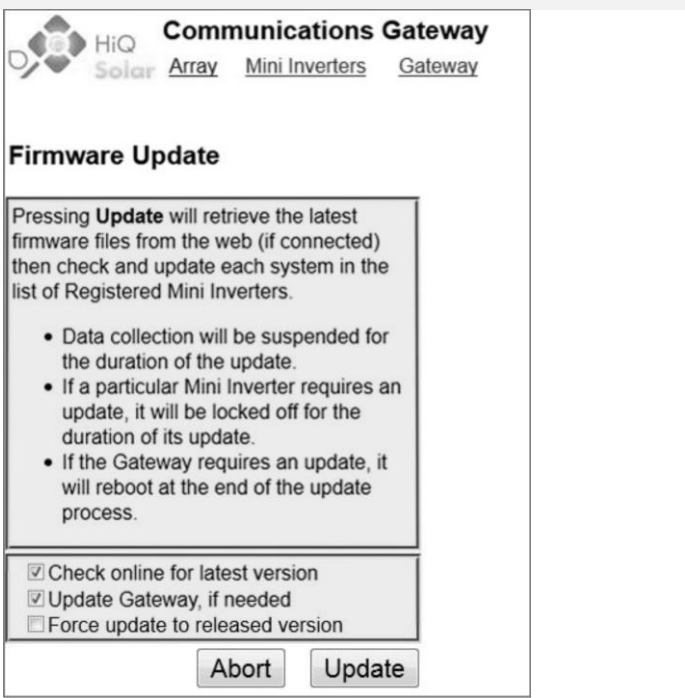
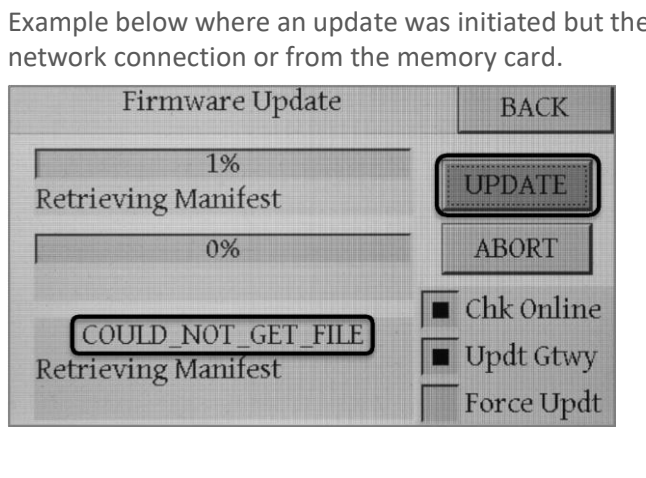

4.5.8. Grid Support and Utility-Interactive Functions – Adjustable Parameters

The HiQ Solar TSXL480-10k-ES inverter system is utility-interactive and provides grid support functions by default. Default values and associated ranges are given in the inverter Specifications Table of Section 6.1. When the Utility requires values other than the default, these adjustments can be made by contacting HiQ Solar Technical Support.

Changes to these values must only be carried out with the express written permission of the Utility, only setting values specified by them.

4.5.9. System Firmware Updates

HiQ Solar occasionally updates system firmware to add features and enhance reliability even further. Firmware updates may be accomplished through a network connection or using a memory card physically inserted into the card slot on the Gateway. Updates may be controlled through the Gateway touchscreen or the Gateway webpage.

Touch screen	Web page
 <p>The touch screen displays the 'Firmware Update' screen. The first screenshot shows progress at 20% for 'Validating Files' and 45% for 'gatex.bim'. The second screenshot shows progress at 100% for 'Update Complete'. Both screens include 'UPDATE' and 'ABORT' buttons, and checkboxes for 'Chk Online', 'Updt Gtwy', and 'Force Updt'.</p>	 <p>The web page shows the 'HiQ Solar Communications Gateway' interface. It includes a 'Firmware Update' section with instructions: 'Pressing Update will retrieve the latest firmware files from the web (if connected) then check and update each system in the list of Registered Mini Inverters.' Below this are three bullet points: 'Data collection will be suspended for the duration of the update.', 'If a particular Mini Inverter requires an update, it will be locked off for the duration of its update.', and 'If the Gateway requires an update, it will reboot at the end of the update process.' There are checkboxes for 'Check online for latest version', 'Update Gateway, if needed', and 'Force update to released version', along with 'Abort' and 'Update' buttons.</p>
 <p>The touch screen displays the 'Firmware Update' screen. The progress bar for 'Retrieving Manifest' is at 1%, and the error message 'COULD_NOT_GET_FILE' is displayed in a red box. The 'Retrieving Manifest' progress bar is at 0%.</p>	 <p>The web page shows the 'HiQ Solar Communications Gateway' interface. It includes a 'Firmware Update' section with instructions: 'Pressing Update will retrieve the latest firmware files from the web (if connected) then check and update each system in the'.</p>

Example below where an update was initiated but the Gateway was unable to find a firmware file through the network connection or from the memory card.

4.5.10. Gateway Access Inside a Local Network

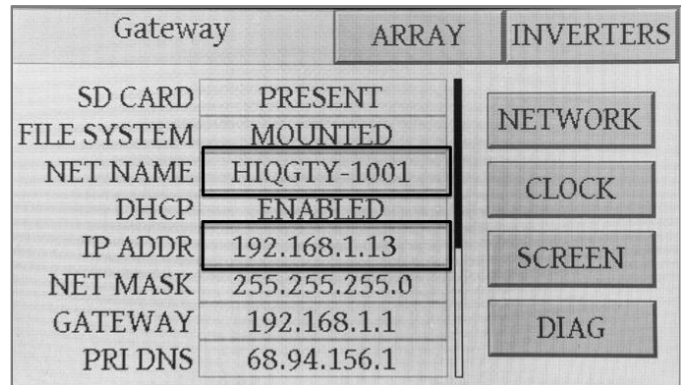
The following sections will be useful for the company IT department.

Note that the Gateway default is to be in DHCP mode – this is the easiest for local access inside a network.

4.5.10.1. Accessing Locally from a Windows Device

1) Looking at the Gateway unit, use the touch screen to display the ‘Gateway’ tab. You may need to scroll to see the view below:

Figure 30: Gateway screen showing the Net name and IP address



2) Open a web browser. Either type into the address bar the ‘NET NAME’ (in our example ‘HIQGTY-1001’) or type in the listed IP address (here 192.168.1.13, but this will vary)². This will bring up the web log in screen. Unless otherwise altered, the following will apply (case sensitive):

- Username: admin
- Password: HiQSolar

You will then see the home screen for that particular Gateway which should look like Figure 31:

Figure 31: Web interface for the Gateway showing array statistics



4.5.10.2. Accessing Locally from a Mac OS Computer or Device Including iPads & iPhones

As above except ‘NET NAME’ is not supported - the IP address will need to be typed into the browser address line.

