

Commercial 1000VDC String Inverter

Solectria PVI 25TL-480-R

Installation and Operation Guide

Model: PVI 25TL-480-R



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1. Important Safety Instructions

1.1 Hazard Symbols



DANGER

Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.



WARNING

Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

NOTICE!

Indicates a hazardous condition, which, if not avoided, could result in property damage.

INFO ✓

Indicates important supplementary information to use the product effectively.

1.2 Symbols on Labels

Table 1-1 Explanation of Symbols on Labels

SYMBOL	DESCRIPTION
=====	DC Signal
~	AC Signal
⊕	Equipment Ground
○	Phase
○	Off
	On
	Refer to Operating Instructions
	Caution: Risk of Electric Shock Do not remove cover until 5 minutes after disconnecting all supply sources
	Caution: Risk of Electric Shock Timed Discharge
	Caution: Hot Surface Do Not Touch
	Warning: Hazardous voltage area under plastic cover. Do not open fuse holders under load. Proper PPE must be used while accessing fuses. For continued protection against risk of fire, replace only with same make and type of fuse.
	Information: For more information, please see the installation and operations manual

1.3 General Safety Messages

DANGER

Electric Shock Hazard: Components with hazardous voltage and energy will electrocute operator. Operator shall avoid touching live components with hazardous voltage and energy.

WARNING

Unqualified Operator Hazard: Operator may cause a hazardous situation by making incorrect installation or wiring connections. A qualified technician shall do all installation and wiring connections to comply with all local, national, and country specific guidelines for safety.

Electrical Shock Hazard: Operator may contact components with hazardous voltage and energy. Use proper safety equipment including Personal Protective Equipment (PPE) when de-energizing the unit. De-energize the unit, wait 5 minutes, and verify the absence of voltage before opening the equipment or removing any protective shields.

Heavy Lifting Hazard: Solectria PVI 25TL-480-R inverters weigh ~22 kg (48.5 lbs). The wire-box weighs ~6 kg (13.2 lbs). Ensure the mounting bracket is properly installed prior to hanging the inverter and wire-box on the bracket. A team of two is recommended to lift and place the inverter and wire-box into position.

Chemicals Hazard: This product can expose you to chemicals including lead, known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

NOTICE!

General Damage to Equipment: Attempting to service the inverter improperly may result in damage. Contact Yaskawa Solectria Solar Technical Support for maintenance.

Use as Intended: Solectria PVI 25TL-480-R inverters are designed for PV grid-tied systems. The inverters are to be installed with floating or ungrounded PV arrays only.

INFO ✓

Read and Follow Instructions: Failure to read and follow instructions may void the warranty. Install the inverter according to the instructions in this manual.

Grid Standard: Please check with the local electric utility supply company before selecting a grid standard. If the inverter is operated with an incorrect grid standard, the electric utility supply company may cancel the interconnection agreement. Placing the inverter into operation before the overall system complies with the national codes, rules and safety regulations of the application is not permitted.

SAVE THESE INSTRUCTIONS

This manual contains important instructions for model:

PVI 25TL-480-R

1.4 Status Panel

The Status Panel consists of four LED icons that provide useful information to the user regarding the current state of the inverter. The Status Panel is shown in Figure 1-1 and the icon symbols are defined in Table 1-2.



Figure 1-1 Status Panel

Table 1-2 LED Indication Meaning

LED LIGHT	DESCRIPTION
POWER	Working Power Indicator Light On: AC Power is available Off: AC Power is not available
FAULT	Fault Status Indicator Light On: Permanent fault Fast Flash: Fault (on 0.5 seconds, off 0.5 seconds) Slow Flash: Warn (on 0.5 seconds, off 2 seconds) Off: No detected fault or power supply is not working
AFCI	GFCI/AFCI Status Indicator Light On: AFCI protection Flash: GFCI fault (on 0.5 seconds, off 2 seconds) Off: No GFCI/AFCI fault or power supply is not working
RSD	RSD Status Indicator Light Green Light On: Power supply working and grid checked Red Light On: Power supply working and grid not checked Off: Rapid shutdown triggers, end of discharge, no AC power

2. Overview

2.1 Intended Use

The SOLECTRIA PVI 25TL-480-R is a grid-tied, photovoltaic (PV), three-phase inverter, suitable for use in commercial or utility-scale installations. The SOLECTRIA PVI 25TL-480-R is an integral part of a typical PV installation, which typically includes PV modules, DC power distribution equipment, a PV inverter, and AC power distribution equipment. The SOLECTRIA PVI 25TL-480-R converts solar power (DC) to 480VAC power suitable for use in buildings and back feeding onto the electrical grid. This inverter is a grid following inverter, which means it synchronizes the output voltage with the grid, as well as synchronizes the output current to the same frequency and phase as the AC grid. The SOLECTRIA PVI 25TL-480-R is an ideal product for use in rooftop, carport, or ground mount installations where quality and performance are paramount.

The SOLECTRIA PVI 25TL-480-R is not intended for use in micro-grid or off-grid applications. Although successful integration into AC-couple systems is possible, Yaskawa Solectria Solar does not support or provide guidance for use in this type of application.

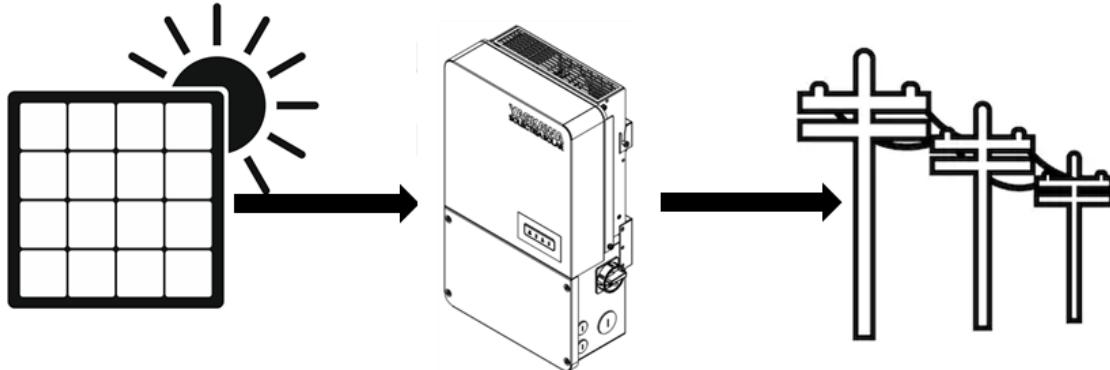


Figure 2-1 Inverter Usage

2.2 Inverter Features

CONVERSION TECHNOLOGY	3 - Level
HIGH EFFICIENCY	Max 98.5%, CEC 98%
GRID ADAPTABILITY	Supports multiple grid trip setpoints Pre-set grid setpoints: IEEE 1547, CA Rule 21, ISO-NE Adjustable reactive power Adjustable power factor (PF) ±0.8 Remote power curtailment
CONNECTIVITY	Modbus, SunSpec Modbus and XML Ethernet Network Card (optional) allows for remote firmware upgrades and advanced controls of the inverter
USER INTERFACE (UI)	Wi-Fi UI accessible with dongle and smart device
MULTICHANNEL MPPT CONFIGURATION	2 MPPT zones
PROTECTIVE ENCLOSURE	NEMA Type 4X Corrosion resistant aluminum Rated for indoor and outdoor use
EASY INTEGRATION	Integrated AC and DC switches 6 positive-fused string input positions Accommodates wide range of AC/DC conductors
RAPID SHUTDOWN READY	Tigo transmitter installed in wire-box

2.3 Inverter Protections

DC POLARITY	Reverse polarity protection on DC inputs
SHORT CIRCUIT PROTECTION	AC and DC short circuit protection
ARC FAULT	DC series arc fault detection
ANTI-ISLANDING	Bidirectional frequency perturbation based on Sandia Frequency Shift Detection
OVER VOLTAGE PROTECTION	Integrated input and output over-voltage protection
OVER CURRENT PROTECTION	Input over-current protection
CONTINUOUSLY MONITORED VARIABLES	DC input insulation resistance with respect to ground DC injection of AC output AC output voltage and frequency Leakage current to ground Internal ambient temperature IGBT power module temperature

2.4 Communication Overview

The SOLECTRIA PVI 25TL-480-R utilizes an advanced communication platform that can be accessed over Wi-Fi using a smart device via the FOMlink wireless antenna device. This provides the user with a single point of access to all inverters within a network, without needing to travel the site to interact with individual inverters.

The SOLECTRIA PVI 25TL-480-R is compatible with Solectria's SolrenView with no additional hardware required. Yaskawa Solectria also supports integration with other third party monitoring platforms.

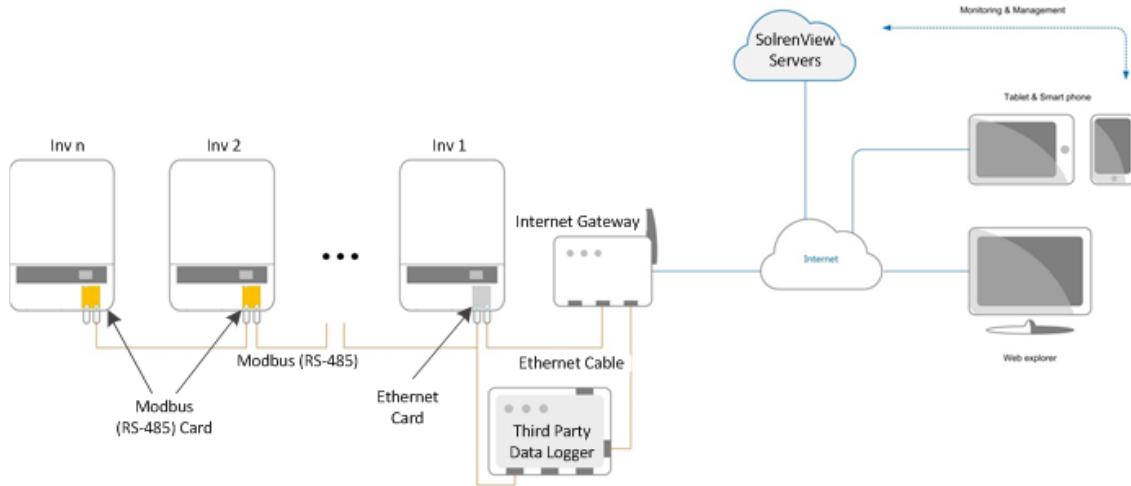


Figure 2-2 Communications Overview

2.5 Inverter Diagrams

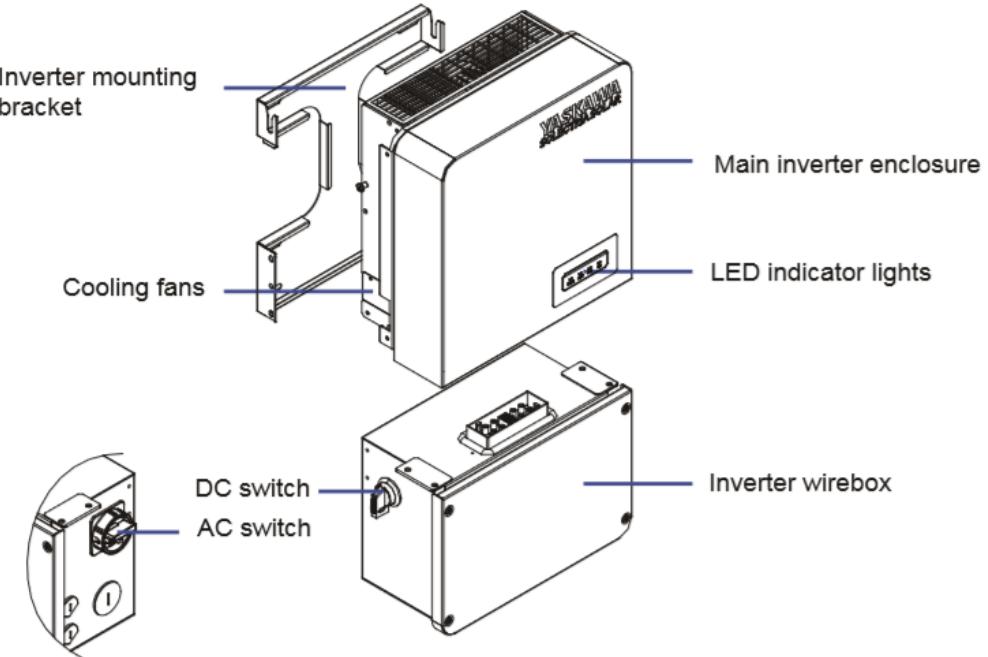


Figure 2-3 SOLECTRIA PVI 25TL-480-R Inverter

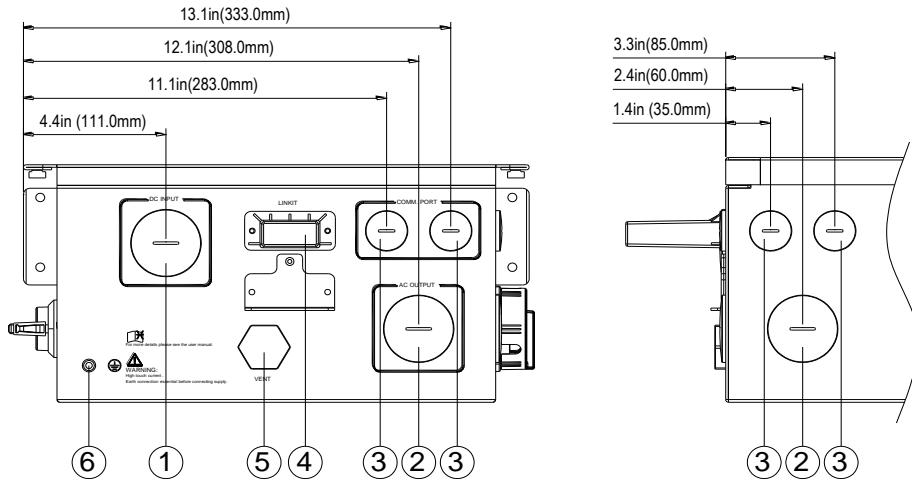


Figure 2-4 Wire-box Conduit Knockout Locations

- ① Knock-outs for DC input, (1) 1-1/2 inch Trade Size
- ② Knock-outs for AC output, (2) 1-1/2 inch Trade Size
- ③ Knock-out for communication, (4) 3/4 inch Trade Size
- ④ FOMlink Dongle port
- ⑤ Vent
- ⑥ External ground connection point (M6)

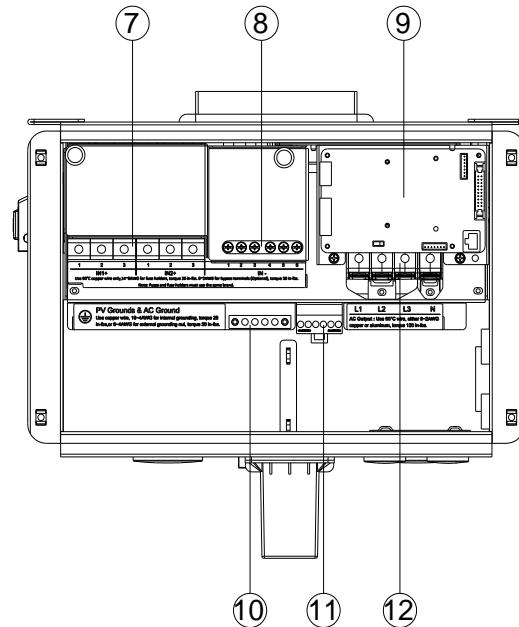


Figure 2-5 Wire-box Internal Connection Points

- ① DC Input fuse holder/terminal (positive)
- ② DC Input terminal (negative)
- ③ Communication board
- ④ Internal ground terminal
- ⑤ RSD transmitter
- ⑥ AC output terminal block

2.6 Schematic Diagram and Circuit Design

The basic electrical schematic diagram of SOLECTRIA PVI 25TL-480-R inverters is shown in Figure 2-4. The input from PV source circuits passes through surge protection circuitry, DC EMI wave filters, and independent DC-DC boost circuitry to achieve maximum-power-point tracking and boost the voltages to a common DC bus. The inverter uses line voltage and frequency measurements to synchronize to the grid and converts the available PV power to AC power by injecting balanced 3-phase AC current into the electric utility grid. Any high frequency AC component is removed by passing through a two-stage relay and EMI wave filter to produce high quality AC power.

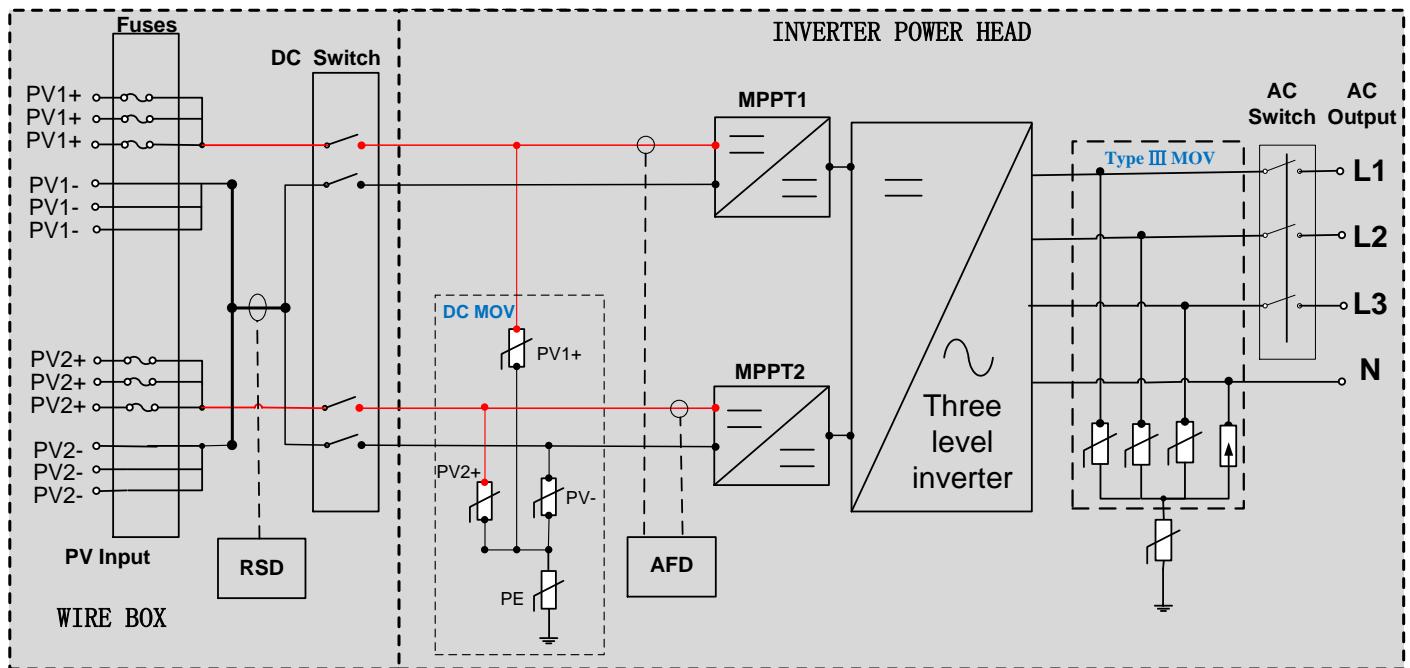


Figure 2-4 Basic electrical schematic diagram

2.7 Labels

The SOLECTRIA PVI 25TL-480-R has labels on the Power Head. Do not deface these labels as they contain important information required for warranty service. The labels on the Power Head show the inverter specifications and FCC compliance. See Figure 2-5.

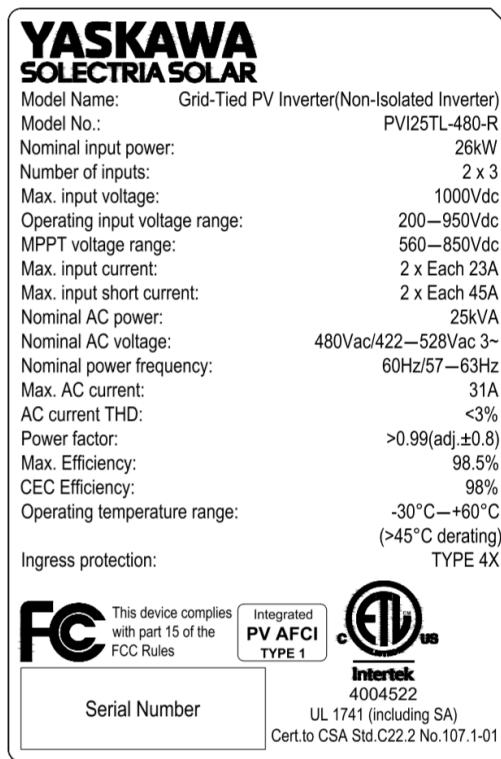


Figure 2-5 Example Power Head Labels for SOLECTRIA PVI 25TL

2.8 Unpacking

The SOLECTRIA PVI 25TL-480-R inverter ships in one box. Prior to installation, be sure to store the packaged inverter(s) out of the elements. The inverter enclosures are not NEMA Type 4X rated until fully installed. Storage temperatures are -40°F to +158°F (-40°C to +70°C). Open the boxes carefully to avoid damaging the contents.

NOTICE!

Store Packaged Inverter Properly: Never expose packaged inverters to rain, water, snow, or other elements that may damage the electronics. The Power Head and Wiring Box are not NEMA Type 4X rated until fully installed. Failure to store the inverters properly will result in damage that is not covered under warranty.

INFO ✓

Do Not Discard Packaging Before Removing all Contents: There are multiple components in each box. Check packaging thoroughly before discarding.

A complete inverter ships with the components show in Figure 2-6 and described in Table 2-1.