² Note that this IP address is for the web page the web server provides; the network connection the Gateway uses to communicate to a local router is the one further down the list labeled ‘Gateway’, 192.168.1.1 in this example.

4.5.11. Accessing the Gateway from Outside the Local Network – LAN-side configuration

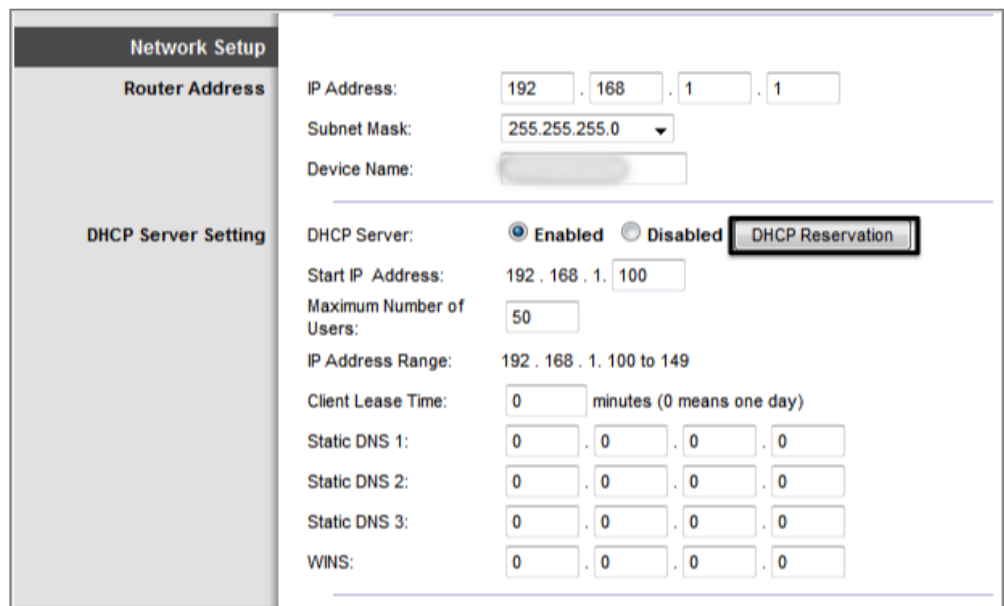
DHCP has a lease time after which it requests renewal, problematic if it ends up with a different IP address. A method must be used to make the IP address stay fixed; this can be:

- i) Keep the Gateway in DHCP but force the router to allocate the same IP address each time. If this is supported by the router it is generally most desirable.
- ii) Change to a fixed IP address.

Router capabilities and user interfaces vary. This example uses a particular Cisco router.

Ideally the Gateway would be left in DHCP mode, and the router configured to keep assigning the same address. If this functionality is supported by the router it might look like Figure 32, here called ‘DHCP Reservation’.

Figure 32: DHCP Reservation on our example Cisco router



As can be seen in the above screenshot, the router has a defined range of 50 IP addresses it has reserved for DHCP allocation, between 100 to 149 for the last field in the address. The DHCP Reservation screen allows examination of the currently logged on devices, and the option of assigning an address in the allowed range to our Gateway. Alternatively, an address can be assigned outside the DHCP range but the Gateway must be configured also.

The screenshot of Figure 33 shows the DHCP reservation screen; here we are assigning an address outside the range (ending in '37').

Figure 33:
Assigning an IP
address outside
the router's DHCP
reservation range

DHCP Reservation

Select Clients from DHCP Tables

Client Name	Interface	IP Address	MAC Address	Select
	LAN	192.168.1.37	00:04:A3:11:CA:25	<input type="checkbox"/>
	LAN	192.168.1.100	00:1E:8F:37:41:9B	<input type="checkbox"/>
	Wireless-N	192.168.1.101	88:87:17:BA:D6:1B	<input type="checkbox"/>
	LAN	192.168.1.102	40:61:86:F7:CF:1E	<input type="checkbox"/>
	Wireless-G	192.168.1.103	00:14:A5:A3:80:CB	<input type="checkbox"/>
	Wireless-N	192.168.1.104	9C:B7:0D:7D:1C:AB	<input type="checkbox"/>
	LAN	192.168.1.105	00:24:8C:D6:B9:24	<input type="checkbox"/>
	LAN	192.168.1.107	8C:89:A5:90:A0:A7	<input type="checkbox"/>
	LAN	192.168.1.108	00:21:6B:68:70:98	<input type="checkbox"/>
	LAN	192.168.1.142	00:E0:81:4C:4B:AE	<input type="checkbox"/>
	LAN	192.168.1.109	60:EB:69:5E:9A:CD	<input type="checkbox"/>
	LAN	192.168.1.110	14:DA:E9:2A:34:38	<input type="checkbox"/>
	Wireless-N	192.168.1.111	74:2F:68:3D:04:EA	<input type="checkbox"/>
	Wireless-N	192.168.1.112	10:40:F3:C2:27:1F	<input type="checkbox"/>
	LAN	192.168.1.113	00:22:68:6D:37:F7	<input type="checkbox"/>
	Wireless-N	192.168.1.114	00:21:5C:30:3E:7D	<input type="checkbox"/>
	LAN	192.168.1.115	E8:9A:8F:A1:A7:6F	<input type="checkbox"/>
	Wireless-N	192.168.1.116	F0:CB:A1:51:16:89	<input type="checkbox"/>
	LAN	192.168.1.117	04:0C:CE:CF:0D:46	<input type="checkbox"/>
	LAN	192.168.1.118	D8:30:62:A6:19:4D	<input type="checkbox"/>
	LAN	192.168.1.119	4C:0F:6E:34:15:64	<input type="checkbox"/>

1.

Manually Add Client

Enter Client Name	Assign IP Address	To This MAC Address	
<input type="text"/>	192.168.1.0	00:00:00:00:00:00	<input type="button" value="Add"/>

Clients Already Reserved

Client Name	Assign IP Address	To This MAC Address	MAC Address
<input type="text"/>	192.168.1.37	00:04:A3:11:CA:25	<input type="button" value="Remove"/>

2.

Having decided upon an IP address, we now need to configure the Gateway.

On the touch screen of the Communication Gateway, press 'Gateway', then the 'Network' button. This will bring up the screen shown in Figure 34.

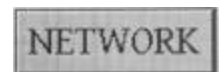


Figure 34: Network setting screen on the Gateway

Network Settings		OK	CANCEL		
	<input checked="" type="checkbox"/> USE DHCP		7	8	9
IP ADDR	192.168.0.30		4	5	6
NET MASK	255.255.255.0		1	2	3
GATEWAY	192.168.0.1		<-	0	.
PRI DNS	192.168.0.1				
SEC DNS	0.0.0.0				

The 'DHCP' check box indicates current status as well as allowing parameters to be changed if DHCP is unchecked. When unchecked it looks like this:



Touching on one of the fields below the check box will activate it and allow changes to be made using the on-screen keypad.