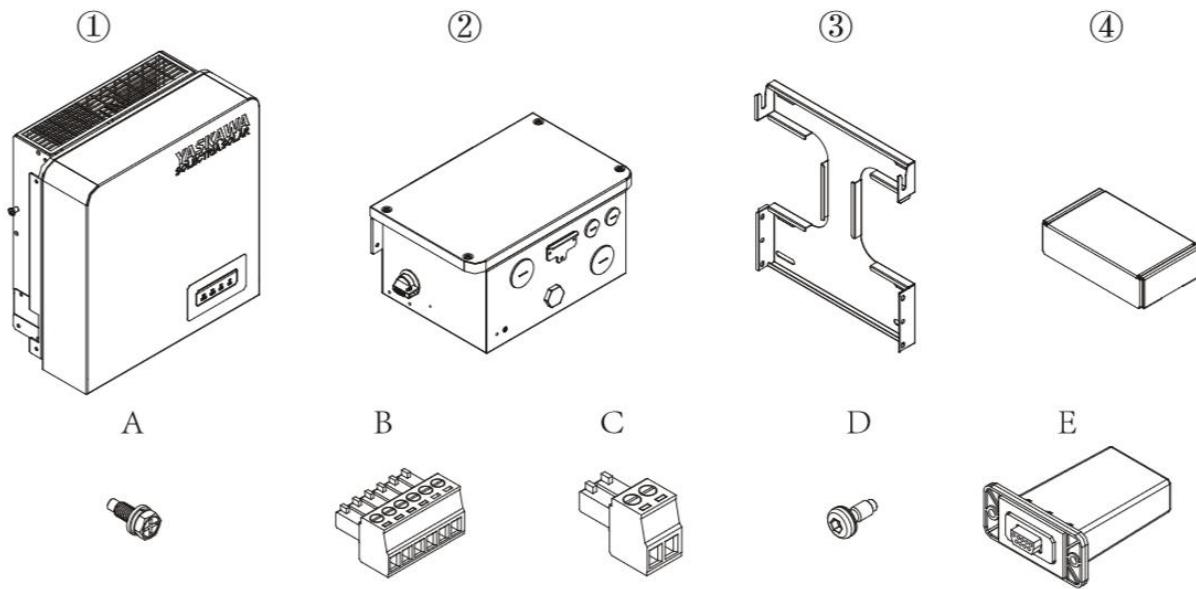


Figure 2-6 Shipment Box Contents

Table 2-1 Shipment Box Contents

IDENTIFIER	PART	QUANTITY	DESCRIPTION
1	Power Head	1	Inverter Power Head, top
2	Wire-Box	1	Inverter Wire Box, bottom
3	Mounting Bracket Assembly	1	Mounting Bracket assembly, 1 piece
4	Accessory Kit	1	Necessary hardware and accessories for installation
A	M6 x 18mm Phillips Screw	12	4 for securing and bonding Wire-Box to Power Head; 6 for securing the inverter to the mounting bracket; 1 for an External Ground connection; 1 spare
B	6 Pin PCB Connector Plug	1	For RS485 Connection
C	2 Pin PCB Connector Plug	1	For Power Supply
D	Hex Socket Screw	1	Spare (for Wire-Box Cover)
E	FOMlink Wi-Fi Module	1	For access to HMI

3. Installation

Before attempting to install the SOLECTRIA PVI 25TL-480-R read Section 3 in its entirety.

WARNING

Read These Instructions: Failure to follow these installation instructions may result in personal injury or death. Read this section in its entirety before attempting to install a SOLECTRIA PVI 25TL-480-R.

NOTICE!

Improper Installation Will Void Warranty: This section includes important information regarding the proper installation environment and mechanical and electrical requirements. Failure to follow these instructions will void the warranty.

NOTICE!

Maintain NEMA 4X Rating: Water ingress could result in unsafe conditions. Please take note of the following recommendations in order to maintain the NEMA rating and prevent water from entering into the system.

- Adding weep holes or any other holes will void the warranty.
- All conduits must be sealed to prevent moisture ingress.
 - Sealing conduit entries at the PV array will provide additional protection. Firestop putty or electrically rated conduit foam is recommended.

NOTICE!

Allowable Ambient Temperature Ranges:

- Storage Temperatures: -40°C to 70°C, Inverter not installed and in storage (in packaging or unpackaged).
- Normal Operating Temperatures: -30°C to 60°C, Inverter installed, connected to electric utility grid, and operating during daylight hours.
- Connected but Off Temperatures: No low temperature limit to 70°C, Inverter installed, connected to electric utility grid but non-operating (daylight or nighttime hours).

PRE-INSTALLATION CHECKLIST

- Check that the inverter environmental specifications (protection degree, operating temperature range, humidity and altitude, etc.) meet the requirements of the specific project location.
- Make sure that the electric utility grid voltage is within range for the grid standard chosen.
- Ensure that the local electric utility grid authority has granted permission to connect to the grid.
- Installation personnel must be qualified electricians or those who have received professional training.
- Wear and use proper personal protective equipment (PPE) during installation.
- Sufficient space according to Figure 3-3 must be provided to allow the inverter cooling system to operate effectively.
- Install the inverter away from flammable and/or combustible substances.
- Avoid installing the inverter in locations that exceed the temperature limits specified for the inverter to prevent undesirable power loss.

NOTICE!

Outdoor Installations that are Left for Extended Periods of Time without Power:

Yaskawa Solectria Solar advises against leaving inverters mounted outdoors for an extended period of time (more than 90 days) or exposing the inverters to cycles of freezing temperatures without both DC and AC power connected to the inverters.

The inverter enclosures are tested and rated NEMA 4X. However, there exists the possibility of water condensation inside the inverter enclosure when it is left exposed to an outdoor environment without power for an extended period of time. Humidity can enter the power head through a small opening between itself and the wire-box. When the inverter is exposed to temperature swings, especially in cold weather, moisture inside the inverter power head could condense over the aluminum heatsink area where inverter semiconductors are mounted. Water droplets on the heatsink may cause a short circuit on live semiconductor devices. When a PV source is applied to the inverter, this PV power source could cause the inverter to fail and result in a short circuit across the PV array.

If the inverter is mounted outdoors without operating power for an extended period of time, Yaskawa Solectria Solar recommends that the inverter power head be inspected for water condensation before any DC or AC power is applied to the inverter. Without inspection, customers run the risk of having electronic circuit damage when power is applied to the inverter during startup. It is advised that customers contact the Yaskawa Solectria Solar service department at +1 (978) 683-9700 x2 for further advice and to schedule an inspection of the inverters on-site.

This Installation Section is broken into five sub-sections: Mechanical Installation, Wire-Box, DC Electrical Installation, AC Electrical Installation, and Communications Installation.

Each subsection begins with general requirements and guidelines which must be considered when designing a system and planning the installation. Each sub-section is concluded with detailed systematic instructions to install the SOLECTRIA PVI 25TL-480-R.

3.1 Installation Sequence Overview

CAUTION

Lifting Heavy Object Hazard: Proper lifting techniques must be used in order to avoid injuries. The Power Head weighs 48.5 pounds (22 kg).

1. Install the Mounting Bracket.
2. Install the Power Head.
3. Remove bulkhead cover from top of Wire-Box.
4. Install the Wire-Box.
5. Connect the Power Head and Wire-Box together.
6. Confirm that the site AC breaker is set to OFF.
7. Remove the cover of the Wire-Box.
8. Land the AC conductors from the grid to the AC terminal block in the Wiring Box, ensuring a Positive Phase rotation.
9. Land the input PV circuit conductors by connecting to the DC fuse holders in the Wiring Box.
10. Land the communication conductors.
11. Install duct seal/firestop putty in all conduit entrances.
12. Replace the plastic shields and the cover of the Wire-Box.

3.2 Mechanical Installation

3.2.1 Inverter Environment

The SOLECTRIA PVI 25TL-480-R is equipped with a NEMA Type 4X rated, Polyester Powder-Coated Aluminum enclosure suitable for outdoor installation in many different climates. Select the mounting location appropriately taking into consideration, snow, wind, rain, direct sun, pests, vegetation growth, and any other local environmental conditions. To increase its life span, it is recommended that the inverter be installed out of direct sunlight; for example, under a shade structure, on a north facing building wall, or on north facing racking. Never install inverters in areas that are prone to flooding, standing water, prolonged snow coverage, or near explosive or flammable materials.

WARNING

Explosion or Fire Hazard: Electrical devices can cause fires. Never install in areas prone to explosive gasses, liquids, or in close proximity to flammable materials.

NOTICE!

Maintain NEMA Type 4X Rating: It is the responsibility of the installer to maintain the NEMA Type 4X rating of the enclosure. Failure to maintain the NEMA Type 4X rating will void the warranty.

NOTICE!

Improper Installation Will Void Warranty: Never install the inverter in areas that are prone to flooding, standing water, or prolonged snow coverage. It is important to ensure the cooling fans and exhausts remain clear from obstructions at all times.

INFO ✓

Temperature Derating: The SOLECTRIA PVI 25TL-480-R is rated for a wide range of operating temperatures. When installed in environments that may experience ambient temperatures near or above the derating temperature of 104F (40C), it is best to keep the inverter out of direct sunlight to minimize temperature de-rating and extend product life.

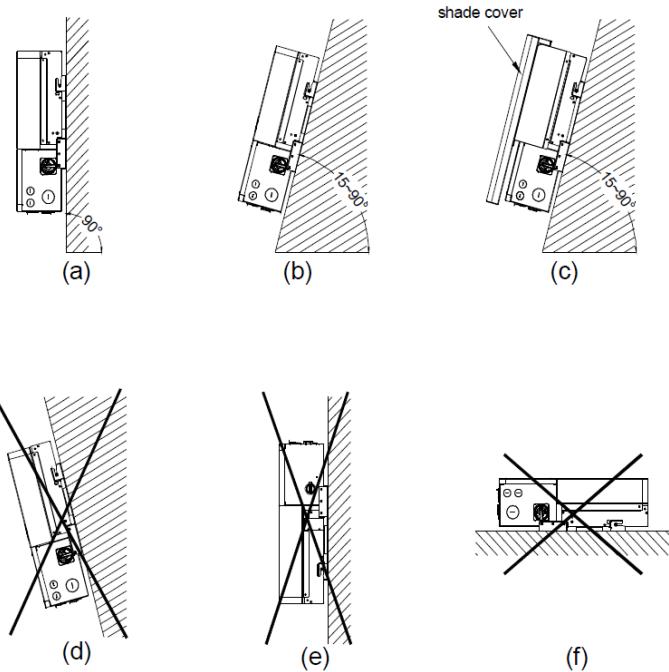


Figure 3-1 Inverter Mounting Options

3.2.2 Inverter Mounting Angle and Orientation

The SOLECTRIA PVI 25TL-480-R is designed to accommodate mounting angles between vertical and 75° from vertical. If tilted at 75° from vertical (15° from horizontal) in an outdoor environment, the Shade Cover accessory is required. See Section 8.1.2 for more details. When possible, install the inverter vertically facing north to minimize damage caused by sunlight exposure and to improve ventilation.

1. The Power Head must be installed above the Wire-Box. Never install the inverter upside down.

2. The bottom edge of the Wire-Box must remain horizontal (perpendicular to a plumb line). No side-to-side tilting is permitted.
3. Do not mount the inverter leaning forward.
4. Do not mount the inverter at an angle lower than 15° from horizontal.

3.2.3 Inverter Dimensions

The dimensions of the SOLECTRIA PVI 25TL-480-R are shown in Figure 3-2.

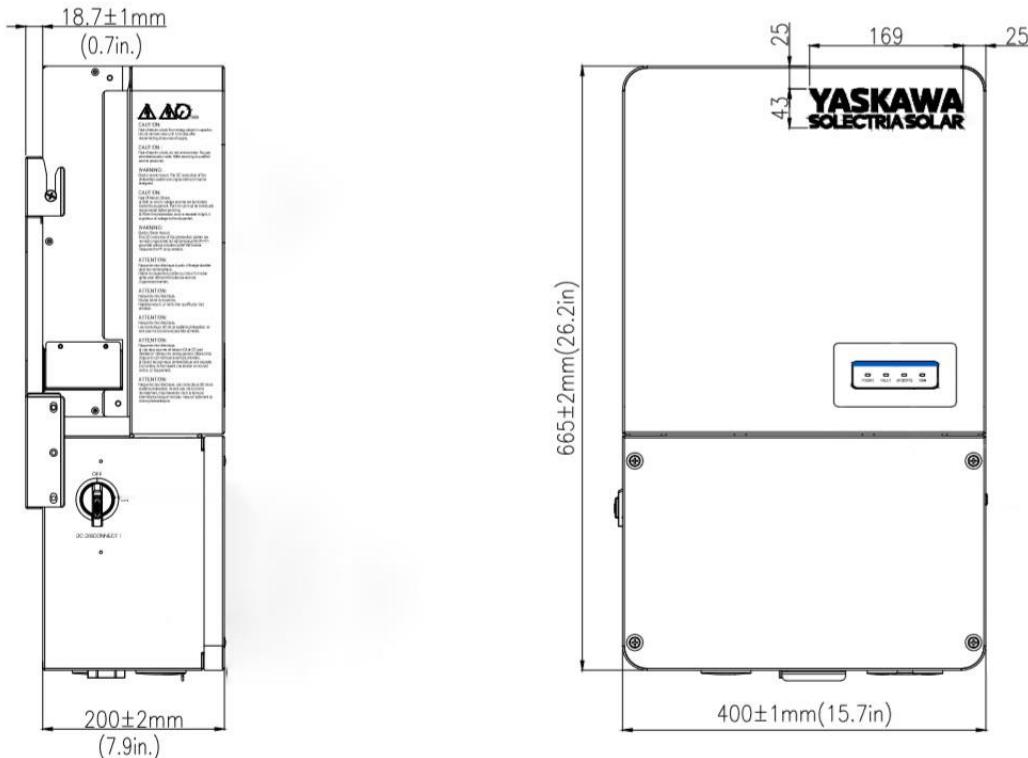


Figure 3-2 Inverter Dimensions

3.2.4 Inverter Spacing

It is important to allow ample spacing for ventilation, wire management, and service. The minimum spacing requirements are shown in Figure 3-3. Always keep the clearance area free from debris, plants, and other obstructions.

NOTICE!

Improper Installation Will Void Warranty: The requirements defined in this section are the minimum allowable clearances. In areas that experience deep snows, heavy rain, excessive heat (greater than 45 °C), or excessive vegetation growth, it may be necessary to increase spacing. It is the responsibility of the installer to ensure the clearance area remains free from debris, plants, and other obstructions at all times. The recommended spacing below the inverter can be modified according to installation requirements. Install the inverter higher than the flood line and/or typical snow build-up.

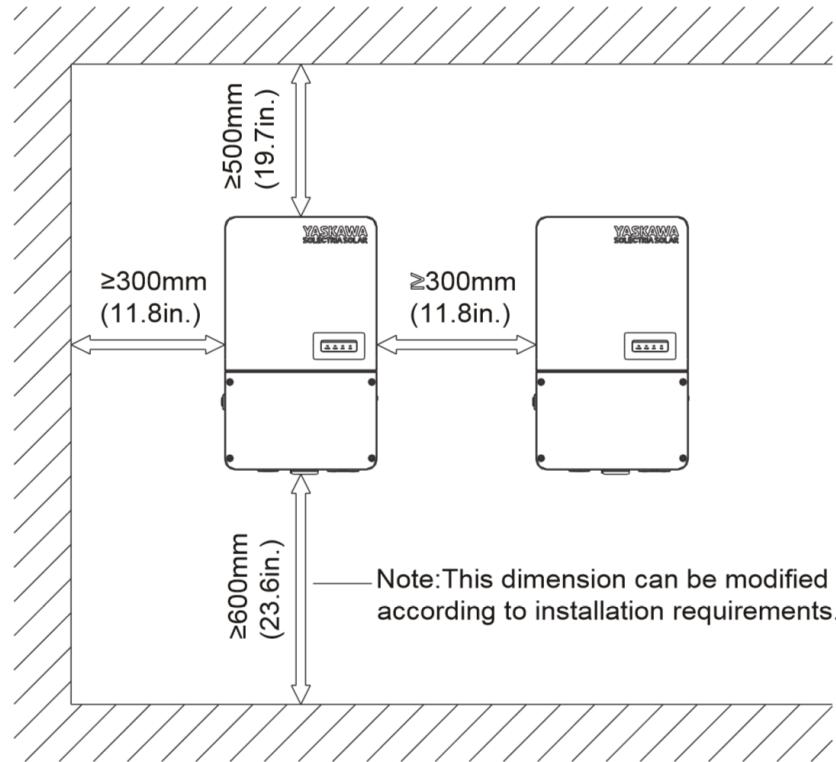


Figure 3-3 Inverter Minimum Spacing and Clearance Area

3.2.5 Mounting

A mounting bracket, shown in Figure 3-5, is provided with each SOLECTRIA PVI 25TL-480-R. Direct mounting to any surface without using the provided mounting bracket is not permitted. The mounting bracket must be securely attached to a structurally sound, flat surface. Acceptable surfaces include U-channel metal racking (such as Unistrut), concrete, and other non-flammable surfaces.

The total installed weight of the SOLECTRIA PVI 25TL-480-R with wiring box is 61.7 lbs (28 kg). It is the responsibility of the installer to perform a structural analysis of the intended mounting surface.

NOTICE!

Improper Installation Will Void Warranty

- Always use the provided mounting bracket secured to a structurally sound surface.
- Never modify the inverter Power Head or Wire-Box enclosure. Doing so will void the warranty

CAUTION

Improper Installation may result in Property Damage or Personal Injury

- Never install the inverter directly to drywall unless attached to a structural member.
- Installing the inverter without the mounting bracket may result in property damage or personal injury.

The Mounting Bracket has six (6) holes, shown in Figure 3-5 to allow the mounting bracket to be secured to the substrate. Use (6) screw fasteners (not included), torque to the proper specifications. Bracket holes are $\Phi 10\text{mm}$.

INFO ✓

Mounting Hardware is Not Included: The SOLECTRIA PVI 25TL-480-R is not supplied with fasteners to attach the Mounting Bracket to the substrate. These must be purchased separately.

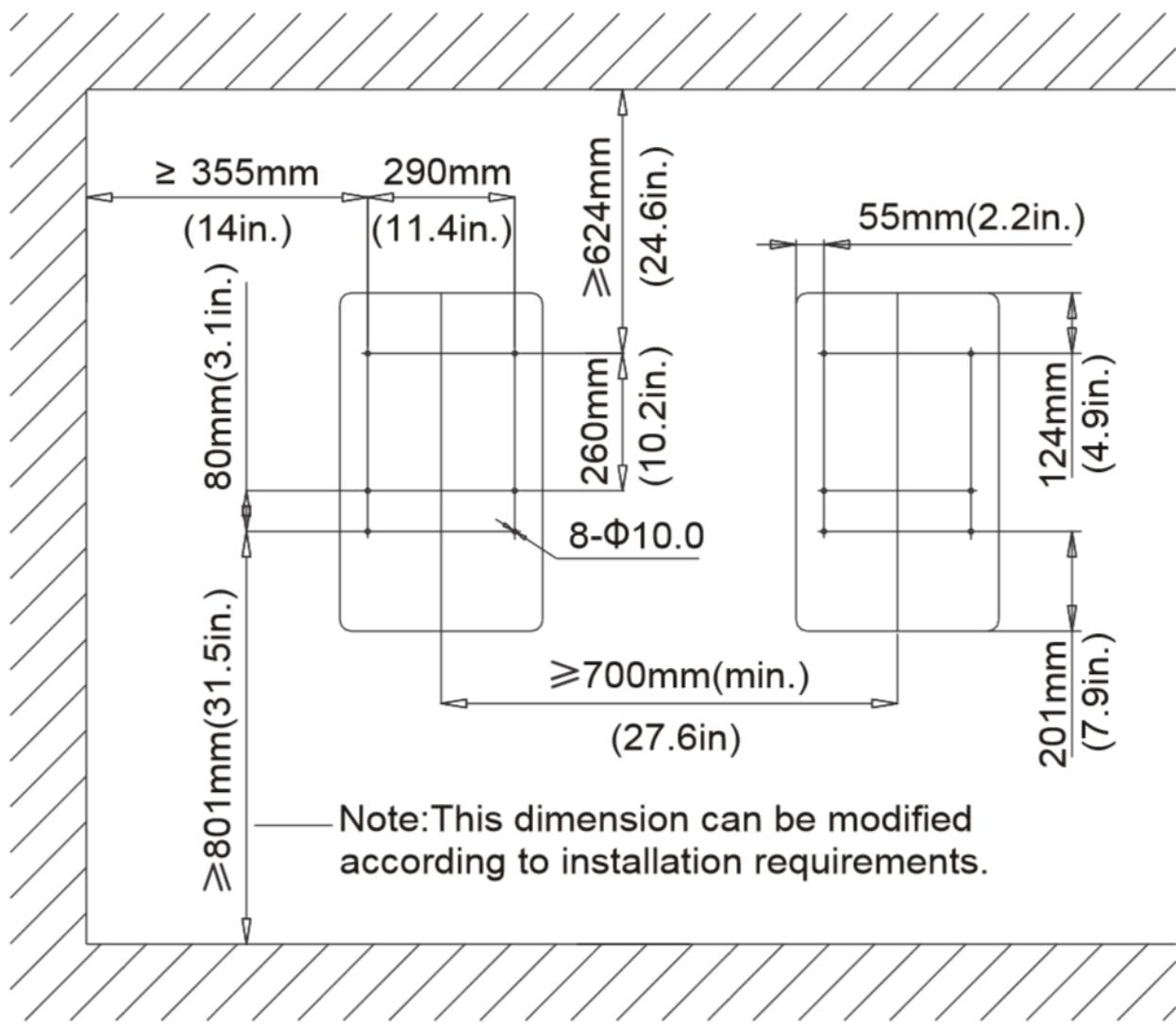


Figure 3-4 Mounting Bracket - Hole Locations

3.2.6 Mechanical Installation, Method

Table 3-1 Tools Required

TOOL	DESCRIPTION
NO. 2 PHILLIPS HEAD SCREWDRIVER	Torque value of 1.6 Nm (14.2 in-lbs)
NO. 10 WRENCH	Torque value of 4 Nm (35.4 in-lbs)
NO. 3 PHILLIPS HEAD SCREWDRIVER	Torque value of 4 Nm (35.4 in-lbs)

3.2.6.1 Assemble and Install Mounting Bracket

The Mounting Bracket is shown in Figure 3-5.