In general:

- Network sub mask will stay at 255.255.255.0 unless being used in certain big companies that might use something different.
- 'Gateway' and 'Pri DNS' (primary DNS) will be taken from the router screen.
- 'Sec DNS' (secondary DNS) will probably stay at 0.0.0.0.

4.5.12. Accessing the Gateway from Outside the Local Network – WAN-side configuration

For our example Cisco router, opening up a port for outside communication is achieved through the 'Application and Gaming' screen, see Figure 35. The aim is for communication to pass through the router, although there will usually be some translation of port labels between what the Gateway expects and what is presented to the outside world on the WAN side of the router.

There are 4 possible ports required to fully access the Gateway and HiQ Solar inverters remotely. Access to the control web page alone requires only the first of those listed in Table 2 to be set up.

Label	Function	External (Customer-changeable as required)	Internal (what the Gateway expects to see)
HTTP	Allows access to the Gateway web page	8100	80
FTPC	FTP Control – allows access to the Gateway memory card and logs	2100	21
FTPD	FTP Data – the return port for files requested using FTPC to be transmitted through	8000 (Use this setting only)	8000
Diag	Diagnostic - Low level system access such as firmware updates for use by HiQ Solar only	1000 (Use this setting only)	1000

Table 2: Port numbering assignments

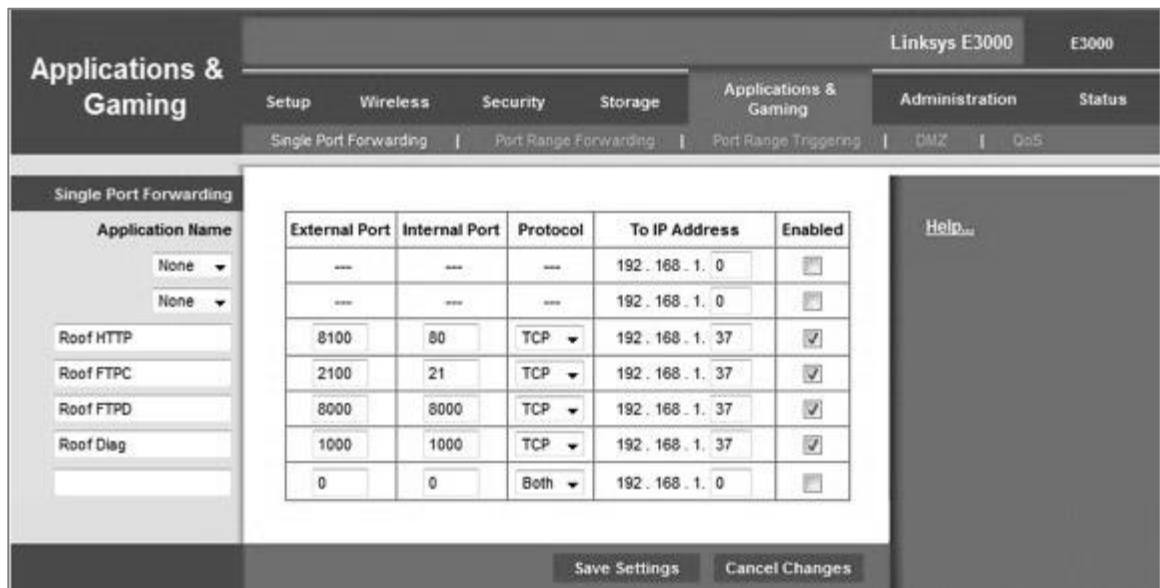


Figure 35: Port forwarding screen on our example router

Click on the ‘Save Settings’ button on the router page or else changes will be lost.

Note that not all routers offer port reassignment as described here. However, having different external port numbers is not strictly necessary; it is suggested as an extra security precaution to avoid using the well-known port assignments for web (80) and FTP (21) on the general Internet. The Gateway's web and FTP servers are both password protected, so the risks are low. In a case where no port forwarding is available, the Gateway direct port numbers (80, 21, 8000, 1000) would be used without specifying different external ports for 80 and 21.

5. Troubleshooting

The primary way of troubleshooting a system is to use the Communication Gateway (GW) to provide clues. The GW can be viewed using the touch screen interface on the device, or accessing it using a web browser. Assuming the issue is not with communications, browser access has the advantage that a mobile device such as a phone can be used while physically at the installation location. As detailed later, the inverter has an indicator light that will also provide insight.



The troubleshooting section is divided up as follows:

- Overview of possible issues (picture)
- If I had this issue, it would look like these symptoms (table)
- If I had these symptoms it could be one of these causes (table)
- More details on selected issues.

5.1. Overview of Possible Issues

Letters on the right (e.g. **(A)**) refer to explanatory notes in Section 5.4.

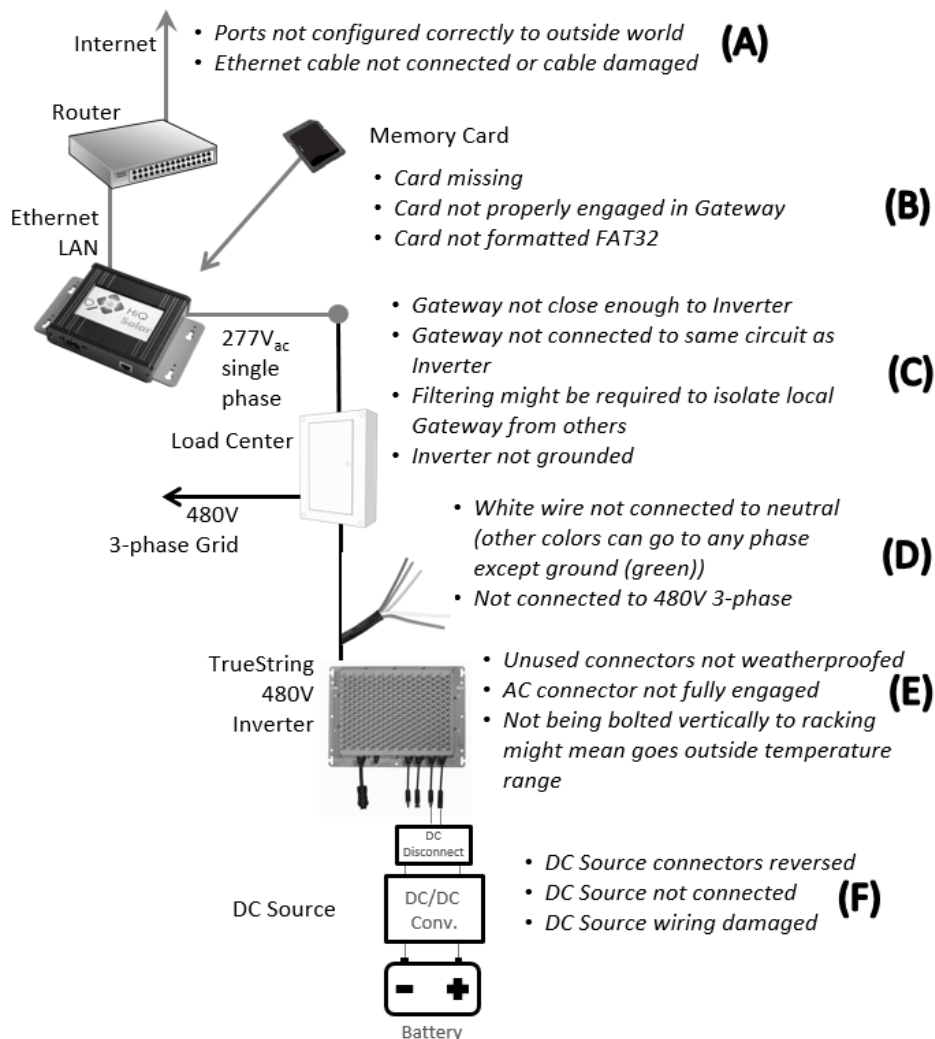


Figure 36: Possible issues diagram

5.2. If I had This Issue, it would Look Like These Symptoms

Letters next to individual faults (e.g. (D)) refer to explanatory notes in Section 5.4.

If this fault occurred I would see.....		Gateway Touch Screen	Web Interface	Inverter Button
AC Grid	<ul style="list-style-type: none"> AC output of inverter not connected to grid (D) AC connector not fully engaged (D) 	Missing figures in AC part of display	As touch screen	Rapidly flashing red
	<ul style="list-style-type: none"> One phase of AC Grid not connected (D) Neutral (white or grey) wire connected to a phase instead of neutral (D) 	One column of figures in AC part of display missing		
	<ul style="list-style-type: none"> Connected to wrong voltage system (e.g. 208V 3-phase) (D) 	Fault probably indicated		
Other	<ul style="list-style-type: none"> Unterminated connectors allow moisture to ingress (E), (F) 	Fault indicated		
DC Source	<ul style="list-style-type: none"> DC Source not connected (F) DC Source wiring fault (F) 	Not treated as a fault – missing statistics in Panel figures		-
Gateway	<ul style="list-style-type: none"> The Gateway is wired into an unrelated AC circuit (C) The Gateway is too far away from an inverter (C) The Gateway is the wrong side of filtering on the AC circuit (C) Neutral (white or grey) wire connected to a phase (D) Inverter not grounded (C) 	No signal or information 'Array Summary' screen has 'AC' indicator showing red	No information, status 'Unknown'	-
	<ul style="list-style-type: none"> No Ethernet connection (A) 	'Array Summary' screen has 'Net' indicator showing red	Unable to connect from the web interface	
	<ul style="list-style-type: none"> Network router not configured correctly (A) 	'Array Summary' screen has 'HiQ' indicator showing red as gateway unable to contact HiQ servers		
	<ul style="list-style-type: none"> No memory card (B) Memory card not fully engaged (B) Memory card not formatted as FAT32 (B) 	'Array Summary' screen has 'SD' indicator showing red	Retrieving long term history not possible	

Table 3: Faults and consequent symptoms

5.3. If I had These Symptoms, it Could be One of These Causes

Letters on the right next to individual faults (e.g. **(D)**) refer to explanatory notes in Section 5.4.

Symptoms			Possible Causes
Inverter Button Indicator	Gateway Touch Screen	Web Interface	
Button flashing red quickly	Missing information in AC display	As touch screen	<ul style="list-style-type: none"> AC output of inverter not connected to Grid (D) AC connector not fully engaged (D)
	Missing information in AC display		<ul style="list-style-type: none"> One phase of AC Grid not connected (D) Connected to wrong voltage system (e.g. 208V 3-phase) (D)
	Fault condition displayed		<ul style="list-style-type: none"> Moisture has been allowed into the system, perhaps because unused connectors have been left un-terminated (E) (F)
-	Missing DC Source information		<ul style="list-style-type: none"> Missing DC Source (F) Faulty wiring or connectors not fully engaged (F)
	'Array Summary' screen has 'SD' indicator showing red		<ul style="list-style-type: none"> Memory card not fully engaged (B) Memory card not formatted as FAT32 (B) Memory card missing (B)
	'Array Summary' screen has 'AC' indicator showing red		<ul style="list-style-type: none"> Gateway not connected to the same AC circuit as the inverter(s) (C) Gateway placed too far from the inverter(s) (C) Filtering present on the Grid interfering with communication (C) Neutral (white or grey) wire connected to a phase (D) Inverter not grounded (C)
	'Array Summary' screen has 'Net' indicator showing red		<ul style="list-style-type: none"> Ethernet cable not connected (A) Router external ports/ firewall not set up correctly (A)

Table 4: Symptoms and possible causes

5.4. Notes on Selected Issues.

5.4.1. Inverter Button Indicator States

If there is power to the inverter, the indicator on the inverter button will be indicating something. As described earlier, these have the following meanings and operations:













Inverter Button Push	Button Indication	Result
1 press 		<ul style="list-style-type: none"> • Make inverter beep (“are you alive?”)
2 presses 		<ul style="list-style-type: none"> • ‘Off & Locked’ - disabled • Do not 5-minute self-start
3 presses 		<ul style="list-style-type: none"> • Enter active state immediately • If locked, unlock & enter active state immediately • (If system is faulted, will unlock but won’t enter active state)
Long press (>2 seconds) 	 (Brief flash)	<ul style="list-style-type: none"> • Alternate functions mode, ready to accept further button pushes. Times out after 10 seconds
1 press (after long press) 		<ul style="list-style-type: none"> • Clear latched faults, for example after RCD or arc-fault test has initiated a fault condition

Figure 37: Inverter button functions and indicator meanings (repeat of Figure 17)


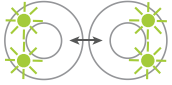




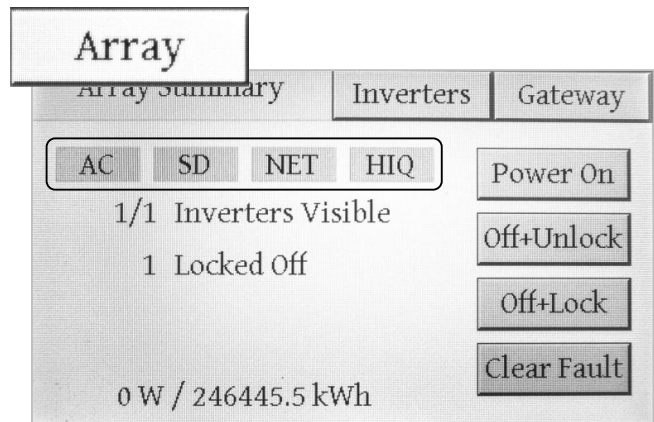
Inverter Indicator State	Meaning
 Solid	<ul style="list-style-type: none"> • Powered up • Not in active state • No faults
 Left-right flash	<ul style="list-style-type: none"> • Power-on self-test (will take <1 minute)
 Green Chaser	<ul style="list-style-type: none"> • Powered up • In active state, no faults
 Rapid Flash	<ul style="list-style-type: none"> • Faulted, e.g. arc detected
 Mostly On	<ul style="list-style-type: none"> • 'Off & Locked' - disabled
 Mostly Off	<ul style="list-style-type: none"> • Sleeping – not in active state

Figure 38: Inverter button functions and indicator meanings (repeat of Figure 18)

(A) Internet Connectivity Issues

- i) No Ethernet connection
- ii) Network router not configured correctly
- iii) Router external ports/ firewall not set up correctly

The 'Array Summary' screen on the Gateway has indicators to aid diagnosis. Guidance is given in Table 5.