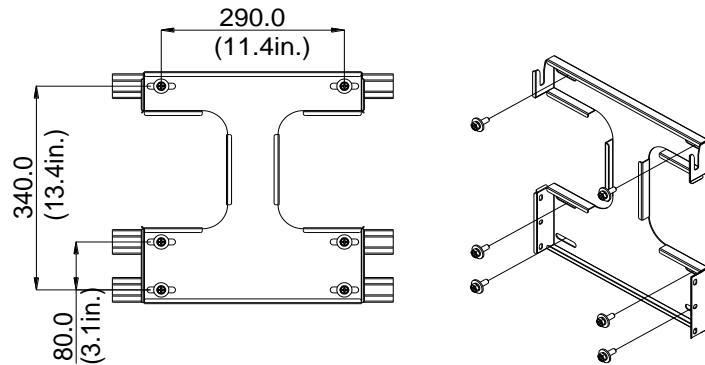


Figure 3-5 Mounting Bracket

3.2.6.2 Install the Power Head

! CAUTION

Lifting Heavy Object Hazard: Proper lifting technique must be used in order to avoid injuries. The Power Head of the Solectria PVI 25TL-480-R weighs 48.5 lbs (22kg).

Hang the inverter on the mounting bracket as shown in Figure 3-6.

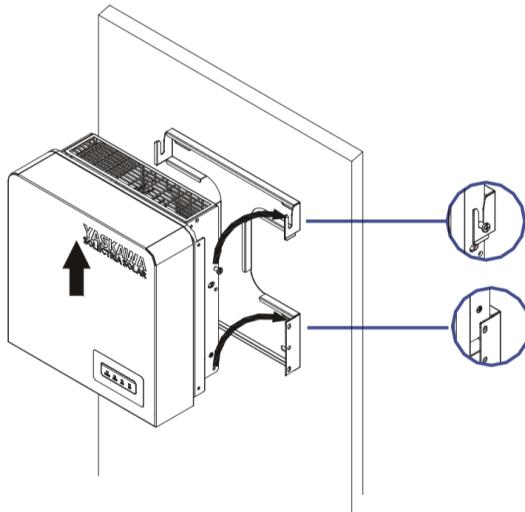


Figure 3-6 Mount the Power Head to the Bracket

3.2.6.3 Install the Wire-Box

NOTICE!

It is not advisable to leave the Wire-Box Installed without the Power Head:

If it is absolutely necessary to have the Wire-Box installed without the Power Head, keep the bulkhead connector cover on or reinstall the bulkhead connector cover.

Remove screws securing the bulkhead connector cover at the top of the wire-box.

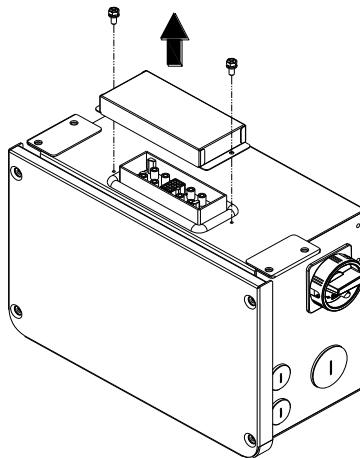


Figure 3-7 Removal of Bulkhead Connector Cover

Save the bulkhead connector cover and screws and attach the cover to the left side of the wire-box after the wire-box is attached to the inverter enclosure. Covers may be required in the future if an inverter or wire-box is to be removed during servicing.

Tool required: No.2 Phillips head screwdriver

3.2.6.4 Secure the Power Head to the Wire-Box

Secure the wire-box to the main enclosure by using the M6x18 screws (4pcs) to fasten the wire-box.

Tool required: No. 10 Wrench or No. 3 Phillips head screwdriver, torque value of 4 Nm (35.4in-lbs) not sure which tool.

! WARNING

Incorrect Torque Leads to Improper Bonding: Ensure the M6x18 screws (4 pcs) for Section 3.2.6.4 are properly torqued and 4 Nm (35.4 in-lbs). This connection provides an electrical grounding bond of the Wire-Box to the upper/main enclosures.

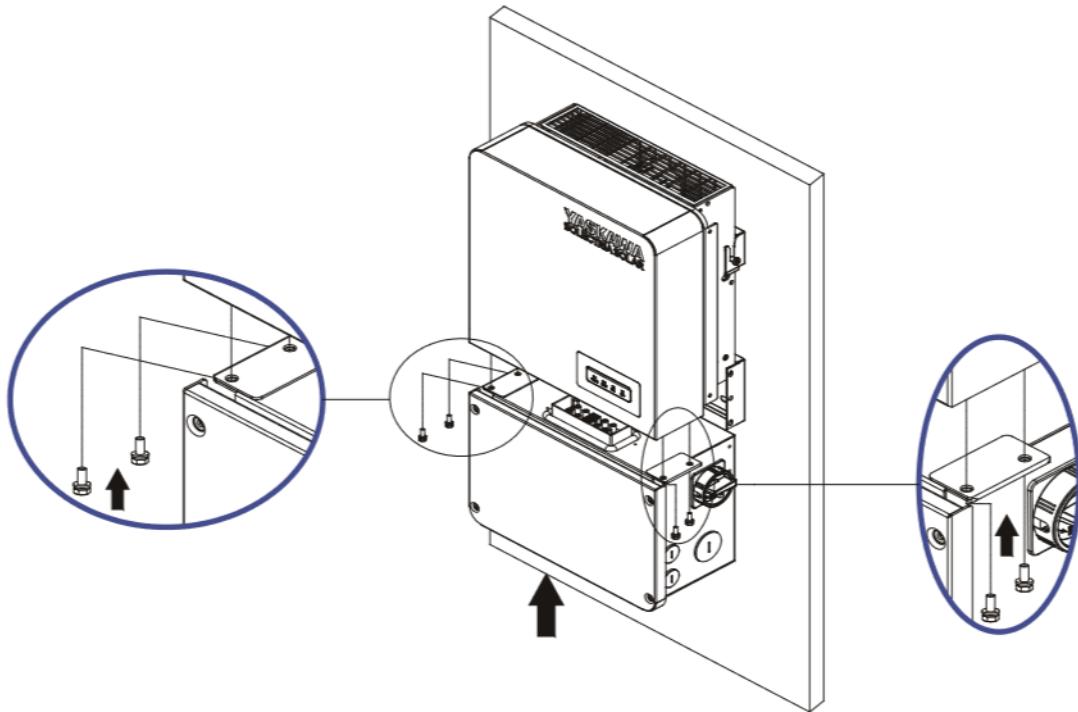


Figure 3-8 Securing Wire-Box to Power Head

3.2.6.5 Attach Enclosures to Mounting Bracket

Attach the main enclosure and the Wire-Box to the mounting bracket with **M6x18 screws** (6 pcs) as shown in Figure 3-8.

Tool required: No.3 Phillips head screwdriver, torque value of 4N.m (35.4in-lbs)

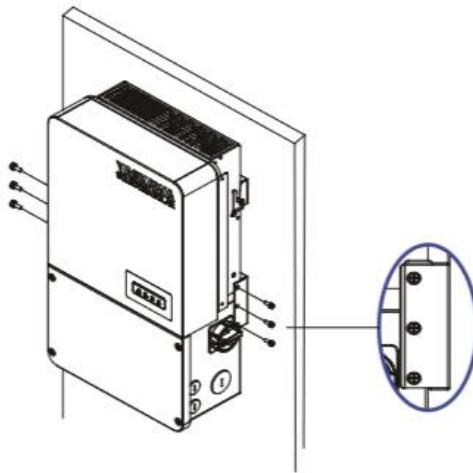


Figure 3-9 Secure the Power Head and Wire-Box to the Bracket

3.2.6.6 Storage of Bulkhead Cover

Attach the bulkhead cover shown in Figure 3-7 to the left side of the wire-box as shown in Figure 3-10 for future use.

Tool required: No.2 Phillips head screwdriver, torque value of 1.6N.m (14.2in-lbs)

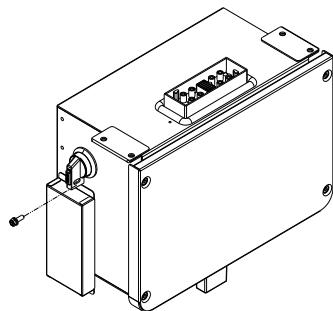


Figure 3-10 Attach Bulkhead Cover to Wire-Box

3.2.6.7 Anti-Theft Padlock (Optional)

The Yaskawa Solectria Solar PVI 25TL-480-R inverter provides the option to install an anti-theft padlock (not included) when the installation is complete. The anti-theft padlock is used to prevent the inverter from being stolen when the equipment is installed outdoors. The inverter may be locked to the bracket, as shown in Figure 3-11.

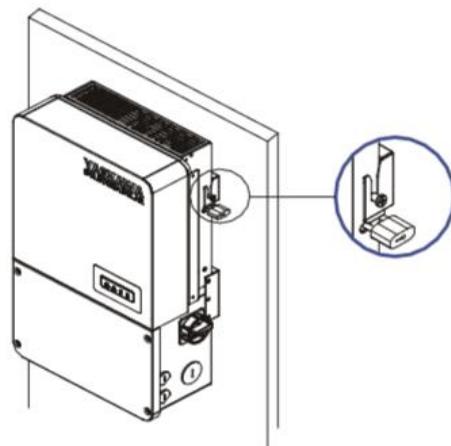


Figure 3-11 Location of Anti-Theft Padlock Hole

The anti-theft padlock shackle should meet the requirements of the dimensions shown in Figure 3-12.

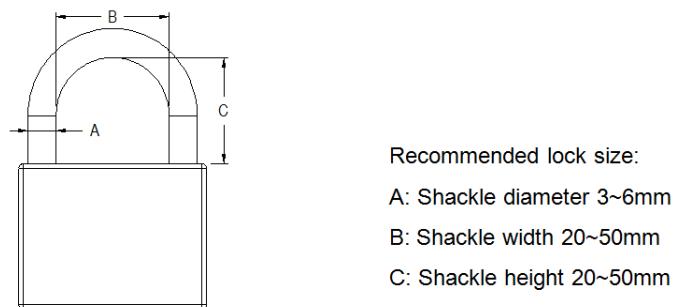


Figure 3-12 Acceptable Dimensions for Anti-Theft Padlock

3.3 Wire-Box

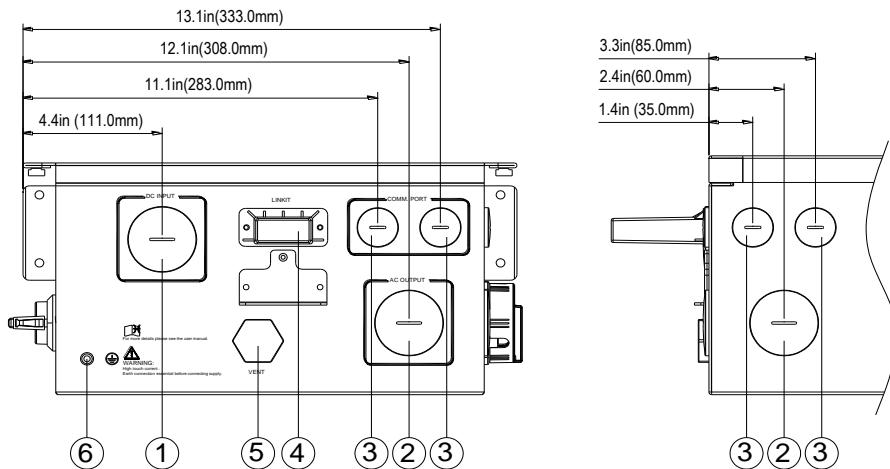


Figure 3-13 Conduit Knock-out Locations on the Wire-Box

- ① Knock-outs for DC input, (1) 1-1/2 inch Trade Size

- ② Knock-outs for AC output, (2) 1-1/2 inch Trade Size
- ③ Knock-out for communication, (4) 3/4 inch Trade Size
- ④ FOMlink Dongle port
- ⑤ Vent
- ⑥ External ground connection point (M6)

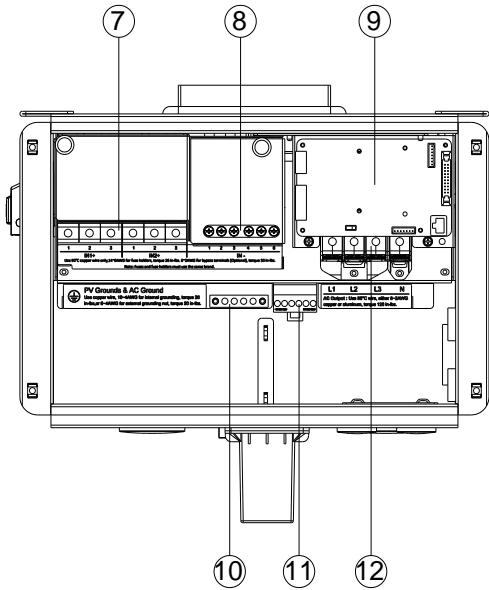


Figure 3-14 Internal Connection Points within the Wire-Box

- ⑦ DC Input fuse holder/terminal (positive)
- ⑧ DC Input terminal (negative)
- ⑨ Communication board
- ⑩ Internal ground terminal
- ⑪ RSD transmitter
- ⑫ AC output terminal block

3.4 Electrical Installation DC

The SOLECTRIA PVI 25TL-408-R provides design flexibility for the installer and designer. The inverter supports a DC/AC ratio of 1.5 and the Wire Box provides two MPPT zones with three inputs each. The following section provides important information regarding the DC input specifications, wiring requirements, and installation instructions.

3.4.1 MPPT Zones

The SOLECTRIA PVI 25TL inverters are factory configured with two MPPTs which are electrically divided into separate PV input zones: PV Input-1 (PV_In1) and PV Input-2 (PV_In2). Each 3-string PV input zone operates as a separate and independent Maximum Power Point Tracker (MPPT). Independent MPPTs can be very useful for sites with partial shading of the array or with arrays consisting of different tilt or azimuth.

NOTICE!

DC Overload: Exceeding the recommended DC to AC ratio may damage the inverter and will void the warranty. Size strings according to information in this section and all applicable electrical codes.

DC/AC Ratio and Current Limits: Both DC to AC ratio and I_{sc} limits must be observed. Failure to meet these requirements may result in damage and will void the warranty.

NOTICE!

High Irradiance Installations: In applications that may experience higher than 1000 W/m² on a regular basis, it is recommended to design a DC-to-AC ratio below the limit of 1.5.

3.4.2 String Mismatch

To ensure optimal performance, the number of PV modules per source circuit should be identical within a given MPPT zone. However, PV input power may be unbalanced between the two MPPT zones. See Figure 3-15 for string/zone combinations.

- DESIGN TIP #1: The max input power per MPPT zone is 22kW. The total inverter max PV power is 37.5kW.
- DESIGN TIP #2: When designing the PV system, ensure each PV source circuit within a single PV input zone includes the same module type (manufacturer and rating), series module count, and module orientation (tilt and azimuth) to maximize MPPT performance and energy harvest.
- DESIGN TIP #3: The difference in the number of source circuits for each MPPT should not exceed one (i.e. PV_In1:PV_In2 = 3:2). Uneven distribution of strings among the two MPPTs (e.g. PV_In1:PV_In2 = 3:1) is not recommended and may result in unnecessary power clipping.

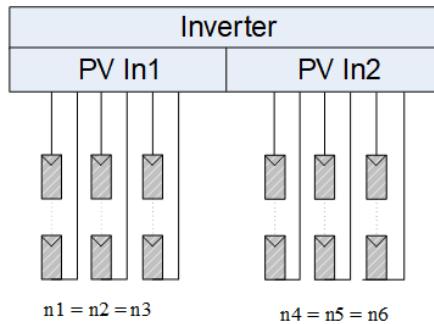


Figure 3-15 Independent MPPT Zones Only



WARNING

Unequal String Lengths and Module Mismatch: Opening fuses under load can cause a hazardous condition. It is strongly recommended to avoid unequal string lengths within a zone and module mismatch.

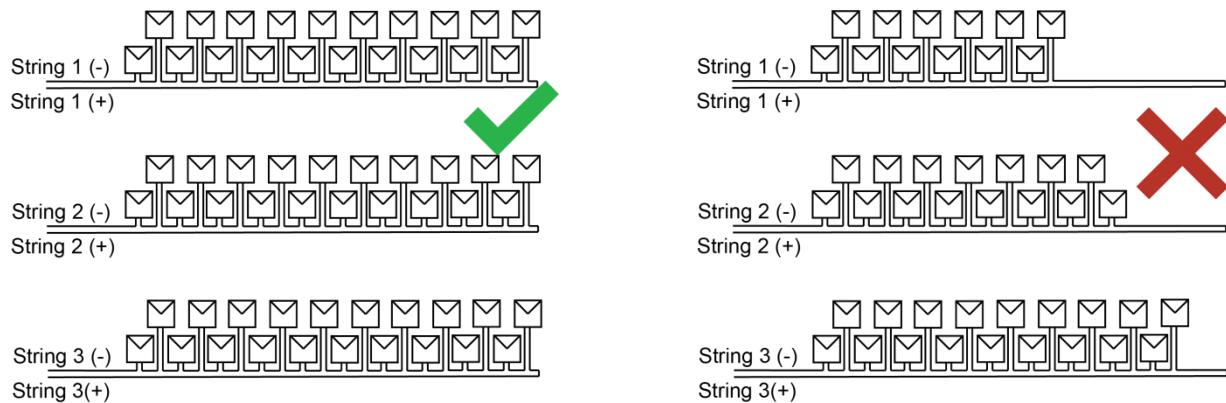


Figure 3-16 Matched (Left) and Mismatched (Right) String Sizes within a Zone or Inverter

3.4.3 DC Connection Specifications

The voltage rating of the DC conductors must meet or exceed 1000VDC and be rated at no less than 90°C (194°F). All electrical conductors must meet the requirements of the NEC and local electrical codes. Although these inverters operate with ungrounded PV arrays, the PV system requires a DC equipment grounding conductor (EGC) to ensure operational safety. The grounding busbars are electrically bonded by way of the inverter chassis.

Table 3-2 DC Conductor and Torque Specifications

WIRE MATERIAL DC INPUT (+/-) CONDUCTORS	ACCEPTABLE CONDUCTOR SIZES	TORQUE VALUE
Copper	14 to 8 AWG	3.0 N·m (26.55 in-lbs)

Table 3-3 DC Input Specifications

DC INPUT	PVI 25TL-480-R
MAXIMUM POWER INPUT VOLTAGE RANGE	560-850 VDC
OPERATING VOLTAGE RANGE (MPPT)	200-950 VDC
START-UP VOLTAGE / POWER	330 V / 80 W
MAXIMUM OPERATING INPUT CURRENT	23.3 A per zone
MAXIMUM OPERATING PV POWER (PER MPPT ZONE)	13 kW
MAXIMUM RATED PV INPUT	22 kW per zone (37.5 kW total)
ABSOLUTE MAXIMUM INPUT VOLTAGE	1000 VDC
NUMBER OF MPP TRACKING ZONES	2
NUMBER OF PV SOURCE CIRCUITS (FUSED INPUTS)	3 per MPPT zone; 6 total
MAXIMUM PV CURRENT (ISC X 1.25) PER ZONE / TOTAL	45 A / 90 A
MAXIMUM RECOMMENDED DC-TO-AC RATIO	1.5

3.4.4 PV Fuses

The SOLECTRIA PVI 25TL-480-R is shipped with factory installed touch-safe fuse holders and 20 A fuses on the positive conductors only. Ensure that the appropriate fuse values are used for the conductors in the PV source circuit, and in accord with NEC 690.9. Yaskawa Solectria does not supply fuses. Use either the 1000VDC Sinofuse RS308 PV fuse series or the Mersen HP10M PV fuse series as replacement fuses if necessary. It is recommended to use the same brand fuse as the fuse holder when possible. The temperature rating of the fuse holder is 90°C.

INFO ✓

Due to improved ground-fault protection requirements in PV systems, the 2017 version of the NEC allows for a single overcurrent protection device in either the positive or negative polarity. If local codes or jurisdictions require fuse protection for each DC input conductor (i.e. NEC 2014 or earlier), additional fusing shall be installed for the conductors connected to the negative (-) DC input terminal of the Solectria PVI 25TL-480-R inverters. The voltage rating of the fuse must be at least 1000V_{DC}. In-line fuses can be used for this purpose. Any additional fusing must be installed outside of the inverter.

The fuse ampere rating is generally selected as $1.56 \times \text{module } I_{sc}$ of the PV string. Refer to NEC 690.8 for Circuit Sizing and Current requirements.

3.4.5 DC Conductor Connection

To ensure the optimum performance of the inverter, please read the following guidelines before performing any DC connections.

- Confirm the maximum open circuit voltage of the PV modules is lower than 1000V_{DC} under any conditions.
- Confirm that the PV modules for each MPPT within the inverter are of the same type and specification before connection.
- Ensure correct polarity of the PV Strings before terminating the DC source circuits. Referring to Figure 3-18, the wiring from the PV string pairs must be checked according to the following steps:
 - Use a multi-meter to measure the PV strings' conductor ends and check the polarity.
 - The positive (+) terminal of the conductor should match the positive (+) terminal of inverter's DC input.
 - The negative (-) terminal of the conductor should match the negative (-) terminal of inverter's DC input.

NOTICE!

DC Polarity Check: It is important to use a multi-meter to check the polarity of the DC source conductors to avoid any risk of reverse polarity.