Indication	Meaning
	The Gateway's AC wiring is correct. For example the Neutral is connected, voltage is within tolerance, no dangerous spikes are present.
	The SD card is inserted and the file system is OK.
	The network is connected. The cable is OK and the Gateway has acquired an IP address.
	The Gateway was able to contact the HiQ server and upload data. Indicator will be yellow while the Gateway attempts to make contact.

Table 5: Meaning of green indications on the Array Summary screen

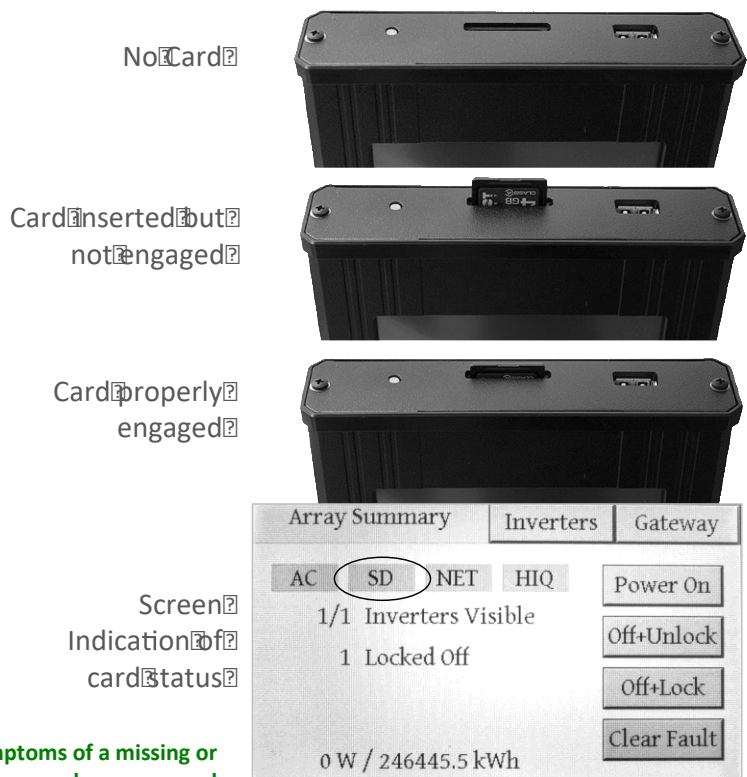
(B) Gateway Memory Card Issues

- i) No memory card
- ii) Memory card not fully engaged
- iii) Memory card not formatted as FAT32

Logging of long-term performance data is saved to the memory card that was supplied with the Gateway. Note that the card is not required for the system to operate, only to retain history information. If the card is in place but not fully engaged, you will see the symptoms shown in Figure 39, with the 'SD' indicator on the 'Array Summary' screen showing red.

The card is formatted with the FAT32 file system. If you wish to use a different memory card than the one supplied, it may need to be formatted. This can be achieved on a personnel computer, consult your computer manual for details.

Figure 39: Symptoms of a missing or not fully engaged memory card



(C) Gateway to Inverter Connectivity Issues

- i) The Gateway is wired into an unrelated AC circuit
- ii) The Gateway is too far away from inverter(s)
- iii) The Gateway is the wrong side of filtering on the AC circuit
- iv) Filtering present on the Grid interfering with communication

The Communication Gateway connects to local inverters using Power Line Communications (PLC). For communication to work, the Gateway must receive a strong enough signal above the noise. It must be on the same electrical circuit as the inverter system, which isn't always easy to establish in a typical company electrical closet with many different circuits present.

Assuming the Gateway is on one phase of the correct inverter system circuit, then issues are likely to arise if the signal strength is low, or equipment between the Gateway and inverter system is interfering with or filtering the signal. Note that some voltage surge protectors can cause this issue. In either case moving the Gateway closer to the inverter system is likely to be the best answer.

It is also possible that two Gateways (or other inverter control devices from other manufacturers nearby) are interfering with each other. In this case an isolating filter to separate the HiQ Solar inverter communications from the outside world might be required.

Note that a failure to establish communications can also occur if the neutral (white or grey) wire is connected incorrectly to one of the phases, as discussed in the next section.

(D) AC Wiring Issues

- i) AC output of inverter not connected to grid
- ii) AC connector not fully engaged
- iii) One phase of AC grid not connected
- iv) Neutral (white or grey) wire connected to a phase instead of neutral
- v) Connected to wrong voltage system (e.g. 208V 3-phase)

The inverter auto-senses phases, so when wiring the system to the grid it does not matter which of the red, blue or orange wires are connected to which phase. However, connecting the neutral (white or grey) wire to one of the phases will show up as a fault, the same fault if one of the 3 phases is disconnected. These conditions will not damage the inverter but should be corrected.

If one of the phases is not connected, it will be visible through the Gateway touchscreen and web-based GUI displays of grid faults.

If the neutral is connected to one phase the power line communications to the Gateway may not work.



CAUTION: Hazard to Equipment

If the inverter is connected to the wrong voltage system, such as 600V 3-phase, damage is likely to result. The system will need to be returned to the factory.

(E) Inverter Installation Issues

- i) Un-terminated connectors allow moisture to ingress
- ii) Inverter in direct sun and temperature range exceeded, causing output to be reduced due to high internal temperatures. This protective feature helps to extend the lifetime of the inverter.

The inverter has Type 6 Ingress Protection per UL50 and is very robust. To maximize reliability and performance for the longest lifetime, it should be mounted vertically in the shade and bolted to metal racking if available. However, it can be ballast-mounted in the shade. If the device is placed in a situation where it exceeds its rated temperature range it will reduce output power accordingly until it is safely back within the operating temperature range.

As with all such devices, Type 6 watertight operation requires that all connectors, whether used or unused, be properly terminated. If this is not the case, moisture may ingress, causing the unit to eventually fail.

(F) DC Source Wiring Issues

- i) DC Source not connected
- ii) DC Source wiring fault
- iii) Faulty wiring or connectors not fully engaged
- iv) Missing DC Source

Mostly self-explanatory issues of connectors not engaged or damaged wiring.