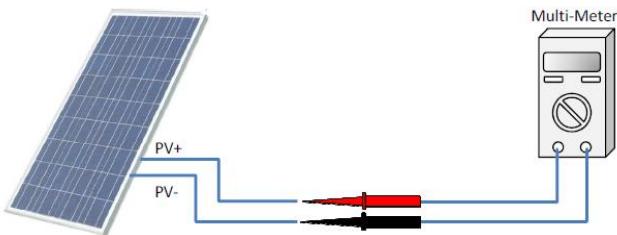


Figure 3-17 Polarity Check

INFO ✓

Wire Ferrules: 10 AWG wire ferrules are intended to preclude the onset of stray/loose wire strands or “bird caging” of the conductor during installation and improve the integrity of the termination. The use of the wire ferrules is not mandatory and shall not void the product warranty if not used.

(The ferrules are not provided by Yaskawa Solectria Solar.)

3.4.6 Electrical Installation DC, Method

DANGER

Electric Shock Hazard: Components with hazardous voltage and energy will electrocute operator. Operator shall avoid touching live components with hazardous voltage and energy. Verify the absence of voltage using an appropriately rated multimeter.

Always Wear Proper PPE: The proper Personal Protective Equipment (PPE) must be worn while working in close proximity of hazardous voltage and energy.

Conduit Installation: All conduit connections must be made in such a way as to maintain the NEMA rate of the enclosure. Failure to maintain the NEMA rating will void the warranty.

WARNING

Turn AC Switch to OFF: Verify the absence of AC voltage prior to terminating any conductors.

Turn the external AC breaker OFF: Verify the absence of AC voltage prior to terminating any conductors.

Open Fuse Holders: Verify the absence of DC voltage and current.

NOTICE!

Check Polarity of DC Inputs: DC inputs with the wrong polarity may cause damage to the inverter. Check for proper polarity with a multimeter.

Use Correct Fuses: Make sure to size the fuses according to NEC requirements.

3.4.6.1 Remove Wire-Box Cover

Prior to installation, confirm the Wire-Box to be used is the Wire-Box as shown in Figure 3-18 below.

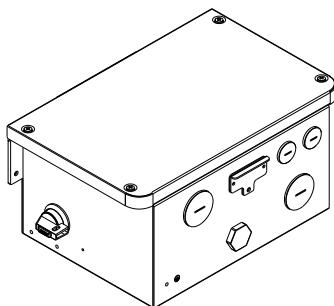


Figure 3-18 PVI 25TL-480-R Wire-Box

Use a No. 3 Phillips-head screwdriver to remove the four (4) screws from the cover of the Wire Box as shown in Figure 3-19.

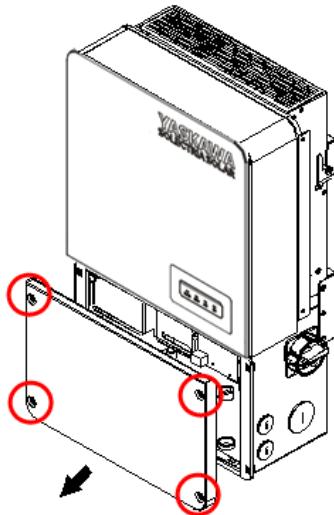


Figure 3-19 Remove Wire-Box Cover

To reinstall the cover, replace cover and align the screws. Use a No. 3 Philips head screwdriver to secure the 4 screws on the cover. Torque to 35.4 in-lbs (4 N.m.)

INFO ✓

Use Hand Tools: It is important to use hand tools (i.e. Screwdriver or T-handle, #3 Phillips) and not power drivers or other types of screw drivers. During cover installation, it is recommended to hold the cover in alignment with balanced force. Partially engage the screws into the threaded inserts before tightening. Maintain alignment to avoid

thread damage, and after screws are fully engaged torque to 35.4 in-lbs (4N.m).

3.4.6.2 1-1/2 inch knockouts

Remove the factory installed liquid-tight hole plugs from the DC knockout holes in the Wire-Box and install 1-1/2 inch Trade Size conduit and conduit fittings. If the use of smaller conduit is desired, use proper weather-tight reducing bushings to ensure the Wire-Box maintains its NEMA 4X rating. Confirm all fittings are properly tightened and route the DC source circuit conductors through the conduit into the Wire-Box.

Table 3-4 DC Electrical Installation DC, Tools Required

TOOL	DESCRIPTION OF USE
#2 PHILLIPS-HEAD SCREWDRIVER	Fuse holder Terminal
DIAGONAL PLIERS OR CABLE CUTTERS	Cut cable
WIRE STRIPPING PLIERS	Remove conductor insulation
TORQUE DRIVER	Torque terminals to specifications
CRIMPING PLIERS / TOOL	Ferrule crimp (optional)

3.4.6.3 Terminate at fuseholders

The Yaskawa Solectria Solar PVI 25TL-480-R wire-box only contains fuse holders for the positive DC conductors. Follow instructions in Section 3.4.6.4 below for the negative conductors. Strip approximately 1/2 inch of the cable jacket from the end of the source circuit conductor. Insert the conductor into the fuse holder terminal ensuring the stranding of the conductor remains firmly twisted and does not separate. Tighten the screw clamp to the torque specified in Table 3-2. Continue terminating the remaining source circuits in this manner for each MPPT (PV_In1 and PV_In2).

3.4.6.4 Terminate at busbar

The PVI 25TL Wire-Box only contains fuse holders for the positive DC conductors. Follow instructions in Section 3.4.6.3 for the positive conductors. Strip approximately 1/2 inch of the cable jacket from the end of the string conductor. Insert the conductor into the busbar ensuring the stranding of the conductor remains firmly twisted and does not separate. Tighten the screw to the torque specified in Table 3-2. Continue terminating the remaining source circuits in this manner for each MPPT (PV_In1 and PV_In2).

3.5 Electrical Installation AC

The SOLECTRIA PVI 25TL is a 480VAC, 60Hz, 3-phase grid tied inverter. The inverter will not operate when installed to any other grid voltage or frequency. This section includes important information regarding the AC grid connection, wiring requirements, and installation instructions.

INFO ✓

String Sizing Tool: Yaskawa Solectria Solar offers a String Sizing Tool to help customers design their PV string sizing at <https://www.solectria.com/support/string-sizing-tool/>

3.5.1 Transformer Configurations

⚠ CAUTION

Improper Transformer Configuration: Inverter will not run and may have hazardous current. Connect transformer in specified configurations only (see Figure 3-20).

NOTICE!

480 VAC, 60Hz, Grid Grounded Wye ONLY: The inverter is only rated for 480 VAC, 60Hz, 3-Phase grounded Wye. Installing the inverter on any other electrical grid will damage the inverter and void the warranty.

INFO ✓

Grid Mismatch: If the grid does not match the requirements of the inverter, the inverter will not start.

Check with your local electric utility before selecting a grid profile. The system must comply with National Electrical Code ANSI/NFPA 70 and with all local rules and safety regulations before the inverter can be operated.

The inverter must be connected to a 480VAC, 60Hz, grounded Wye configured transformer/electrical grid. If the installation location does not meet these requirements, an isolation transformer may be used.

The inverter side of the transformer must have a grounded Wye configuration. See Figure 3-20 for approved transformer configurations; no other configurations are permitted. Figure 3-21 shows examples of transformers that are not acceptable.

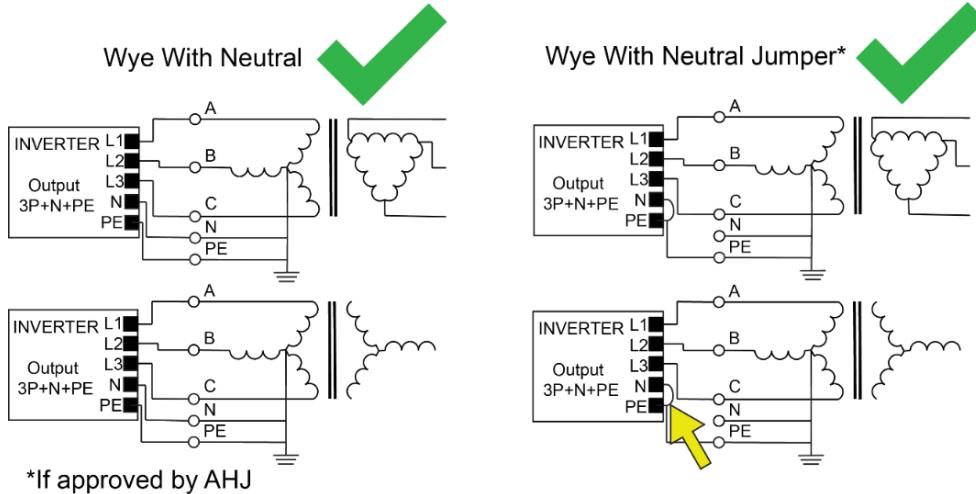


Figure 3-20 Permitted Transformer Configurations

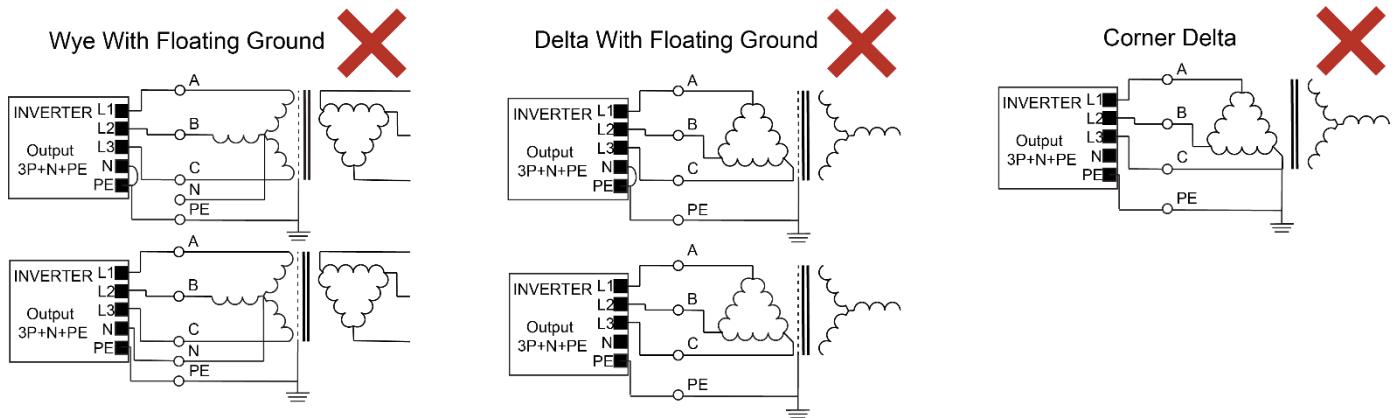


Figure 3-21 Transformer Configurations NOT Permitted

- Transformer short-circuit impedance ($Z\%$) should be less than 6%.
- Transformer VA rating must be at least 100% of the sum of the connected inverter VA ratings.
- It is recommended that the transformer VA rating be selected based on IEEE C57.159-2016 *Guide on Transformers for application in Distributed Photovoltaic (DPV) Power Generation Systems*. It is the responsibility of the system designer to determine and take in account the reliability of the transformer or other system parameters.
- The transformer does not require a static shield.
- The maximum number of inverters connected to a single transformer is 70.

A complete guide to transformer requirements can be found in the [Application Note: Interconnection Guidelines for Yaskawa Solectria Solar Transformerless Inverters](#).

3.5.2 Neutral Requirements

The neutral conductor from the inverter to the point of interconnection is optional. It is used by the inverter for voltage sensing only and does not carry current. Therefore, the neutral conductor size may be reduced to a size no smaller than the EGC.

Depending on the authority having jurisdiction (AHJ), it is permissible to install the provided neutral-to-ground jumper. In this configuration, no neutral conductor is required. If terminated properly, this connection will not affect the function of the inverter. Always check with the AHJ before removing the neutral conductor and installing the neutral to ground jumper.

NOTICE!

Neutral to Ground Jumper: Do not use a jumper between neutral and ground if the neutral conductor is connected. Using a jumper with the neutral conductor connected may result in damage and void the warranty.

3.5.3 AC Conductor Specifications

Yaskawa Solectria requires the use of conductors rated at a minimum of 90°C.

With longer wire runs, the use of larger conductors than those required by the NEC can help reduce voltage drop and increase overall system efficiency. The recommended maximum voltage drop from the Inverter to the Point of Common Coupling (the grid) is 2% at full load and including conductor temperature considerations. Voltage drop greater than 2% may require changing the transformer tap or, as a last resort, adjusting the GridMaxVolt trip point settings.

The AC connections consist of 3 phases (L1, L2, and L3), ground, and neutral. Conductors must be rated for a minimum of 600 V. Use conductors in accordance with Table 3-5.

Table 3-5 AC Connection Specifications

	WIRE MATERIAL	ACCEPTABLE CONDUCTOR SIZES	REQUIRED TORQUE
AC OUTPUT (L1, L2, L3) CONDUCTORS	Copper Aluminum	8 to 2 AWG (90°C) 6 to 2 AWG (90°C)	14 N-m (120 in-lbs) 14 N-m (120 in-lbs)
NEUTRAL	Copper/Aluminum	According to NEC 705.95(B)	
EQUIPMENT GROUNDING CONDUCTOR (EGC)	Copper	6 to 4 AWG	5.6 N-m (50 in-lbs)

3.5.3.1 AC Breaker Specifications

The SOLECTRIA PVI 25TL series inverter requires a 100 A, 3-pole AC breaker, see Table 3-6.

Table 3-6 AC Breaker Specifications

AC BREAKER SIZE	MIN AC OCPD	MAX AC OCPD
	39 A (3 pole)	50 A (3 pole)

3.5.4 Use of Aluminum Conductors

The AC terminals in the SOLECTRIA PVI 25TL-480-R are dual rated by UL for use with copper and aluminum conductors. When using aluminum conductors it is important to prepare the conductors properly to prevent oxidation and overheating. Follow the steps below to prepare and terminate the conductors.

- Strip insulation from the aluminum conductor.
- Remove the oxidation from the connection area of the aluminum conductor using a wire brush or other abrasive means.
- Immediately apply a UL listed oxide-inhibiting compound.
- Terminate the conductor on the appropriate terminal and torque to the proper value as per Table 3-5.

NOTICE!

Use of Aluminum Conductors: Special care must be taken when using aluminum conductors. Failure to properly prepare and maintain aluminum conductors can result in overheating and property damage. Damage caused by improper use of aluminum conductors will void the warranty.

3.5.5 Electrical Installation AC, Method

DANGER

Electric Shock Hazard: Components with hazardous voltage and energy will electrocute operator. Operator shall avoid touching live components with hazardous voltage and energy. Verify the absence of voltage using an appropriately rated multimeter.

Always Wear Proper PPE: The proper Personal Protective Equipment (PPE) must be worn while working in proximity to hazardous voltage and energy.

Conduit Installation: All conduit connections must be made in such a way as to maintain the NEMA 4X rating of the enclosure. Failure to maintain the NEMA rating will void the warranty.

Table 3-7 Electrical Installation AC, Tools Required

TOOL	DESCRIPTION OF USE
#2 FLATHEAD SCREWDRIVER	Internal grounding bar
#3 PHILLIPS-HEAD SCREWDRIVER	External grounding
5MM SOCKET HEAD WRENCH	AC terminal block
DIAGONAL PLIERS OR CABLE CUTTERS	Cut cable
WIRE STRIPPING PLIERS	Remove conductor insulation
CRIMPING PLIERS / TOOL	Crimp terminals

WARNING

Turn AC Switch to OFF: Verify the absence of AC voltage prior to landing any conductors.

Turn the external AC breaker OFF: Verify the absence of AC voltage prior to terminating any conductors.

3.5.5.1 Use the 1-1/2 inch knockouts

Remove the liquid-tight hole plug from the right side or bottom of the AC input portion of the wire-box to install 1-1/2 inch Trade Size conduit and conduit fittings. Then route the cables through the conduit and into the wire-box.

NOTICE!

Grounding Conductors: Terminate the grounding conductors prior to terminating the AC cables.

3.5.5.2 Grounding and Bonding

The inverter provides one (1) grounding connection on the AC side and one (1) bonding location. These configurations are illustrated in Figure 3-22.

- Grounding via the ground busbar (left) [1]. This is required for grounding the equipment by running the EGC with the ungrounded conductors.
- Bonding via the external grounding point (right) [2]. The external bonding connection is provided in case the inverter/mount needs to be bonded to a metallic structure on which it may be mounted.

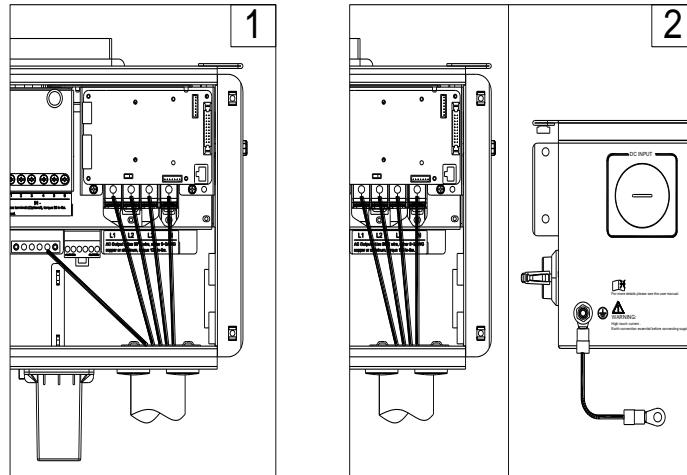


Figure 3-22 AC Output and Ground Cable Connection

NOTICE!

Neutral to Ground Jumper: Do not use a jumper between ground and Neutral if the Neutral conductor is connected. Using a jumper with the Neutral conductor connected may result in damage and will void the warranty.

Connect the AC conductors to the AC terminal block and connect the PE (GND) cable to the grounding terminal block. The neutral conductor is optional. When terminating the ground at the busbar a ferrule is recommended but not required. Set up the conductors referring to Figure 3-23 and Figure 3-24.

When the diameter of copper wire $> \varphi 0.64\text{mm}$, it can be connected directly

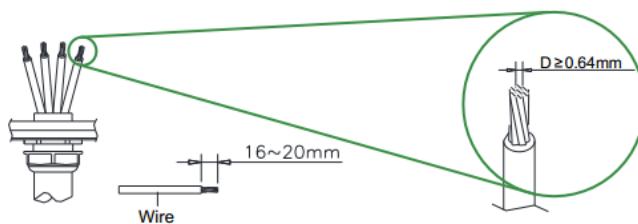


Figure 3-23 Grounding Conductors that can be Directly Connected

When the diameter of copper wire $\leq \varphi 0.64\text{mm}$, must use casing like E25-18 to compact the wires

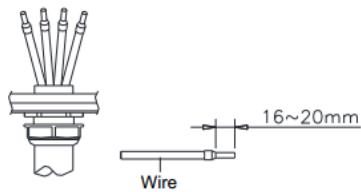


Figure 3-24 Grounding Conductors that need Wire Ferrules

When bonding the inverter/mount to a metallic structure is required, use the OT type terminal to connect the ground conductor to the external bonding point at the bottom of the wire-box. The bonding point is located at the bottom of the Wire-Box as shown in Figure 3-25.

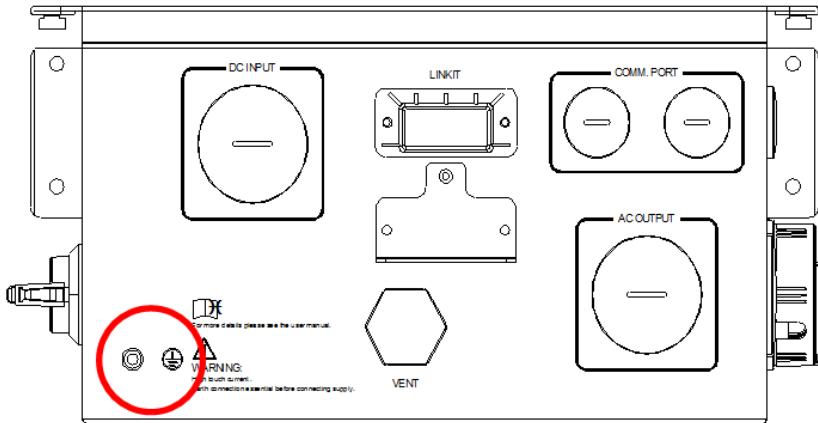


Figure 3-25 Bottom of Wire-Box: External Grounding Point Location

NOTICE!

Order of Connection Conductors: Always connect the Equipment Grounding Conductor (EGC) before terminating any of the AC conductors.

When the output of the inverter is connected to the grid, an external AC circuit breaker is required to be installed to safely disconnect the inverter from the grid should an overcurrent event occur.

The Grid connection type must be a 4-wire Wye, grounded neutral, and the inverter may connect to the grid via 3 or 4-wires. The neutral conductor from the inverter to the point of interconnection (POI) is optional.

An AC circuit breaker (OCPD) may be selected as per the NEC and Table 3-6. Selecting a breaker of another size may either result in nuisance tripping or rejection from the AHJ.

3.6 Communication Installation

The SOLECTRIA PVI 25TL-480-R inverters support industry standard Modbus RS-485 communications. Its interface can be accessed over Wi-Fi using a smart device.

The SOLECTRIA PVI 25TL-480-R is compatible with the Solectria's web-based monitoring platform (SolrenView) through the optional Ethernet Network Card. The Ethernet Network Card also allows for data to be sent to an online portal that is used for remote diagnostics and automatic firmware upgrades. Third party monitoring platforms are supported via RS-485 shielded, twisted-pair connection.

This section includes important information regarding communication design requirements, wiring requirements, and installation instructions.