6. Specifications

6.1. Power System Specifications

Inverter Specifications	
DC Ports (2 identical inputs/outputs)	
DC maximum voltage	1,000 V _{dc}
DC voltage range, full power, per DC port	450-850 V _{dc}
DC maximum current, per DC port	12 A each, 24 A total
DC maximum source short circuit current, per DC port	30 A each, 60 A total
AC Port	
AC maximum continuous input/output power to 40°C	9.975 kW _{ac} max
AC de-rate with temperature, 40 to +65°C	-175W/°C
AC nominal input/output current, per phase	12.0 A
AC maximum continuous input/output current, per phase	12.0 A
AC maximum branch circuit overcurrent protection	80 A
AC 3-phase system compatibility	480 V Wye, 3 phases, neutral and ground
AC voltage ³ , phase to phase (min/nom/max)	422 / 480 / 528 V _{rms}
AC voltage ³ , phase to neutral (min/nom/max)	244 / 277 / 305 V _{rms}
AC operating frequency ³ (min/nom/max)	58.5 / 60 / 62 Hz
AC reconnect time delay ³ (min/default/max)	1 / 300 / 1000 s
AC synchronization in-rush current	0 A
AC minimum wire gauge for the grid connection	14 AWG
Maximum output fault current and duration	12 A, 0.1 ms
Power Factor ³	≥0.99 (adjustable: 0.8 leading to 0.8 lagging) See P-Q Curves, page 40.
AC output waveform	True sine wave
AC disconnect means	The AC connector has been evaluated and approved for use as the load-break disconnect required by the NEC ⁴ .

³ These parameters can be adjusted as required by the Utility, see following page for ranges.

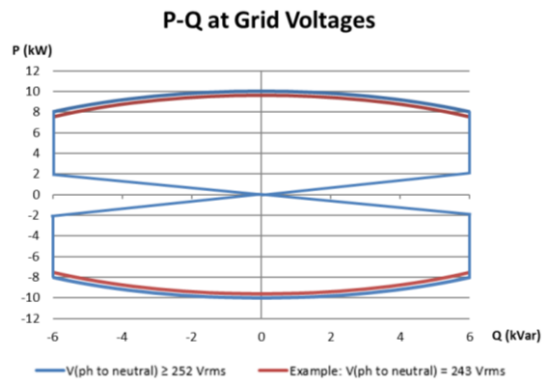
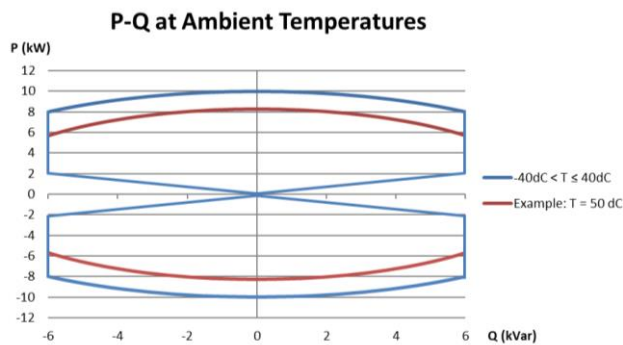
⁴ NEC section 690.17, allowed by the exception of meeting requirements specified in 690.33

Operating Parameter Condition		Unit	Default	Min	Max	
AC Voltage, Ride Through	High, Region 2	Voltage ($V_{rms, L-N}$)	332.4	332.4	360.1	
		Time (seconds)	0.16	-	-	
	High, Region 1	Voltage ($V_{rms, L-N}$)	304.7	304.7	332.4	
		Time (seconds)	13	1	13	
	Low, Region 1	Voltage ($V_{rms, L-N}$)	243.8	193.9	243.8	
		Time (seconds)	21	2	21	
	Low, Region 2	Voltage ($V_{rms, L-N}$)	193.9	138.5	193.9	
		Time (seconds)	11	2	11	
	Low, Region 3	Voltage ($V_{rms, L-N}$)	138.5	83.1	138.5	
		Time (seconds)	1.5	0.16	5	
	Frequency, Ride Through	High, Region 2	Frequency (Hz)	62	62	64
			Time (seconds)	0.16	0.16	1000
High, Region 1		Frequency (Hz)	62	60.1	62	
		Time (seconds)	300	0.18	1020	
Low, Region 1		Frequency (Hz)	58.5	57	59.9	
		Time (seconds)	300	0.18	1020	
Low, Region 2		Frequency (Hz)	57	53	57	
		Time (seconds)	0.16	0.16	1000	
Ramp Rate		Soft Start Ramp Rate	% $I_{nominal}$ /second	100	0.1	100
		Normal Ramp Rate	% $I_{nominal}$ /second	100	0.1	100
Volt/VAR	Inflection Point 4	Voltage ($V_{rms, L-N}$)	332.4	304.7	332.4	
		VAR	-1000	-6000	0	
	Inflection Point 3	Voltage ($V_{rms, L-N}$)	290.9	277	304.7	
		VAR	0	0	0	
	Inflection Point 2	Voltage ($V_{rms, L-N}$)	263.2	249.3	277	
		VAR	0	0	0	
	Inflection Point 1	Voltage ($V_{rms, L-N}$)	221.6	193.9	249.3	
		VAR	1000	0	6000	
	Specified Reactive Power	VAR	0	0	6000	
	Response Time	Time (seconds)	1	0.25	1000	
Frequency/Watt	High/Low Frequency Deadband	Frequency (Hz)	0.036	0.017	1	
	High/Low Frequency Scaling Factor	-	0.05	0.03	0.05	
	Response Time	Time (seconds)	5	1	10	
Volt/Watt	V/W Starting Voltage	Voltage ($V_{rms, L-N}$)	290.9	290.9	301.9	
	V/W Ending Voltage	Voltage ($V_{rms, L-N}$)	304.7	293.6	304.7	
	Power Limit	Watts	2000	0	10000	
	Response Time	Time (seconds)	10	0.5	60	

Other Specifications	
Peak efficiency	98.2 %
AC Voltage Trip Limit Accuracy	±2.7 V
Frequency Trip Limit Accuracy	0.05 Hz
Trip Time Accuracy	±34 ms or 1%
Weight	13.6 kg (30.6 lb.)
Operating temperature range	-40 to +65 °C (-40 to +150 °F)
Power consumption standby/ night	<8.3 W
Cooling	Natural convection, no cooling fan
Communication	Power Line Communication
Environmental rating	Outdoor / rooftop, NEMA type 6
Certification, inverter	CA Rule 21 (UL1741-SA), UL1741/IEEE1547, UL1699B, CAN/CSA C22.2 NO. 107.1, FCC Part 15 ⁵ .
Included warranty	10 Years, optionally extendable

6.2. P-Q Curves

The following graphs show the relationship between real power and reactive power for the TrueString XL inverter for different environmental and grid conditions.