3.6.1 Communication Board

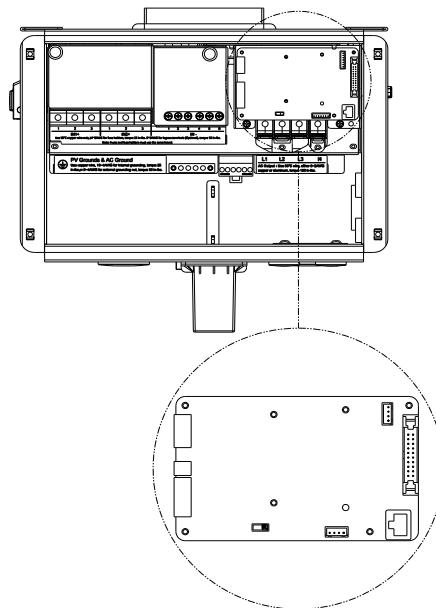


Figure 3-26 Communication Board in the Wire-Box

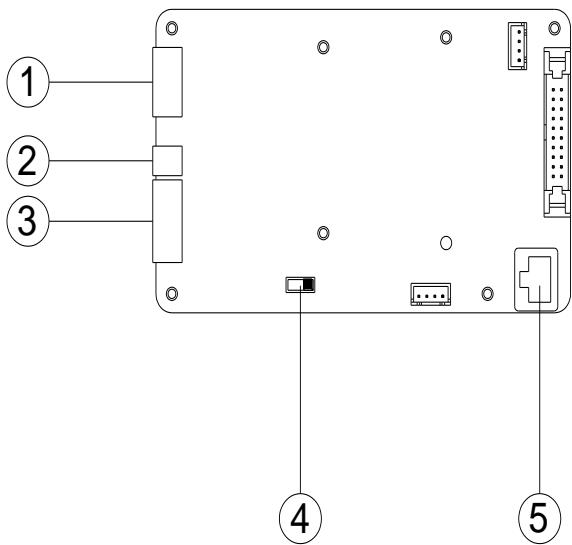


Figure 3-27 Communication Board Connections

- ① RS485 (Reserved)
- ② Power port (2pin connector)
 - 1. GND
 - 2. +12V
- ③ RS485 port (6pin connector)
 - 1. 485_A
 - 2. 485_B
 - 3. 485_GND
 - 4. 485_A
 - 5. 485_B
 - 6. 485_GND
- ④ Selector Switch (S201): 120Ω terminal resistor switch for communications.
 - 1. ON: Enable the termination resistance
 - 2. OFF: Disable termination resistance
- ⑤ RJ45(Reserved)

3.6.2 Ethernet Network Card

A maximum of 32 devices can be connected to this card. When provided with an internet connection, it can send data to an online portal that Yaskawa Solectria Solar can use for troubleshooting and remote diagnostic purposes. As well, customers can opt to purchase access to this portal for easy O&M of their system. It is also used for allowing the connection of a third-party monitoring system. Customers are strongly encouraged to provide internet to the Ethernet Network Card in order for it to be used for remote diagnostic purposes. Once connected, Yaskawa Solectria Solar can remotely check inverter parameters (currents, voltages, parameter settings, etc.) and alarm messages. Yaskawa Solectria Solar can also use this device to remotely update firmware on all the inverters connected to it.

3.6.3 Connection to the Internet

Connection to the Internet is strongly recommended for SOLECTRIA PVI 25TL-480-R inverters. An internet connection will provide the user with several important features including:

- ✓ Automatic firmware updates.
- ✓ Remote diagnostics & troubleshooting.
- ✓ Access for Yaskawa Solectria Solar Technical Support & Service.
- ✓ Remote monitoring via SolrenView (optional).

DANGER

Electric Shock Hazard: Disconnect the inverter from the AC grid and PV modules before removing covers or opening the equipment. Wait at least 5 minutes after disconnecting from the DC and AC sources before servicing or maintaining the inverter. Ensure hazardous high voltage and energy inside the inverter has been discharged prior to servicing.

3.6.4 Communication Conductors

Yaskawa Solectria Solar recommends the following shielded, twisted-pair cables for RS485 communications:

- ✓ Belden 9841, Belden 3106A or Southwire 58164802

It is recommended that industrial-grade shielded RS-485 cable be used in lieu of unshielded twisted pair. RS-485 communication cables are connected via the 6-pin connector to the port labeled (2) in Figure 3-27. When creating a network of multiple inverters, the cables are terminated to the same 6-pin connector and 6-pin connector. Figure 3-28 shows a single inverter communication connection in (1) and a network configuration in (2).

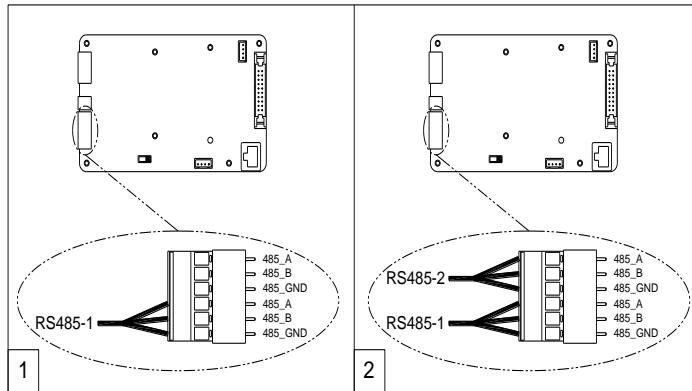


Figure 3-28 Connection of Single (1) and Multiple Inverters (2)

INFO ✓

Shielded Cable: Solar PV inverters create an electrically noisy environment that can disrupt inverter communication. It is important to use shielded cable to ensure communication is not interrupted.

Separate Communication Conductors from Power Conductors: Never run communication conductors in the same conduit as power conductors. It is important to keep communication conductors away from power conductors to reduce noise. If power conductors must intersect with communication conductors, it is preferable to have the intersection at a 90 degree angle.

3.6.5 Monitoring Compatibility

The SOLECTRIA PVI 25TL-480-R is compatible with SolrenView and third-party Data Acquisition Systems (DAS). When using SolrenView monitoring the Ethernet Network Card is necessary. If connecting with third party monitoring providers, RS-485 connections must be used.

3.6.6 Connecting Multiple Inverters

Multiple inverters shall be connected together in a serial (daisy-chain) fashion only. It is also suggested to follow the below requirements:

- The maximum number of inverters in any single daisy chain is 32 inverters.
- Use shielded twisted pair as described in 3.6.4.
- It is recommended to limit the maximum length of the RS-485 daisy chain to a maximum length of 3000 feet (914 m).

When the inverters are monitored via the RS-485 communication, a unique RS-485 address for each inverter can be set up through the APP interface. The daisy-chain topology is recommended for the RS-485 network connection to minimize noise and bus reflections, as shown in Figure 3-29 RS-485 Network Connection. Other communication topologies, such as the star networks, are not recommended.

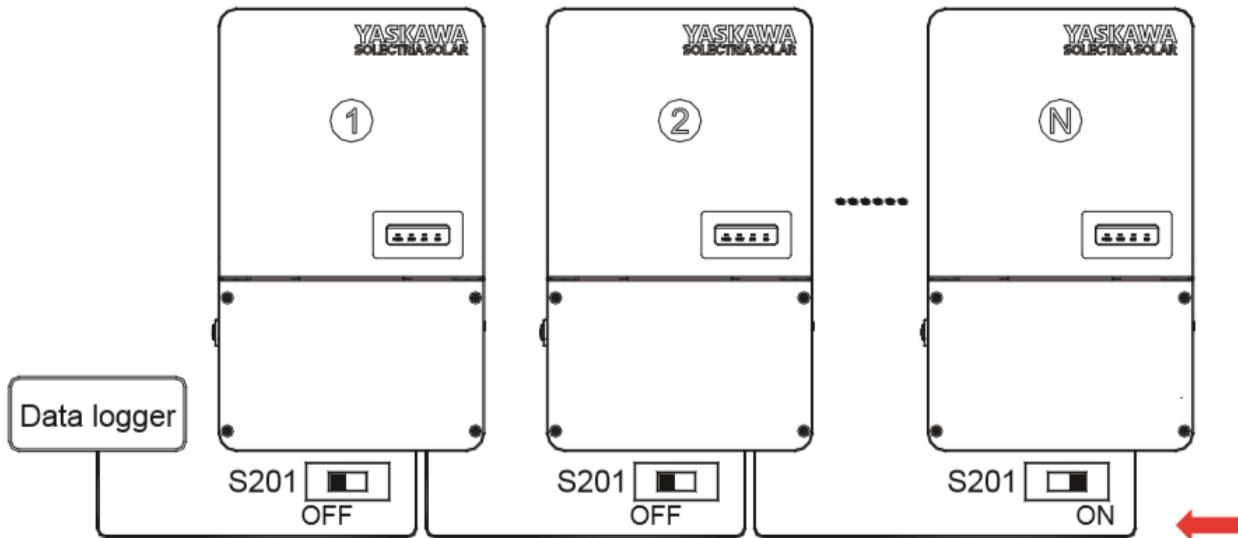


Figure 3-29 RS-485 Network Connection

If there are multiple inverters in the RS-485 network, the selector switch S201 of the last inverter in the daisy-chain should be in ON position, to have the 120Ω terminal resistor enabled. The selector switch S201 of all other inverters should be in the OFF position to disable the terminal resistor.

3.6.7 Third-Party Data Acquisition System (DAS) Connection

NOTICE!

Ethernet Only Connection: The PVI 25TL-480-R inverter only supports RS485 connections to a 3rd party DAS.

The PVI 25TL-480-R inverters can be connected to an external Data Acquisition System (DAS) via an RS-485 shielded twisted pair serial connection as shown in Figure 3-31. These inverters can communicate with an external monitoring system via the standard Modbus RTU protocol.

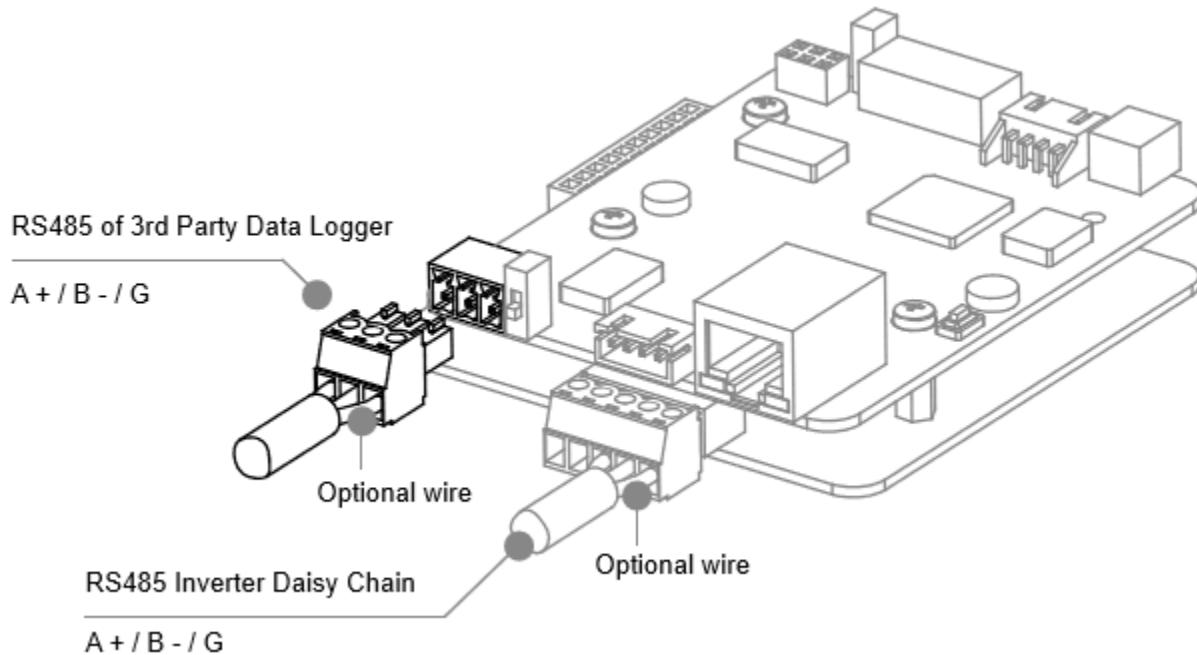


Figure 3-30 Third-Party Data Logger Connection Point on the Ethernet Network Card

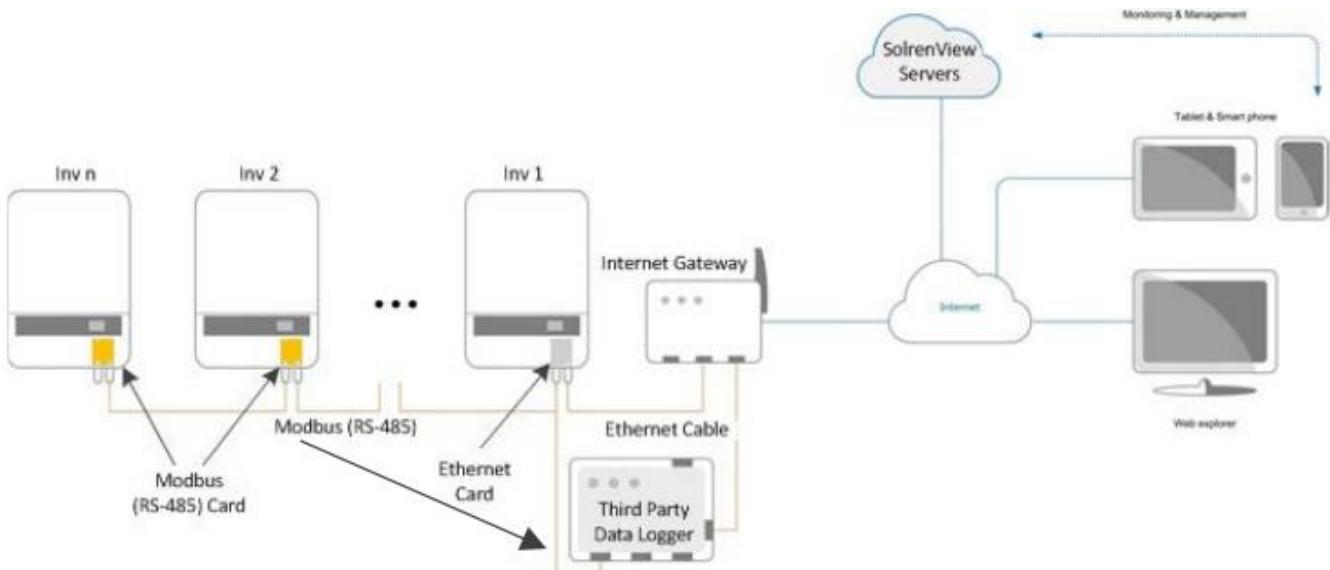


Figure 3-31 PVI 25TL-480-R Inverters in a RS-485 Daisy Chain to Third-Party DAS

- When connected to an external DAS, Yaskawa Solectria Solar PVI 25TL-480-R inverters support up to 32 inverters/devices on the RS-485 daisy chain. The Inverter Modbus IDs are configurable from 1 to 128.
- Yaskawa Solectria Solar recommends limiting the RS-485 daisy chain to a maximum length of 3000 ft. (914m).
- Care must be taken when daisy chaining the inverters, utilizing a shielded twisted pair cable such as Belden 9841 or Southwire 58165802.

- The shield continuity should be maintained for the entire length of the daisy chain and should only be connected to ground (GND) at the DAS. The shield should not be connected to any of the inverters to prevent any possible grounding loops.
- It is important to terminate the Modbus (RS-485) daisy chain correctly to minimize any bus noise and reflections. The daisy chain should be terminated at the source (the DAS) and at the last Modbus device in the daisy chain.
- Non-serial, such as star or ring, network topologies should always be avoided.

3.7 Resealing the Wiring Box

3.7.1 Replace Cover

Put the cover back on the Wire-Box. Use a #3 Phillips-head torque driver to tighten the cover screws to 4 Nm (35.4 in-lbs).

4. Startup

4.1 Startup Checklist



WARNING

Follow the Checklist: For your safety, please follow the guidelines below during the startup of your inverters.

4.1.1 App Download

- Download the “Yaskawa Connect Pro” App in the Apple or Google Play Store. This app provides the human-machine interface (HMI) into the PVI 25TL-480-R inverter and is supported on iOS 9.0+ and Android 4.1+.

4.1.2 Mechanical Installation

- Ensure that the mounting bracket is secure and all the screws have been tightened to the specified torque values. (Please refer to Section 3.2.)
- Confirm all knockouts are sealed and conduits are securely attached to the inverter creating a water-tight seal.
- Confirm that all conduit entries into the inverter have been sealed with duct sealant to prevent condensation from entering into the Wire-Box.

4.1.3 Electrical Connections

- Make sure all conductors are landed on the correct terminals and properly labeled.
- Ensure that no sharp edges from cable ties exist. Appropriate cable management is the key to avoiding physical damage.
- Make sure all connections are tightened to torque specifications as per Section **Error! Reference source not found.** and Section 3.5.
- Make sure the DC Switch on the inverter is in the “OFF” position.
- Make sure the AC Switch on the inverter is in the “OFF” position.

4.1.4 Electrical Check

- Make sure the AC circuit breaker is properly sized.
- Test the AC voltage and confirm that it is within the normal operating range.

- Test the polarity of DC inputs and confirm they are proper.
- Make sure the open circuit voltage of input strings is less than 1000VDC.

4.2 Startup Steps

WARNING

Electrical Shock Hazard

Installer may come into contact with components that have hazardous voltage and energy potential.
Use proper safety equipment when energizing the inverter.

Follow these instructions when turning on an inverter.

- Turn ON the site AC breaker for the inverter.
- Complete the connection of the input PV source circuits (close the fuse holders).
- Turn ON the DC switch on the inverter. When the energy supplied by the PV array is sufficient, the Power LED of the inverter will light up. The inverter will then start up.

4.3 Connection to the Inverter – Wireless Option

Once powered, the inverter will automatically create a wireless network that will be visible as an Access Point from smart devices (tablet, smartphone, etc.).

1. Make sure the FOMlink Dongle Module is plugged into the inverter
2. Open the Yaskawa Connect Pro App

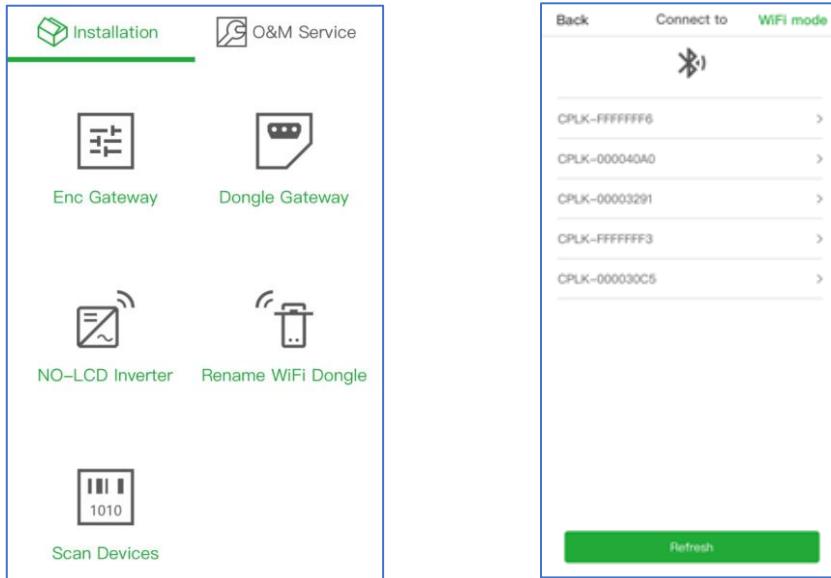
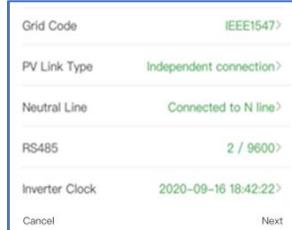


Figure 4-1 Setting up Wi-Fi Link

3. Click on the “No-LCD Inverter” Option and select “Bluetooth connection”.
 - a. In the case where your smart device’s Bluetooth is not compatible with FOMlink, it is also possible to directly connect to its Wi-Fi SSID by turning on the wireless connection on your smart device. Then

connect it to the access point created by the FOMlink dongle. Choose the Wi-Fi Network named “CPLK-XXXXXX”, where XXXXXX is the serial number (SN) found on the side of the FOMlink Dongle Module.

4. The inverter will need to be initialized on the first start up.



- a. Figure 4-2 System Setting**Grid Standard**: Select a grid standard



Figure 4-3 Grid Standard Options

INFO ✓

Selection of Grid Standard: Please check with your local electric utility company before selecting a grid standard. If the inverter is operated with a wrong grid standard, the electricity supply company may cancel the interconnection agreement.

Placing the inverter into operation before the overall system complies with the national rules and safety regulations of the application is not permitted.

- b. **PV Link Type:** The DC input configuration and MPP Tracker shall only be configured as Independent.
- c. **Neutral Line Setting:** Enter whether a neutral line is installed or not.
- d. **RS485:** Enter the communication data Modbus Address and Baud Rate.

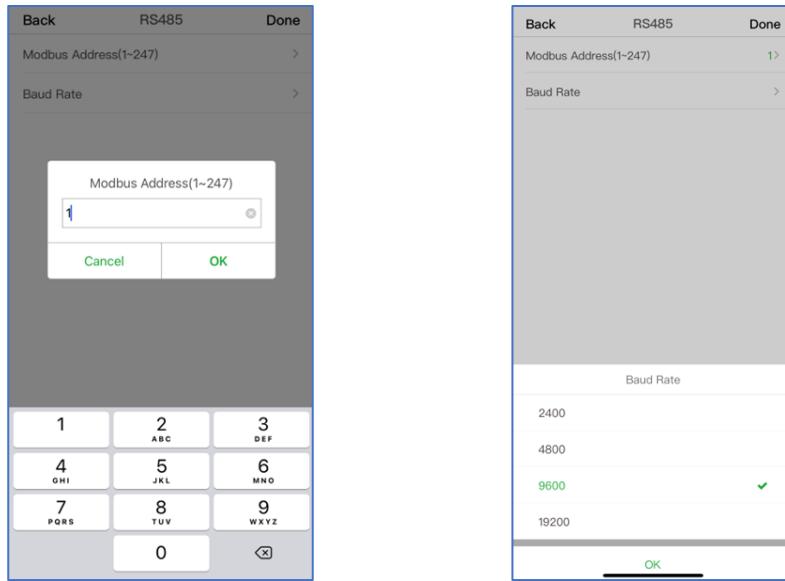


Figure 4-4 RS-485 Submenu Screens

- e. **Inverter Clock:** Set the system clock.
- f. **Change Password:** Change current password.

When the device screen shows the normal operation status Figure 4-5 and the “POWER” light on the LED panel is illuminated, this means that the grid connection and power generation are successful.



Figure 4-5 Normal Operation Status

If the inverter fails to operate normally, the “FAULT” light will illuminate and the fault information will show on the Device screen and you can skip to History check the detail as shown in the Figure 4-6.



Figure 4-6 Fault Information Interface

5. App Interface

5.1 Overview

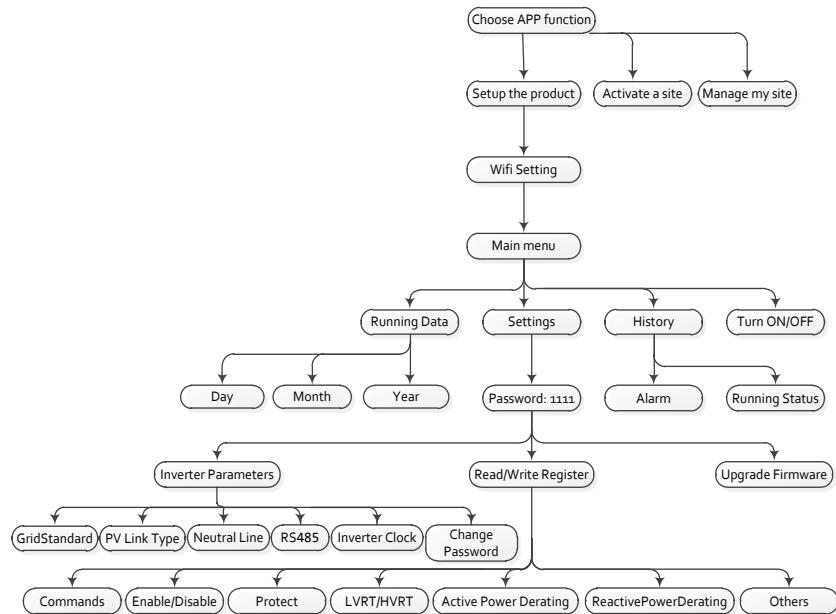


Figure 5-1 App Interface Flow Chart

5.2 Main Menu

In the MAIN menu, it is possible to access the following sub-menus via the four buttons on the bottom of the screen:

- Running Data
- Settings

- History
- Turn ON/OFF

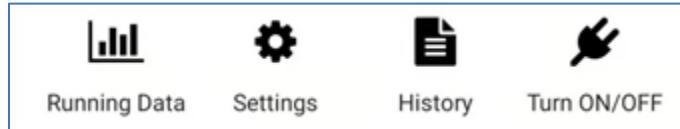


Figure 5-2 Sub-menu buttons on bottom of Main Menu screen

5.2.1 Running Data

In the Running Data sub-menu you can view the power generation by Day, Month, or Year as shown in Figure 5-3.

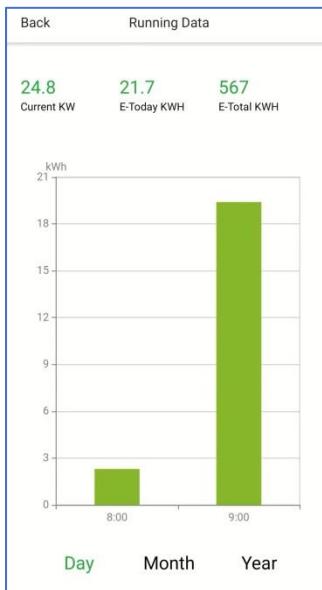


Figure 5-3 Running Data Sub-menu

5.2.2 Settings

To access the Settings sub-menu, use password “1111”.

This sub-menu allows access the following sub-menus:

- Inverter Parameters
- Read/Write Register
- Upgrade Firmware

5.2.2.1 Inverter Parameters

In the Inverter Parameters section it is possible to access the following sub-menus: GridStandard, PV Link Type, Neutral Line, RS485, Inverter Clock and Change Password.

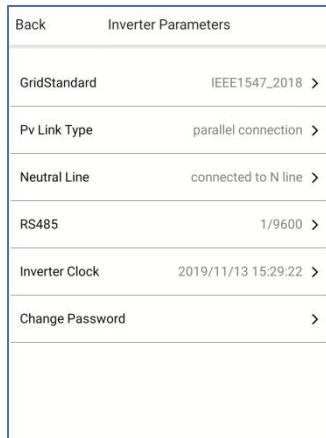


Figure 5-4 Inverter Parameters Sub-menu

5.2.2.2 Read/Write Register

In the Read/Write Register section it is possible to access the following sub-menus:

- Protect
- ActivePowerDerating
- ReactivePowerDerating
- ARC
- LVRT/HVRT
- Others
- Enable/Disable
- Commands

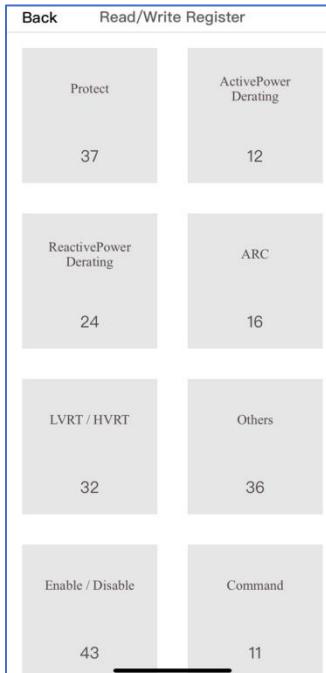


Figure 5-5 Read/Write Register Sub-menu

5.2.2.2.1 Protect

This interface is used to display and set the Protect parameters of the AC grid voltage, frequency and recovery, etc as shown below in Figure 5-6:

Back	Protect
GridVoltMax1	110.00 % >
VoltMaxTripT1	1.00 Secs >
GridVoltMax2	120.00 % >
VoltMaxTripT2	0.16 Secs >
GridVoltMax3	120.00 % >
VoltMaxTripT3	0.16 Secs >
GridVoltMin1	88.00 % >
VoltMinTripT1	2.00 Secs >
GridVoltMin2	60.00 % >
VoltMinTripT2	1.00 Secs >
GridVoltMin3	45.00 % >
VoltMinTripT3	0.16 Secs >
VoltMax	108.00 % >
VoltMin	90.00 % >
VoltRecoveryT	300.00 Secs >

Back	Protect
GridFrqMax1	60.50 Hz >
FrqMaxTripT1	2.00 Secs >
GridFrqMax2	62.00 Hz >
FrqMaxTripT2	0.16 Secs >
GridFrqMax3	62.00 Hz >
FrqMaxTripT3	0.16 Secs >
GridFrqMin1	59.50 Hz >
FrqMinTripT1	2.00 Secs >
GridFrqMin2	57.00 Hz >
FrqMinTripT2	0.16 Secs >
GridFrqMin3	57.00 Hz >
FrqMinTripT3	0.16 Secs >
FrqMax	60.30 Hz >
FrqMin	59.80 Hz >
FrqRecoveryT	300.00 Secs >

Back	Protect
GridFrqMin2	57.00 Hz >
FrqMinTripT2	0.16 Secs >
GridFrqMin3	57.00 Hz >
FrqMinTripT3	0.16 Secs >
FrqMax	60.30 Hz >
FrqMin	59.80 Hz >
FrqRecoveryT	300.00 Secs >
VoltMax	110.00 % >
MaxTripV	600.00 Secs >
VoltMin	88.00 % >
MinTripV	600.00 Secs >
GridVoltUnbalance	10.00 % >
Phase-PETripVolt	45.00 % >
Phase-PERcvVolt	35.00 % >

Figure 5-6 Protect Submenu Parameters

Table 5-1 Protection Submenu Parameters with lower limit, default, and upper limit settings (IEEE 1547-2018 and Rule 21)

Grid Over Voltage Protection

Parameter name	Description	Setup range (lower limit, default & upper limit) IEEE1547-2018	Setup range (lower limit, default & upper limit) Rule21
GridVoltMax1	Threshold value of Level 1 Max. grid voltage	{100%, 110%, 135%}	{100%, 110%, 135%}
VoltMaxTripTime1(S)	Threshold value of Level 1 Max. grid trip voltage	{0, 2, 655}	{0, 12.5, 655}
GridVoltMax2	Threshold value of Level 2 Max. grid voltage	{100%, 120%, 135%}	{100%, 120%, 135%}
VoltMaxTripTime2(S)	Threshold value of Level 2 Max. grid trip voltage	{0, 0.16, 655}	{0, 0.16, 655}
GridVoltMax3	Threshold value of Level 3 Max. grid voltage	{100%, 120%, 135%}	{100%, 120%, 135%}
VoltMaxTripTime3(S)	Threshold value of Level 3 Max. grid trip voltage	{0, 0.16, 655}	{0, 0.16, 655}

Grid Low Voltage Protection

Parameter name	Description	Setup range (lower limit, default & upper limit) IEEE1547-2018	Setup range (lower limit, default & upper limit) Rule21
GridVoltMin1	Threshold value of Level 1 Min. grid voltage	{30%, 70%, 100%}	{30%, 88%, 100%}
VoltMinTripTime1(S)	Threshold value of Level 1 Min. grid trip voltage	{0, 10, 655}	{0, 20.5, 655}
GridVoltMin2	Threshold value of Level 2 Min. grid voltage	{30%, 45%, 100%}	{30%, 70%, 100%}
VoltMinTripTime2(S)	Threshold value of Level 2 Min. grid trip voltage	{0, 0.16, 655}	{0, 10.5, 655}
GridVoltMin3	Threshold value of Level 3 Min. grid voltage	{30%, 45%, 100%}	{30%, 50%, 100%}
VoltMinTripTime3(S)	Threshold value of Level 3 Min. grid trip voltage	{0, 0.16, 655}	{0, 1.5, 655}
VMaxRov	Recovery Max threshold grid voltage protection	{80 %, 107.92%, 135%}	{80%, 107.99%, 135%}
VMinRov(V)	Recovery Min threshold. grid voltage protection	{20%, 90%, 100%}	{20%, 90%, 100%}
VRcovT(S)	Recovery time of grid voltage protection	{0, 300, 655}	{0, 300, 655}

Grid Over Frequency Protection

Parameter name	Description	Setup range (lower limit, default & upper limit) IEEE1547-2018	Setup range (lower limit, default & upper limit) Rule21
GridF.Max1	Protection threshold value of Level 1 Max. grid frequency	{60, 61.2, 66}	{60, 60.5, 66}
FMaxTripTime1(S)	Trip time of Level 1 Max. grid frequency	{0, 299.5, 655}	{0, 299.5, 655}
GridF.Max2	Protection threshold value of Level 2 Max. grid frequency	{60, 62, 66}	{60, 62, 66}
FMaxTripTime2(S)	Trip time of Level 2 Max. grid frequency	{0, 0.16, 655}	{0, 0.16, 655}
GridF.Max3	Protection threshold value of Level 3 Max. grid frequency	{60, 62, 66}	{60, 62, 66}
FMaxTripTime3(S)	Trip time of Level 3 Max. grid frequency	{0, 0.16, 655}	{0, 0.16, 655}

Grid Low Frequency Protection

Parameter name	Description	Setup range (lower limit, default & upper limit) IEEE1547-2018	Setup range (lower limit, default & upper limit) Rule21
GridF.Min1	Protection threshold value of Level 1 Min. grid frequency	{54, 58.5, 60}	{54, 58.5, 60}
FrqMinTripTime1(S)	Trip time of Level 1 Min. grid frequency	{0, 299.5, 655}	{0, 299.5, 655}
GridF.Min2	Protection threshold value of Level 2 Min. grid frequency	{54, 56.5, 60}	{54, 57, 60}
FMinTripTime2(S)	Trip time of Level 2 Min. grid frequency	{0, 0.16, 655}	{0, 0.16, 655}
GridF.Min3	Protection threshold value of Level 3 Min. grid frequency	{54, 56.5, 60}	{54, 57, 60}
FMinTripTime3(S)	Trip time of Level 3 Min. grid frequency	{0, 0.16, 655}	{0, 0.16, 655}
FMaxRcov(Hz)	Recovery Max threshold grid Frequency protection	{54, 61.1, 66}	{54, 60.4, 66}
FMinRcov(Hz)	Recovery Min threshold. grid Frequency protection	{54, 58.6, 60}	{54, 58.6, 60}

FRcovT(S)	Recovery time of grid frequency protection	{0, 300, 655}	{0, 300, 655}
VoltMax	The upper limit grid voltage of moving average filter	{100%, 110%, 135%}	{100%, 110%, 135%}
MaxTripT	The trip time of the upper limit grid voltage of moving average filter	{0, 600, 655}	{0, 600, 655}
VoltMin	The lower limit grid voltage of moving average filter	{80%, 88%, 100%}	{80%, 87.99%, 100%}
MinTripT	The trip time of the lower limit grid voltage of moving average filter	{0, 600, 655}	{0, 600, 655}
GridVoltUnbalance	Unbalance rate of grid voltage	(0.01%,10%,10%)	(0.01%,10%,10%)

5.2.2.2 ActivePowerDerating

“ActivePowerDerating” menu is used to set the active power derating parameters including Active Power Derating, Over Frequency Derating, and High Temperature Frequency Derating, etc. The parameters are shown in Figure 5-7.



Figure 5-7 ActivePower Derating Parameters

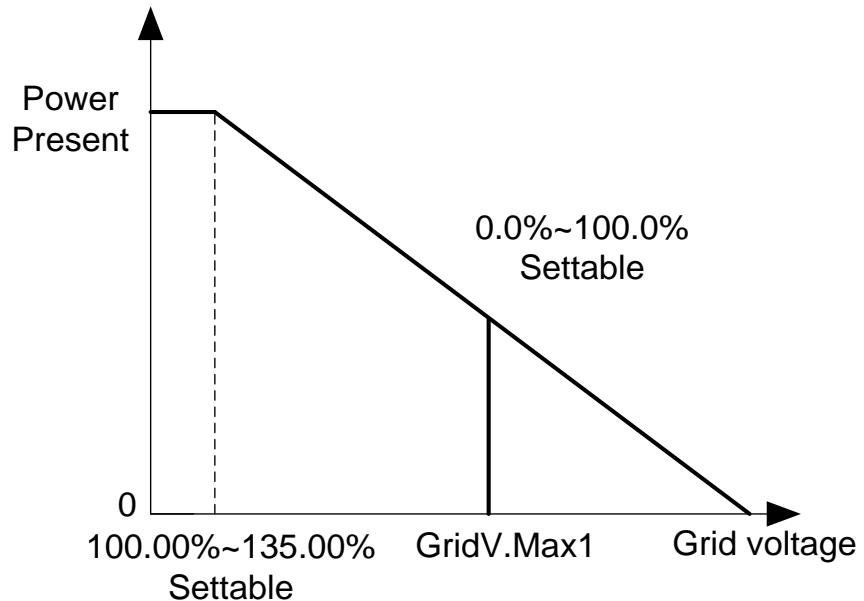


Figure 5-8 Over-Voltage Derating Curve

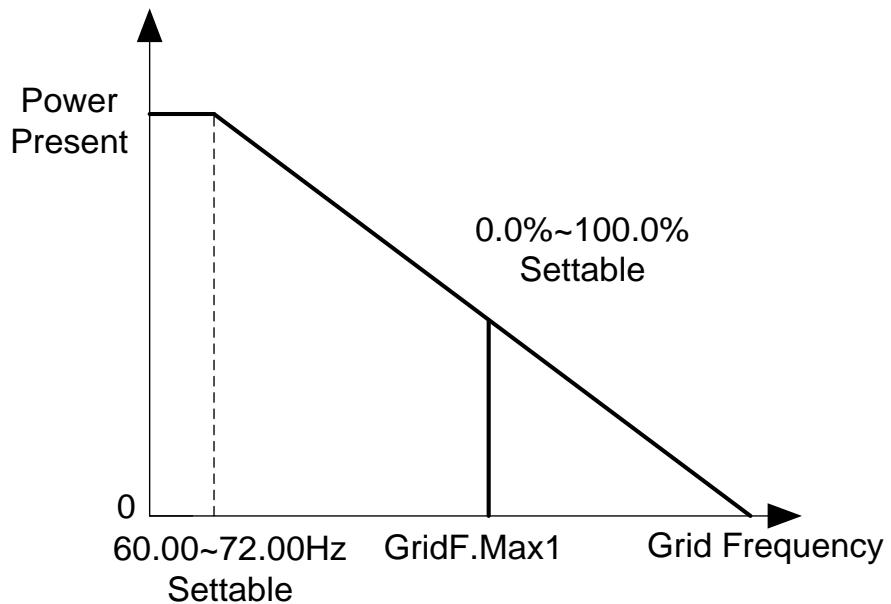


Figure 5-9 Over-Frequency Derating Curve

Table 5-2 Active Power Derating Setup Ranges with Lower Limit, Default, and Upper Limit for IEEE 1547-2018 and CA Rule 21

PARAMETER NAME	DESCRIPTION	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) RULE21
OvrFrqMin	The trigger frequency of OverFrequency derating	{60, 60.04,72}	{60, 60.04 ,72}
OvrFrqMax	The end frequency or Rate of Overfrequency derating (Depends on the specific standard)	{60,62.532,72}	{60, 62.034 ,72}
OvrFrqSlop	The Rate of Overfrequency derating.	{0.01%,30%,100%}	{0.01%,30%,100%}
RecoveryFrq	The recovery frequency of OverFrequency derating	{58.8, 59.964 ,66}	{58.8, 59.964 ,66}
OvrFrqRecoveryT	The recovery time of OverFrequency derating	{0,60,1200}	{0,60,1200}
VirtualDamping	Resonance damping coefficient	{0,0,5}	{0,0,5}
OperationOverVol	Operating overvoltage protection value	{100%,120%,135%}	{100%,120%,135%}
VwCurveV1	Grid overvoltage derating starting voltage V1	{100%, 106%,110%}	{100%, 106%,110%}
VwCurveP1	Grid overvoltage derating starting power P1	{0%,100%,100%}	{0%,100%,100%}
VwCurveV2	Grid overvoltage derating end voltage V2	{100%,110%,135%}	{100%,110%,135%}
VwCurveP2	Grid overvoltage derating end power P2	{0%, 0%,100%}	{0%, 0%,100%}
OpenLoopRespT	Open loop response time	{0.5,10,90}	{0.5,10,90}

5.2.2.2.3 ReactivePowerDerating

The “ReactivePowerDerating” submenu is used to set the Grid reactive power derating parameters including PF parameters and Q parameters, etc. The parameters are shown in Figure 5-10.

Note: The PF and Q value can be adjusted by remote software if the “Remote” is selected.

Back	ReactivePower Derating
PFSetValue	1.000 >
PFpCurveP1	50.0 % >
PFpCurvePf1	1.000 >
PFpCurveP2	100.0 % >
PFpCurvePF2	-0.900 >
PFpCurveTriVolt	100.00 % >
PFpCurveUndoVolt	90.00 % >
QuCurveU1	107.99 % >
QuCurveQ1	0.0 % >
QuCurveU2	110.00 % >
QuCurveQ2	-50.0 % >
QuCurveU1i	92.01 % >
QuCurveQ1i	0.0 % >
QuCurveU2i	90.00 % >
QuCurveQ2i	50.0 % >

Back	ReactivePower Derating
QuCurveQ2	-50.0 % >
QuCurveU1i	92.01 % >
QuCurveQ1i	0.0 % >
QuCurveU2i	90.00 % >
QuCurveQ2i	50.0 % >
QuCurveTriPower	20.0 % >
QuCurveUndoPower	5.0 % >
QpCurveP1	20.0 % >
QpCurveQ1	0.0 % >
QpCurveP2	50.0 % >
QpCurveQ2	0.0 % >
QpCurveP3	100.0 % >
QpCurveQ3	-44.0 % >
QpCurveOpenLoopRespTime	10.0 Secs >

Figure 5-10 ReactivePowerDerating Parameter Screens

- PF Set** - Use this mode to set a static PF value.

Note: Change the reactive power by adjusting the PowerFactor.

- PF(P) Curve** – Use this mode to follow the default or user-specified PF curve.

Note: The power factor changes according to the power change, as shown in Figure 5-11.

- Q(U) Curve** – Use this mode to follow the default or user-specified Q(U) curve.

Note: The reactive compensation changes according to the grid voltage, as shown in Figure 5-12.

INFO ✓

PF(P) Curve and Q(U) Curve Functions: These functions are only available for IEEE 1547 Grid Standards.