⁵ Note: This equipment has been tested and found to comply with the 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 this 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:

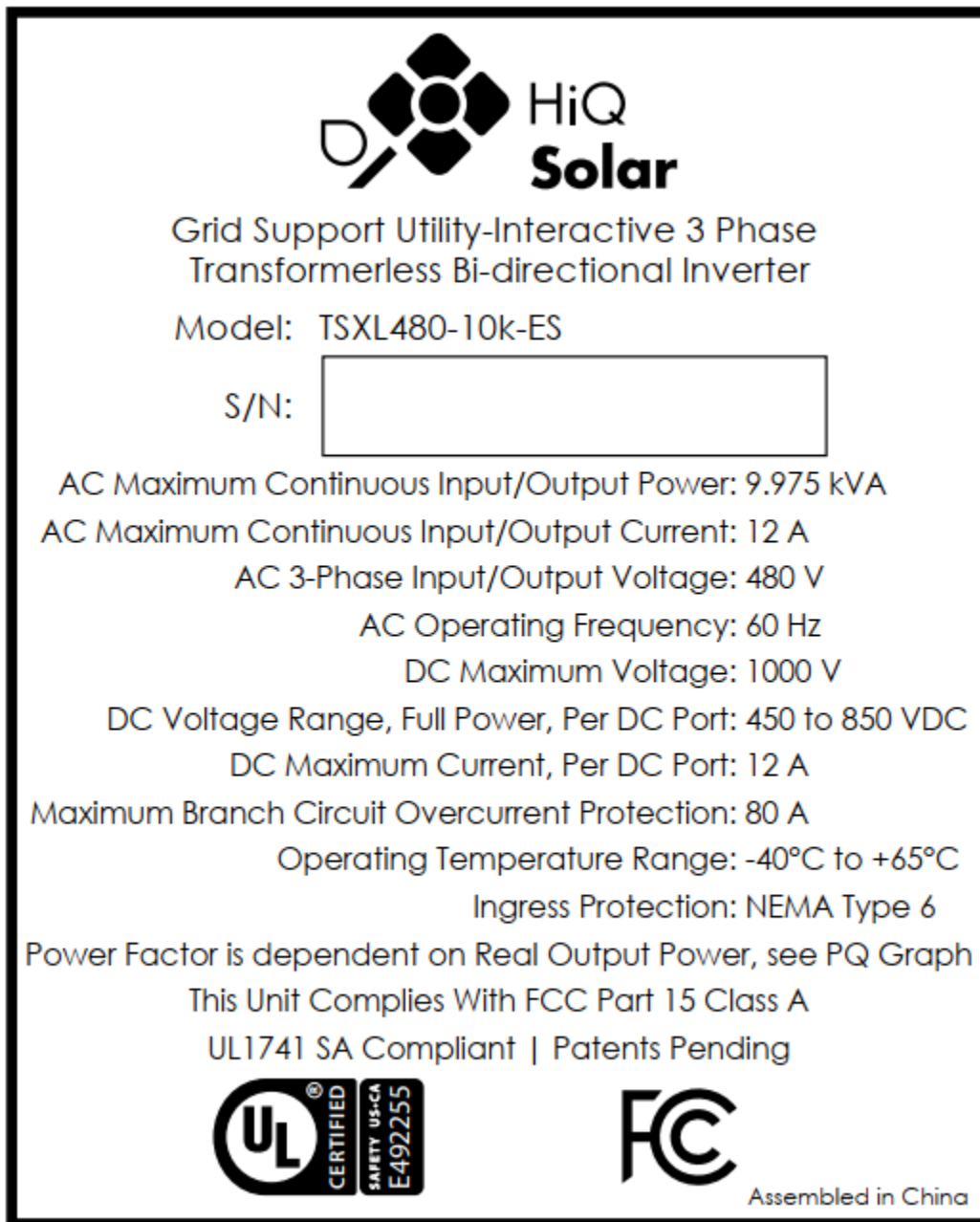
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

6.3. Communications Gateway Specifications

Gateway Specifications	
AC input voltage, min/nom/max	244/277/305 V
AC frequency, min/nom/max	59.3/60.0/60.5 Hz
Operating ambient temp range	-20 to +50 °C
Power consumption	1.5W typical (4W max)
Mounting, environmental rating	Indoor - NEMA 1
Memory card	SD compatible, 4-32GB tested, FAT32 formatted
Communication with HiQ Solar inverter	Proprietary Power Line Communication
LAN connection, Ethernet	10/100BASE, RJ45 8P8C modular plug
Limited warranty	10 years, optionally extendable
Compliance, certifications	UL 60950-1, CSA C22.2 No. 60950-1, FCC Part 15 ⁵
Weight	1.3lbs

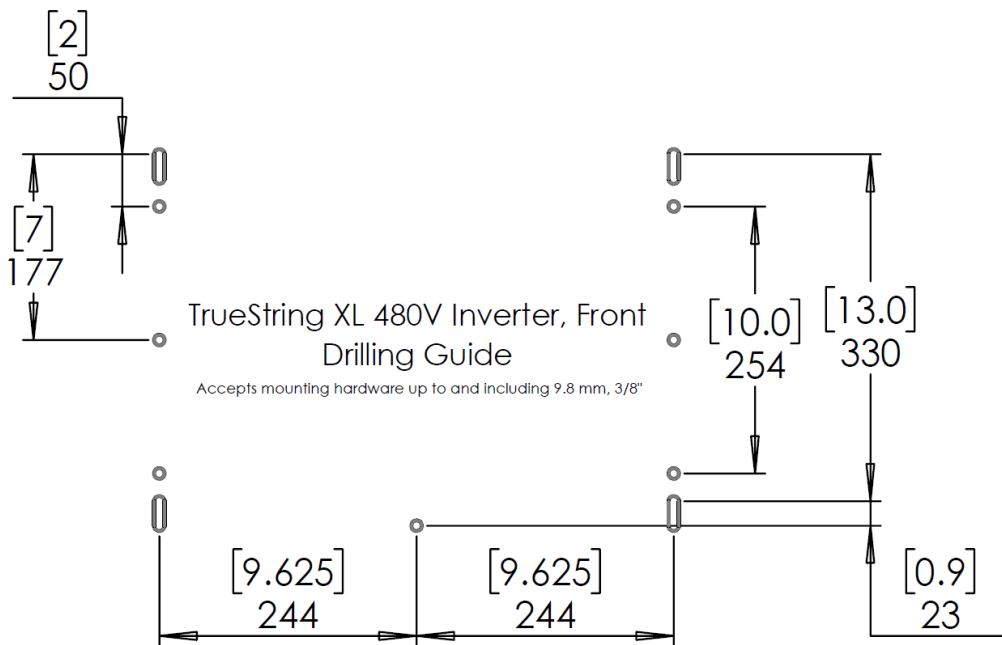
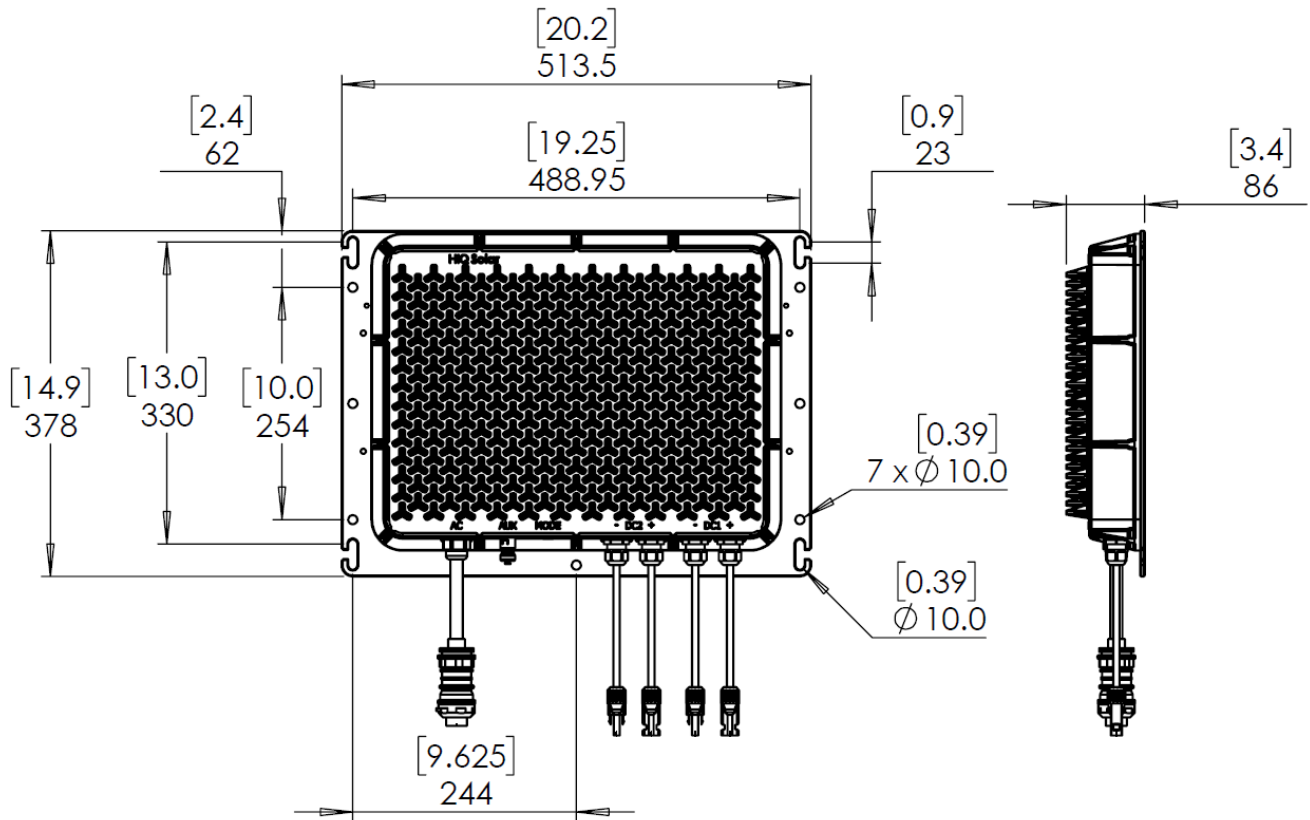
6.4. Unit Rating Label