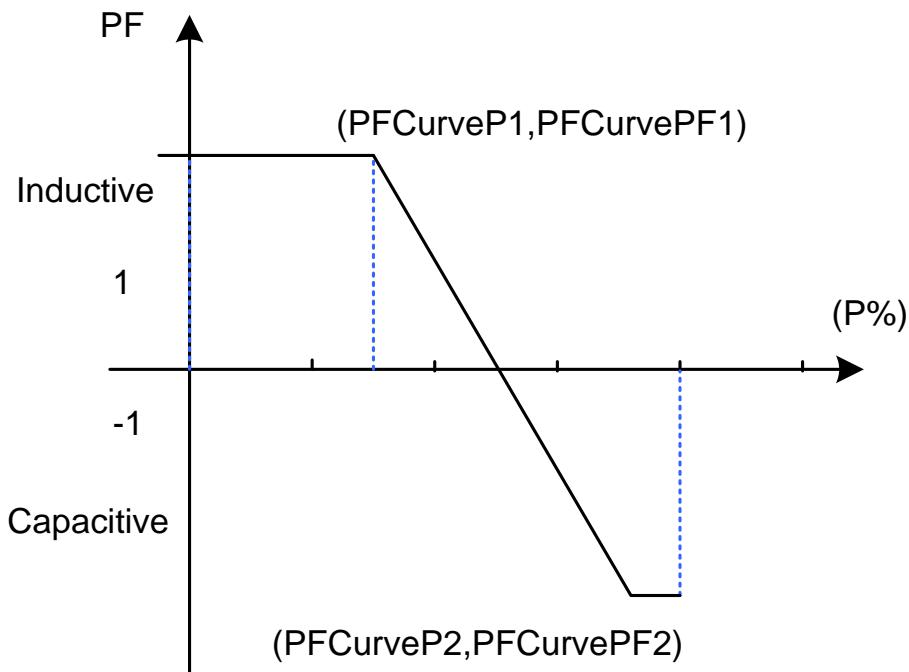


Figure 5-11 PF(P) Curve Mode Curve

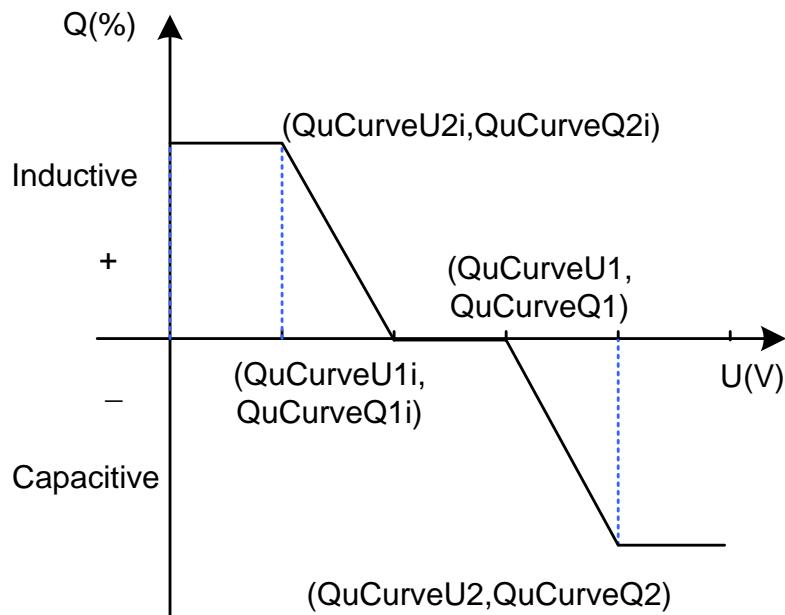


Figure 5-12 Q(U) Curve Mode Curve

Table 5-3 Reactive Power Derating Grid Parameters

PARAMETER NAME	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	DESCRIPTION
PFSetValue	{-1,-0.8},{1},{0.8,1}	{-1,-0.8},{-0.95},{0.8,1}	Local Power Factor Setting
PFpCurveP1	{0%,50%,100%}	{0%,50%,100%}	Power of PF(P)Curve point 1
PF_PCurvePF1	{-1,-0.8},{1},{0.8,1}	{-1,-0.8},{1},{0.8,1}	PF of PF(P)Curve point 1
PFpCurveP2	{0%,100%,100%}	{0%,100%,100%}	Power of PF(P)Curve point 2
PF_PCurvePF2	{-1,-0.8},{-0.9},{0.8,1}	{-1,-0.8},{-0.9},{0.8,1}	PF of PF(P)Curve point 2
PFpCurveTriVolt	{100%,100%,110%}	{100%,100%,110%}	The trigger voltage of PF(P)Curve
PFpCurveUndoVolt	{90%,90%,100%}	{90%,90%,100%}	The end voltage of PF(P)Curve
QuCurveU1	{100%,102%,110%}	{100%,103.3%,110%}	Voltage of Q(U)Curve point 1
QuCurveQ1	{-60%,0%,60%}	{-60%,0%,60%}	Reactive power of Q(U)Curve point 1
QuCurveU2	{100%,108%,110%}	{100%,107%,110%}	Voltage of Q(U)Curve point 2
QuCurveQ2	{-60%,-44%,60%}	{-60%,-30%,60%}	Reactive power of Q(U)Curve point 2
QuCurveU1i	{90%,98%,99%}	{90%,96.7%,99%}	Voltage of Q(U)Curve point 1i
QuCurveQ1i	{-60%,0%,60%}	{-60%,0%,60%}	Reactive power of Q(U)Curve point 1i
QuCurveU2i	{80%,92%,100%}	{80%,92%,100%}	Voltage of Q(U)Curve point 2i
QuCurveQ2i	{-60%,44%,60%}	{-60%,30%,60%}	Reactive power of Q(U)Curve point 2i
QuCurveTriPower	{5%,20%,100%}	{5%,20%,100%}	The trigger power of Q(U)Curve
QuCurveUndoPower	{5%,5%,100%}	{5%,5%,100%}	The end power of Q(U)Curve

5.2.2.2.4 LVRT/HVRT

The “LVRT/HVRT” submenu is used to set the LVRT (Low Voltage Ride-Through) and HVRT (High Voltage Ride-Through) parameters as shown in Figure 5-13:

Back	LVRT / HVRT
LVRTVolt1	0.00 % >
LVRTTime1	0.00 Secs >
LVRTVolt2	0.00 % >
LVRTTime2	1.20 Secs >
LVRTVolt3	45.00 % >
LVRTTime3	1.20 Secs >
LVRTVolt4	45.00 % >
LVRTTime4	10.50 Secs >
LVRTVolt5	65.00 % >
LVRTTime5	10.50 Secs >
LVRTVolt6	65.00 % >
LVRTTime6	20.50 Secs >
LVRTVolt7	83.00 % >
LVRTTime7	20.50 Secs >
LVRTVolt8	83.00 % >

Back	LVRT / HVRT
LVRTTime8	20.50 Secs >
HVRTVolt1	125.00 % >
HVRTTime1	0.00 Secs >
HVRTVolt2	125.00 % >
HVRTTime2	0.80 Secs >
HVRTVolt3	124.00 % >
HVRTTime3	0.80 Secs >
HVRTVolt4	124.00 % >
HVRTTime4	12.50 Secs >
HVRTVolt5	115.00 % >
HVRTTime5	12.50 Secs >
HVRTVolt6	115.00 % >
HVRTTime6	12.50 Secs >
HVRTVolt7	115.00 % >
HVRTTime7	12.50 Secs >
HVRTVolt8	115.00 % >
HVRTTime8	12.50 Secs >

Figure 5-13 LVRT / HVRT Parameters

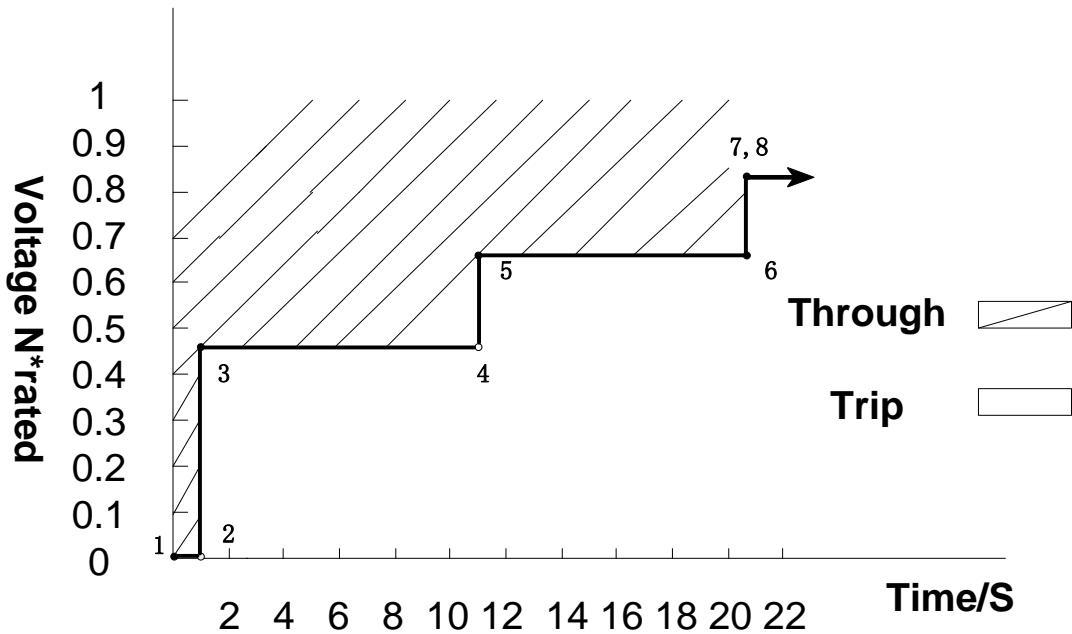


Figure 5-14 LVRT Curve

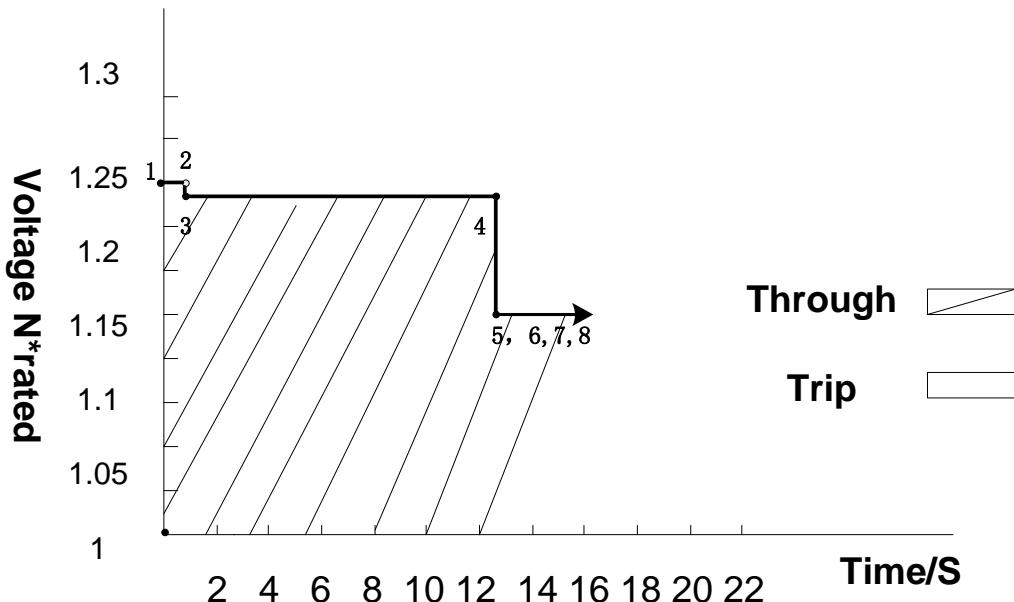


Figure 5-15 HVRT Curve

Table 5-4 LVRT Parameter List with Setup Lower Limit, Default, and Upper Limit

PARAMETER NAME	DESCRIPTION	LVRT Parameters	
		SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) RULE21
LVRTVoltPara (1,2)	Threshold value of Low voltage ride through(first or second point)	{0%, 0%, 100%} {0%, 0%, 100%}	{0%, 0%, 100%} {0%, 0%, 100%}
LVRTTimePara(1,2)	Time of Level Low voltage ride through (first or second point)	{0, 0, 655} {0, 0.16, 655}	{0, 0, 655} {0, 1.2, 655}
LVRTVoltPara (3,4)	Threshold value of Low voltage ride through (third or fourth point)	{0%, 45%, 100%} {0%, 45%, 100%}	{0%, 50%, 100%} {0%, 50%, 100%}
LVRTTimePara(3,4)	Time of Level Low voltage ride through (third or fourth point)	{0,0.16, 655}	{0,1.2, 655}

		{0, 10.5, 655}	{0, 10.5, 655}
LVRTVoltPara (5,6)	Threshold value of Low voltage ride through (fifth or sixth point)	{0%, 70%, 100%} {0%, 70%, 100%}	{0%, 70%, 100%} {0%, 70%, 100%}
LVRTTimePara(5,6)	Time of Level Low voltage ride through (fifth or sixth point)	{0, 10.5, 655} {0, 20.5, 655}	{0, 10.5, 655} {0, 20.5, 655}
LVRTVoltPara (7,8)	Threshold value of Low voltage ride through(seventh or eighth point)	{0%, 88%, 100%} {0%, 88%, 100%}	{0%, 88%, 100%} {0%, 88%, 100%}
LVRTTimePara(7,8)	Time of Level Low voltage ride through(seventh or eighth point)	{0, 20.5, 655} {0, 20.5, 655}	{0, 20.5, 655} {0, 20.5, 655}

Table 5-5 HVRT Parameters with Setup Range of Lower Limit, Default, and Upper Limit

HVRT			
PARAMETER NAME	DESCRIPTION	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) RULE21
HVRTVoltPara (1,2)	Threshold value of high voltage ride through (first or second point)	{100%, 125%, 135%} {100%, 125%, 135%}	{100%, 125%, 135%} {100%, 125%, 135%}
HVRTTimePara(1,2)	Time of Level high voltage ride through (first or second point)	{0, 0, 655} {0, 0.16, 655}	{0, 0, 655} {0, 0.11, 655}
HVRTVoltPara (3,4)	Threshold value of high voltage ride through (third or fourth point)	{100%, 120%, 135%} {100%, 120%, 135%}	{100%, 120%, 135%} {100%, 120%, 135%}
HVRTTimePara(3,4)	Time of Level high voltage ride through (third or fourth point)	{0, 0.16, 655} {0, 2.5, 655}	{0, 0.11, 655} {0, 12.5, 655}
HVRTVoltPara (5,6)	Threshold value of high voltage ride through (fifth or sixth point)	{100%, 110%, 135%} {100%, 110%, 135%}	{100%, 110%, 135%} {100%, 110%, 135%}
HVRTTimePara(5,6)	Time of Level high voltage ride through (fifth or sixth point)	{0, 2.5, 655} {0, 12.5, 655}	{0, 12.5, 655} {0, 12.5, 655}
HVRTVoltPara (7,8)	Threshold value of high voltage ride through (seventh or eighth point)	{100%, 110%, 135%} {100%, 110%, 135%}	{100%, 110%, 135%} {100%, 110%, 135%}
HVRTTimePara(7,8)	Time of Level high voltage ride through (seventh or eighth point)	{0, 12.5, 655} {0, 12.5, 655}	{0, 12.5, 655} {0, 12.5, 655}

eighth point)

5.2.2.2.5 Others

The Others submenu is for miscellaneous parameters that do not fit in a specific category.

Back	Others
PowerOnDelay	5 Secs >
PVStartupVolt	330 V >
PVSlowStartS	5.00 % >
ErrSoftStartP	0.16 % >
NormSoftStopP	6.00 % >
NormSoftStartP	4.00 % >
NormDeratingStep	6.00 % >
StartUpMinTemp	-30.0 °C >
FaultPowerT	95.0 °C >
FaultEnvT	83.0 °C >
HVRTTripVolt	110.0 % >
LVRTTripVolt	88.0 % >
LVRTPstReactiveL	150.0 % >
LVRTNegReactiveL	200.0 % >
PSetPercentLocal	100.0 % >

Back	Others
QSetPercentLocal	0.0 % >
ISOProtection	250 kΩ >
GFCIStaticValue	25.0 % >
GFCIStaticT	0.20 Secs >
GFCIDynProFactor	100.0 % >
DCIProtection1	0.50 % >
DCIProtectionT1	60.00 Secs >
DCIProtection2	950 mA >
DCIProtectionT2	1.00 Secs >
DuplicationControl	0 % >
MPPTScanPeriod	3600 Secs >
CheckSumGroup1_6	200 >
PhaseLoseCoeff	3.0 % >
PhaseLoseRcvCoeff	2.0 % >
PhaseLoseVUnbalance	10.00 % >
ReactiveStep	50.00 % >
PVSlowStartStep	10.00 % >
OptiVoltMinMppt1	200.0 V >
OptiVoltMaxMppt1	950.0 V >
OptiVoltMinMppt2	200.0 V >
OptiVoltMaxMppt2	950.0 V >

Figure 5-16 Others Submenu Parameters

Table 5-6 Others Submenu Parameters Setup Ranges with Lower Limit, Default, and Upper Limit Settings

PARAMETER NAME	DESCRIPTION	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) IEEE1547-2018	SETUP RANGE (LOWER LIMIT, DEFAULT & UPPER LIMIT) RULE21
PowerOnDelay	Startup delay time	(1,5,1200)	(1,5,1200)
PVStartupVolt	PV start-up voltage	(200, 330 ,400)	(200, 330 ,400)
PVSlowStartPwDelta	The output power should be slow increased due to the change of PV illumination at the Rule21 standard.	{0.01%,10%,10%}	{0.01%,10%,10%}
ErrSoftStartP	Power startup step after Grid Fault	{0.01%,0.16%,100%}	{0.01%,2%,100%}
NormSoftStopP	Normal power step in soft stop	{0.01%,6%,100%}	{0.01%,10%,100%}
NormSoftStartP	Normal power step in soft startup	{0.01%,4%,100%}	{0.01%,100%,100%}
NormDeratingStep	Normal Power Derating step	{0.01%,6%,100%}	{0.01%,100%,100%}
StartUpMinTemp	The minimum startup temperature	{-35,-30,-20}	{-35,-30,-20}
HVRTTripVolt	The trigger Voltage of HVRT	{100%,110%,135%}	{100%,110%,135%}
LVRTTripVolt	The trigger Voltage of LVRT	{70%,88%,100%}	{70%,88%,100%}
LVRTPstReactiveI	The coefficient of positive sequence reactive current	{0%,150%,300%}	{0%,150%,300%}
LVRTNegReactiveI	The coefficient of negative sequence reactive current	{0%,200%,300%}	{0%,20%,300%}
PSet_Percent	Local electric dispatch Active Power setting value	{0%,100%,100%}	{0%,100%,100%}
QSet_Percent	Local electric dispatch Reactive Power setting value	{-60%,0%,60%}	{-60%,0%,60%}
ISOProtection	Minimum insulation resistance	{1k,250k,2000k}	{1k,250k,2000k}
GFCIStaticValue	The static threshold value of Leakage current	{100, 250 ,1000}	{100, 250 ,1000}

GFCIStaticT	GFCI static protection time	{0,0,2,655}	{0,0,2,655}
GFCIDynProFactor	GFCI dynamic protection factor	{0%,100%,200%}	{0%,100%,200%}
DCIProtection1	maximun DCI value1	{0.1%,0.5%,5%}	{0.1%,0.5%,5%}
DCIProtectionT1	Trip time 1 of DCI value	{0,10,120}	{0,10,120}
DCIProtection2	maximun DCI value2	{5,950,5000}	{5,950,5000}
DCIProtectionT2	Trip time 2 of DCI value	{0,1,120}	{0,1,120}
DuplicationControl	Parameter of repetitive control	{0%,0%,100%}	{0%,0%,100%}
MPPTScanPeriod	MPPTScan Cycle	{300,3600,5400}	{300,3600,5400}

5.2.2.2.6 Enable/Disable

The Enable/Disable submenu is used to enable or disable function and protect parameters as shown here:

Back	Enable / Disable
Article 1 groups, control parameter setting of i... >	
CtrModeReactivePw	Disable dispatch mode >
CtrModeActivePw	Disable dispatch mode >
MPPTScanEn	Disable >
ARCEnable	Enable >
Island Protect	Enable >
LVRTModeSetting	Disable >
HVRTModeSetting	Disable >
NormSoftStopPEn	Enable >
PIDCheckEn	Disable >
GridVoltMax1En	Enable >
GridVoltMax2En	Enable >
GridVoltMax3En	Disable >
GridVoltMin1En	Enable >
GridVoltMin2En	Enable >
Back	Enable / Disable
GridVoltMin3En	Enable >
GridFrqMax1En	Enable >
GridFrqMax2En	Enable >
GridFrqMax3En	Disable >
GridFrqMin1En	Enable >
GridFrqMin2En	Enable >
GridFrqMin3En	Disable >
VoltMaxMovAvgEn	Disable >
VoltMinMovAvgEn	Disable >
GFCIStaticEn	Enable >
GFCIDynProEn	Enable >
OvrFrqDeratingMode	Disable >
DCIProtection1En	Enable >
DCIProtection2En	Disable >
GridVoltUnbalanceEn	Disable >
Back	Enable / Disable
GridVoltUnbalanceEn	Disable >
UDerEn	Disable >
OvrVoltDerEn	Disable >
PVSlowStartSEn	Disable >
ISOProtectionEn	Enable >
FANDetectEn	Enable >
ACSPDDetectEnSet	Disable >
OperationOverVolEn	Disable >
ActivePowerOver	Disable >
ReactivePowerOver	Disable >
PhaseLoseCoeffEnable	Disable >
Phase-PEEnable	Disable >
MPPTRangEnable	Disable >
RapidShutdownEnabBit	Disable >

Figure 5-17 Enable / Disable Submenu Parameters

Table 5-7 Enable / Disable Parameters with Lower Limit, Default and Upper Limit Settings (IEEE 1547-2018 and Rule 21)