The following label appears on the back of the unit baseplate.



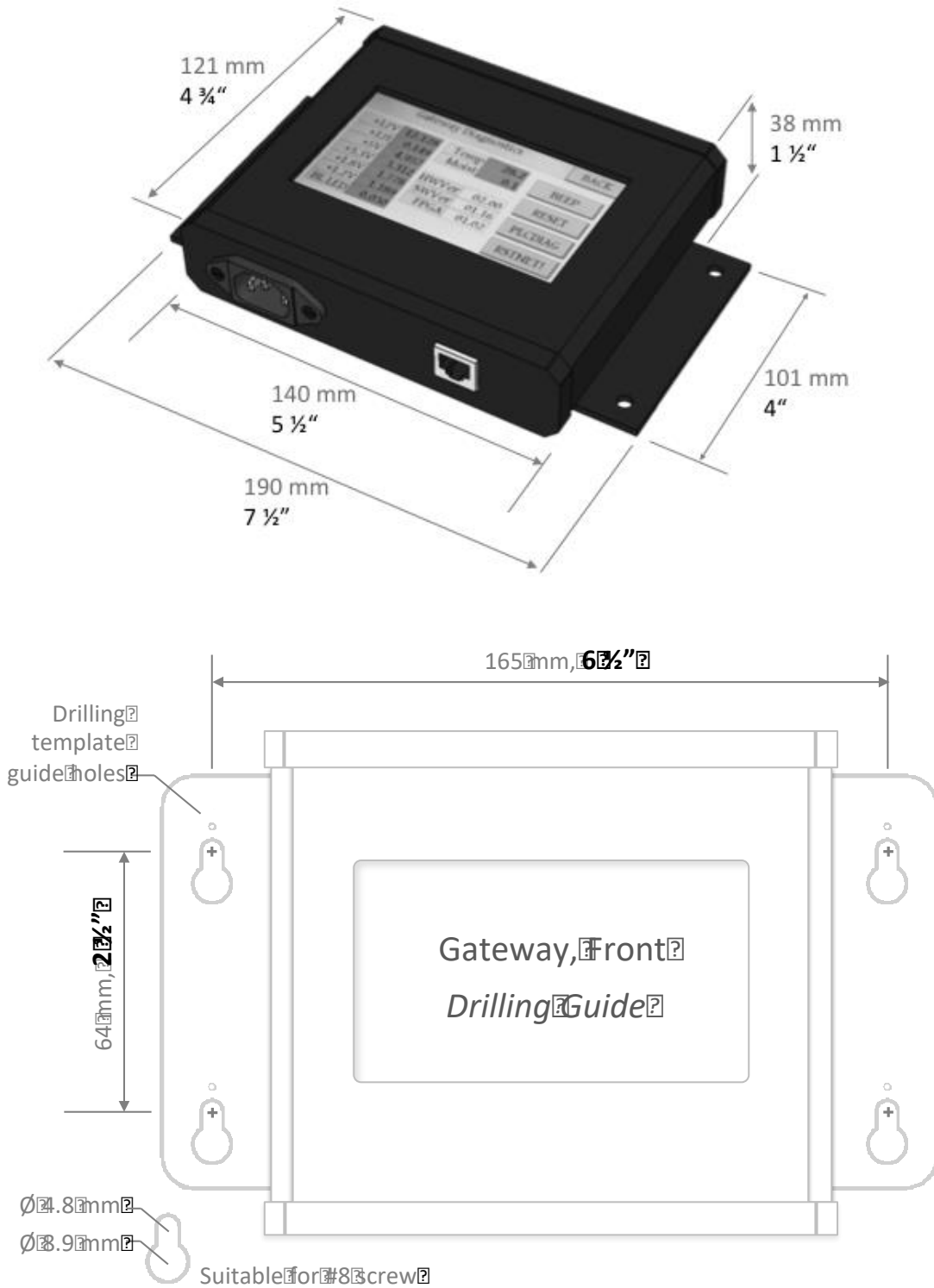
6.5. Physical Dimensions & Drilling Guides

6.5.1. TSXL480-10k-ES Inverter



Dimensions are in mm, bracketed dimensions are in inches.

6.5.2. Gateway



[End of Document]