Parameter name	Description	Setup range (lower limit, default & upper limit) IEEE1547	Setup range (lower limit, default & upper limit) Rule-21
CtrParaGroup	<p>The enabled control parameters group.</p> <p>0:Article 5 groups, control parameter setting of inverter loop</p> <p>1:Article 1 groups, control parameter setting of inverter loop</p> <p>2:Article 2 groups, control parameter setting of inverter loop</p> <p>3:Article 3 groups, control parameter setting of inverter loop</p> <p>4:Article 4 groups, control parameter setting of inverter loop</p>	{0, 4, 4}	{0, 4, 4}
ReactivePwModeSelect	<p>The control mode of reactive power</p> <p>0: Disable dispatch mode.</p> <p>1: Remote dispatch mode.</p> <p>2: Local control ,by Q</p> <p>3: Local control ,by PF</p> <p>4: PF(P)curve</p> <p>5: Q(U) curve</p> <p>(Association register address= 0x2200. 0x250F.0x2707. 0x2709)</p> <p>6:Q(P)Curve</p>	{Disable, Disable, Remote , Q,PF,PF(P),Q(u), Q(P)}	{Disable, Q(u), Remote , Q,PF,PF(P),Q(u) , Q(P)}
ActivePwModeSelect	<p>The control mode of active power</p> <p>0: Disable dispatch mode.</p> <p>1: Remote dispatch mode.</p>	{Disable, Disable, Remote,Local}	{Disable, Disable, Remote,Local}

	2: Local control. (Association register address=0x250E.0x2708)		
MPPTScanEn	MPPT scan enable/disable control 0: Disable 1: Enable (Association register address=0x2519)	{Disable, Disable, Enable}	{Disable, Disable, Enable}
ARCEnable	Arc detection enable/disable control 0: Disable 1: Enable (Association register address=0x2300~0x230D)	{Disable, Enable, Enable}	{Disable, Enable, Enable}
Island Protect	Island enable/disable control 0: Disable 1: Enable	{Disable, Enable, Enable}	{Disable, Enable, Enable}
LVRTModeSetting	0: Disable 1:Enable no power output 2:Enable reactive power output 3:Enable active power output	{Disable, Enable reactive power output , Enable no power output, Enable reactive power output , Enable active power output }	{Disable, Enable reactive power output , Enable no power output, Enable reactive power output , Enable active power output }
HVRTModeSetting	0: Disable 1:Enable no power output 2:Enable reactive power output 3:Enable active power output	{Disable, Enable reactive power output , Enable no power output, Enable reactive power output , Enable active power output }	{Disable, Enable reactive power output , Enable no power output, Enable reactive power output , Enable active power output }
NormSoftStopPEn	Disable or Enable the soft stop	{Disable, Enable,	{Disable, Enable,

	function	Enable}	Enable}
Gridxx1,2ProEn	Disable or Enable the grid protect function and please refer to 5.4.2.3 setting the grid protect parameters	{Disable,Enable, Enable}	{Disable,Enable, Enable}
Gridxx3ProEn	Disable or Enable the grid protect function and please refer to 5.4.2.3 setting the grid protect parameters	{Disable, Enable, Enable}	{Disable, Enable, Enable}
VoltMaxMovAvgEn	Enable/disable control of limiting the upper of moving average filter 0: Disable 1: Enable	{Disable,Disable, Enable}	{Disable,Disable, Enable}
VoltMinMovAvgEn	Enable/disable control of limiting the lower of moving average filter 0: Disable 1: Enable	{Disable,Disable, Enable}	{Disable,Disable, Enable}
GFCIStaticEn	GFCI static detection enable/disable control 0: Disable 1: Enable	{Disable,Enable, Enable}	{Disable,Enable, Enable}
GFCIDynProEn	GFCI dynamic detection enable/disable control 0: Disable 1: Enable Over frequency derating enable/disable control 0: Disable 1~5: Enabling corresponding function 1 : Enable 2 : Reserved	{Disable,Enable, Enable}	{Disable,Enable, Enable}
OvrFrqDeratingMode	{Disable,Disable, Enable}	{Disable,Disable, Enable}	

	3 : Reserved 4 : Reserved 5 : Reserved		
DCIProtection1En	DCI protection1 enable/disable control 0: Disable 1: Enable	{Disable,Enable, Enable}	{Disable,Enable, Enable}
	DCI protection2 enable/disable control 0: Disable 1: Enable	{Disable,Disable, Enable}	{Disable,Disable, Enable}
GridVoltUnbalanceEn	Unbalance rate of grid voltage detection enable/disable control 0: Disable 1: Enable	{Disable,Enable, Enable}	{Disable,Enable, Enable}
	Grid voltage derating enable/disable control 0: Disable 1: Enable	{Disable,Disable, Enable}	{Disable,Disable, Enable}
PowerMutateRatio (HECO)	Only for HECO grid standard. Disable or Enable the slow start function after power mutation. And please refer to 5.4.2.7 setting the parameter.		
ISOProtectionEn	ISO detection enable/disable control 0: Disable 1: Enable	{Disable,Enable, Enable}	{Disable,Enable, Enable}
	Fan detection enable/disable control 0: Disable 1: Enable	{Disable,Enable, Enable}	{Disable,Enable, Enable}

	The AC SPD test enables settings 0: Disable 1: Enable	{Disable,Disable,Enable}	{Disable,Disable,Enable}
ACSPDDetectEnSet	Operating overvoltage detection enables setting 0: Disable 1: Enable	{Disable,Disable,Enable}	{Disable,Disable,Enable}
OperationOverVolEn			

5.2.2.2.7 Commands

In the Read/Write Register section it is possible to access the following sub-menus:

- “**Power On/Off**” menu: Manual Turn ON/OFF: Manual Power ON/OFF is required after regulation setting or manual (fault) shut-down.
- “**ForceRestart**” menu: If a fault shutdown happens, a severe fault may have occurred inside the inverter. The user can perform a forced reboot for one time per Power on in this menu if the user needs to restart the inverter.
- “**FactoryDefaults**” menu: The manufacturer’s parameter default values can be restored when the inverter is not in operation mode. Otherwise “Fault Operated” will be reported.
- “**MPPTScan**” menu: “MPPTScan” is used to execute the MPPT scanning manually. The device screen will skip to normal operation interface if the MPPT scanning succeeds or remain on the “MPPTScan menu” interface if the scanning fails. MPPT scan function is used for multi-MPP tracking, and is useful if the PV modules are partly shadowed or installed with different angles. The factory setting of MPPT scan is **Enabled**, yet can also be set to Disabled. When the MPPT scan function is enabled, the scan period is 60 minutes. The inverter will scan the maximum power point in the MPPT range, according to the following conditions :

The total input power is lower than 90% of the active power.

Once this MPPT scan function is activated on the device, it will search the maximum power point at a voltage step of 5V in the MPPT range for full load, and retrieve the maximum power point.

- “**ARCDetect**” menu: Execute the “ARC Detect”, the inverter will stop operating and test ARC. Arcing check and protection is mainly divided into two parts, the Arcing check board is responsible for whether there is Arcing in line, and transfer Arcing protection signal to the DSP in the dominating control board. The control board DSP is responsible for the control of inverter off the grid after receiving Arcing signal to ensure safety. The Arcing board failure will cause “ARC board err” shown on the device and it will not connect to the grid until the arc board is OK. If there is Arcing fault, the device displays the fault which can only be cleared manually.
- “**ArcClear**” is used to clear the ARC fault. The operation result will appear on the Device, ie. “Succeed” or “Failed”.

Back	Command
PowerOnOff	>
ForceRestart	>
FactoryDefaults	>
AutoTest	>
MPPTScan	>
ARCDetect	>
ARCClear	>
PFSetValue Remote	0.000 >
PSetPercent Remote	0.0 % >
QSetPercent Remote	0.0 % >
FreqLv2PrtEn(CEI)	>

5.2.3 Fault Recording

The Fault Recording Menu can store up to 128 fault records.

5.2.4 History

There are 2 submenus in the History menu:

- Alarm
- Running Status

They are accessed by selecting the History button and then toggling between the two menus as show in Figure 5-18.

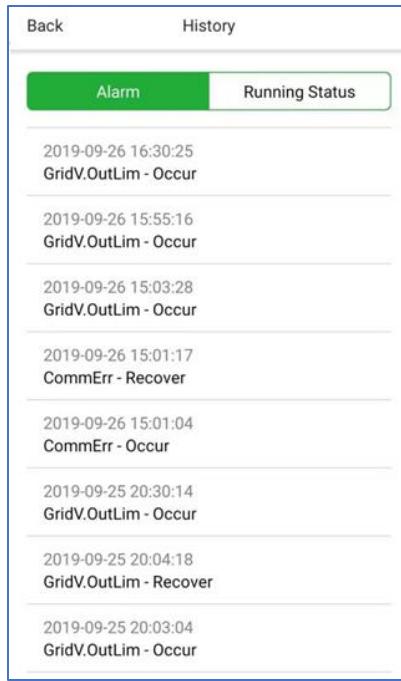


Figure 5-18 History Submenu

5.2.5 Turn On / Off

Manual Turn ON/OFF: Manual Power ON/OFF is required after regulation setting or manual (fault) shut-down. Select the submenu “Turn ON/OFF”.

- **Turn ON:** Click “Turn ON” and “OK” to start the inverter, the inverter will start up and operate normally if the start-up conditions are met. Otherwise, the inverter will go to stand-by mode.
- **Turn OFF:** Normally, it is not necessary to Turn OFF the inverter, but it can be shut down manually if regulation setting or maintenance is required. Click “Turn OFF” and “OK”, then the inverter will be shut down.

INFO ✓

Automatic Turn ON/OFF: This is the standard inverter running mode while the inverter is turned on. The inverter will start up automatically when the PV array output voltage and power meet set values, AC power grid is normal, and the ambient temperature is within the allowable operating range. The inverter will be shut down automatically when the output voltage and power of PV modules are lower than the set value, AC power grid fails, or the ambient temperature exceeds the allowable operating range.

6. Fault Shutdown and Troubleshooting

6.1 LED Status Panel

Please see Section 1.4 for the LED Status Panel explanation.

6.2 Fault and Troubleshooting

DANGER

Electric Shock Hazard: Disconnect the inverter from the AC grid and PV modules before opening equipment. Make sure hazardous high voltage and energy inside the wire-box has been discharged. Wait at least 5 minutes after disconnecting all power sources before opening and maintaining the inverter.

The inverter will shut down automatically if the PV power generation system fails, such as from a short circuit on the output lines, grid overvoltage / under-voltage, grid over-frequency / under-frequency, high ambient temperature or internal malfunction of the machine. The fault information will be displayed on the Yaskawa Connect Pro APP interface. The Fault Recording Menu can store up to 128 fault records.

The causes of a fault can be identified based on the faults listed in Table 6-1. Proper analysis is recommended before contacting customer service. There are 4 types of faults: alarm, warn, protection and hardware faults.

WARNING

Operating the DC Switch: The DC Switch is rated to break loads under normal operating conditions. However, a DC short circuit could be hazardous and the following procedures should be followed before turning OFF the DC Switch under fault conditions.

If there is a fault and it is safe to access the inverter:

- Read/record the fault code(s) displayed on the APP interface.
- Turn OFF the inverter via the APP or Remote access.
- Turn OFF the AC feed breaker.
- Turn OFF the AC Switch.
- If possible, read the DC MPPT currents displayed on the APP interface:
 - If the MPPT current is <24A or the irradiance is obviously low, turn OFF the DC switch.
 - If it is safe to open the wire-box, proceed with troubleshooting procedures listed in Table 6-1. Make sure appropriate safety precautions and PPE are used.
- If it is not possible to read the DC MPPT currents through the APP interface, and no fire, smoke or voltage (AC or DC) to ground is present in the enclosure:
 - Follow general safety practices including PPE to open the wire-box.
 - Measure the DC current on each string. If zero, open the fuse holder for each string reading approximately zero amps.
 - If the DC current is >0.25A, do not open the fuse holder.
 - When all possible fuses are open, measure the total MPPT current. If it is <24A, turn OFF the DC switch.
 - If turning OFF the DC switch causes smoke, then (if safe) turn the DC switch back ON and wait until low irradiation ~30min prior to sunset to continue troubleshooting.

If there is a fault and it is unsafe to access the inverter:

- Notify someone else. Initiate emergency mitigation plan if necessary.
 - If smoke or fire exists, procure a fire extinguisher that is rated for electrical fires.

- If a fire has escaped the inverter enclosure – notify 911 immediately.
- Turn OFF the AC feed breaker as soon as possible/safe.
- If safe but conditions are deteriorating, consider:
 - Using the fire extinguisher.
 - Cutting the string conductors – one cable at a time with insulated cutters (while wearing appropriate PPE).
- Monitor conditions until low irradiation ~30min prior to sunset. If safe, turn OFF AC and DC switches on the inverter and proceed with normal troubleshooting procedures listed in Table 6-1.

Table 6-1 Fault Codes and Recommended Solutions

FAULT CODE	EXPLANATION
ALARM	
1.CommErr	<p>Definition:</p> <p>Communication inside inverter failed</p> <p>Possible causes:</p> <p>Terminal block connecters of internal communication wires have poor contact</p> <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1.Observe for 5 minutes and see whether the alarm will be eliminated automatically; 2.Switch off 3-phase working power supply and then reboot the system; 3.Contact after-sales service personnel
2.ExtFanErr	<p>Definition:</p> <p>Cooling fan failure</p> <p>Possible causes:</p> <ol style="list-style-type: none"> 1.Fan is blocked; 2.Fan service life has expired; 3. Fan socket connector has poor contact. <p>Recommended solutions:</p>

	<ol style="list-style-type: none"> 1.Observe for 5 minutes and see whether the alarm will be eliminated automatically; 2.Check for foreign objects on fan blades; 3.Switch off 3-phase work power supply and then reboot the system; 4.Contact after-sales service personnel <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1.Observe for 5 minutes and see whether the alarm will be eliminated automatically; 2.Check for foreign objects on fan blades; 3.Switch off 3-phase work power supply and then reboot the system; 4.Contact after-sales service personnel
3. IntFanErr	

WARN

Warn0030 (EepromErr)	<p>Definition:</p> <p>Internal alarm</p> <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1.Observe for 5 minutes and see whether the alarm will stop automatically; 2.Contact after-sales service personnel
Warn0040 (DC SPD fault)	<p>Recommended solutions:</p> <p>The alarm is reserved now. The alarms in field can be ignored.</p>
Warn0050 (TempSensorErr)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1.Observe temperature display; 2.Switch off 3-phase working power supply and then reboot the system; 3.Contact after-sales service personnel
Warn0100 (AC SPD fault)	<p>Recommended solutions:</p> <p>The alarm is reserved now. The alarms in field can be ignored.</p>

PROTECTION

Protect0090	<p>Recommended solutions:</p>
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(Bus over voltage)	<p>1. Restart inverter by cycling both AC and DC switches. Wait for one minute between OFF and ON for all energy to discharge.</p> <p>2. If inverter cannot clear fault, replace inverter</p>
Protect0070 (Bus imbalance)	<p>Recommended solutions:</p> <p>1. Raise limit of IDCmax (for example, 400mA) to allow inverter more room to adjust in transient condition to cope with imbalance of impedance and voltage between Grid phases</p> <p>2. If after adjustment, alarm still occurs, replace inverter</p>
Protect0030 (Inverter Over Current)	<p>Recommended solutions:</p> <p>1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge.</p> <p>2. If inverter cannot clear fault, replace inverter</p>
GridV.OutLim	<p>Recommended solutions:</p> <p>1. Make sure the grid connection is good.</p> <p>2. Restart the inverter again.</p>
GridF.OutLim	<p>Recommended solutions:</p> <p>1. check the AC wires connection and AC frequency is in range;</p> <p>2. check the measurement value in LCD, if the grid frequency is in limit, restart the inverter.</p>
Protect0020 (Grid relay error)	<p>Recommended solutions:</p> <p>1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge.</p> <p>2. If inverter cannot clear fault, replace inverter</p>
TempOver (Over-temperature protection)	<p>Recommended solutions:</p> <p>1. Confirm that external ambient temperature is within the specified range of operating temperature;</p> <p>2. Check whether air inlet is blocked;</p> <p>3. Check whether fan is blocked;</p> <p>4. Check whether the location of installation is appropriate or not;</p> <p>5. Observe for 30 minutes and see whether the alarm will be eliminated automatically;</p>

	<p>6.Contact after-sales service personnel</p> <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. If the inverter can start up, then recalibrate. 2. If the inverter always report this alarm and cannot start up, then replace inverter. <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Raise limit of DCImax (for example, 400mA) to allow inverter more room to adjust in transient condition to cope with imbalance of impedance and voltage between Grid phases 2. After raising limit, if inverter cannot clear fault, replace inverter. <p>Check wires of PV and ground:</p> <ol style="list-style-type: none"> 1. Turn OFF AC switch to disconnect inverter from Grid. 2. Open fuse drawers to de-couple PV strings from each other. Test strings with string test set. 3. Add one PV string at a time, and start up inverter to see if alarm occurs. 4. If there is no alarm, turn OFF AC switches to disconnect from Grid and add in the next string. Startup inverter again. 5. Continue until you can find the string that triggers the alarm. Trace wirings of faulted string to find any leakage to Earth Ground. 6. The parameter ISOResist in hidden menu can be adjusted a bit. <p>Check wires of PV and ground:</p> <ol style="list-style-type: none"> 1. Turn OFF AC switch to disconnect inverter from Grid. 2. Open fuse drawers to de-couple PV strings from each other. Test strings with string test set 3. Add one PV string at a time, and start up inverter to see if alarm occurs. 4. If there is no alarm, turn OFF AC switches to disconnect from Grid and add in the next string. Startup the inverter again. 5. Continue until you can find the string that triggers the alarm. Trace wirings of faulted string to find any leakage to Earth Ground. <p>Recommended solutions:</p>
Protect0180 (The sampling offset of DCI)	
Protect0170 (DCI high)	
IsolationErr (Insulation resistance low)	
GFCIErr (leakage current high)	
Protect0150	

(Mini MCU Fault)	<ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter
Protect0110 (BUS over voltage (firmware))	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter
Protect0100 (The sensor fault of leakage current)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace Filter board or inverter.
PV Reverse (PV input reverse connection)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Turn DC Switch OFF 2. Open Fuse holder to isolate PV source circuits 3. Use meter to find out which PV source circuit is connected in reverse polarity 4. Correct PV source circuit connection
PVVoltOver	<p>Recommended solutions</p> <ol style="list-style-type: none"> 1. Measure voltage at DC terminals in wire-box and compare with reading in Measurement menu. PV voltage must be less than 1000V in open circuit condition. 2. If display reading is not within 2% of meter reading, replace inverter. <p>If display reading is within 2% of meter reading, adjust number of PV modules in the source circuit.</p>
Protect0230 (Inverter open-loop self-test fault)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter
ARC Protect	<p>Recommended solutions</p> <ol style="list-style-type: none"> 1. Check logic connector to Arc board to be secure.

	<p>2. Run Arc Fault Test from Settings Menu.</p> <p>3. If Alarm re-occurs, replace arc board or wire-box</p> <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Check logic connector to Arc board to be secure. 2. Run Arc Fault Test from Settings Menu. 3. If Alarm re-occurs, replace arc board or wire-box
FAULT	
Fault0130 (Bus over total voltage)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter. <p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Raise limit of IDCmax (for example, 400mA) to allow inverter more room to adjust in transient condition to cope with imbalance of impedance and voltage between Grid phases. 2. If after adjustment, alarm still occurs, replace inverter.
Fault0110 (Bus imbalance)	
Fault0100 (Grid relay fault)	<p>Recommended solutions:</p> <ol style="list-style-type: none"> 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter <p>Check wires of PV and ground:</p> <ol style="list-style-type: none"> 1. Turn OFF AC switch to disconnect inverter from Grid. 2. Open fuse drawers to de-couple PV strings from each other. Test source circuits with source circuit test set 3. Add one PV string at a time and start up inverter to see if alarm occurs. 4. If there is no alarm, turn OFF AC switches to disconnect from Grid and add in the next string. Startup inverter again. 5. Continue until you can find the string that triggers the alarm. Trace wirings of faulted string to find any leakage to Earth Ground.
Fault0090 (Static leakage current high)	

Fault0060 (CPLD Fault)	Recommended solutions: 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace Control Board or inverter
Fault0020 (Bus over volt Hardware)	Recommended solutions: 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter
Fault0150 (Open-loop self-check failure)	Recommended solutions: 1. Restart inverter by recycle both AC and DC switches. Wait for 1 minute between OFF and ON for all energy to discharge. 2. If inverter cannot clear fault, replace inverter

7. Maintenance and Decommissioning of Inverters

This section defines the activities required to properly maintain the inverter and must be done by qualified personnel, trained in the installation, decommissioning and maintenance of PV inverters.

7.1 Product Maintenance

Maintenance is required to ensure the inverter remains in proper condition, prolonging service life and preventing potential issues.

7.1.1 Check Electrical Connections

Check all conductor connections as regular maintenance inspection every 6 months to one year, depending on the temperature changes at the installation site.

Check the conductor/cable connections. If loose, tighten all the terminals to proper torque, referring to Chapter 3 Installation.

Check for damage to the conductor/cable jacket. Repair or replace any damaged conductors/cables.

7.1.2 Clean the Air Vent Grate

The inverter can become hot during normal operation. It uses built in cooling fans to provide sufficient air flow and to help in heat dissipation.

Check the air vent grate regularly to make sure it is not blocked. Clean the grate with a soft brush or vacuum cleaner attachment if necessary. The frequency of this cleaning depends on the installation environment.

7.1.3 Replace the Cooling Fans

If the internal temperature of the inverter is too high or abnormal noise is heard, assuming the air vent is not blocked and is clean, it may be necessary to replace the external fans. Please refer to Figure 7-1 for replacing the cooling fans.

- Use a No. 2 Phillips head screwdriver to remove the 2 screws on the fan tray.
- Disconnect the waterproof cable connector from the cooling fan.
- Use a No. 2 Phillips head screwdriver to remove the screws. Each fan is attached to the fan tray with 4 screws.
- Attach the new cooling fans on the fan tray and screw into place. Fasten the cable on the fan tray with cable ties.
 - Torque value: 0.8-1N.m (7.1-8.91in-lbs)
- Install the assembled fan tray back on the inverter and secure with the original screws.
 - Torque value: 1.2N.m (10.6in-lbs)

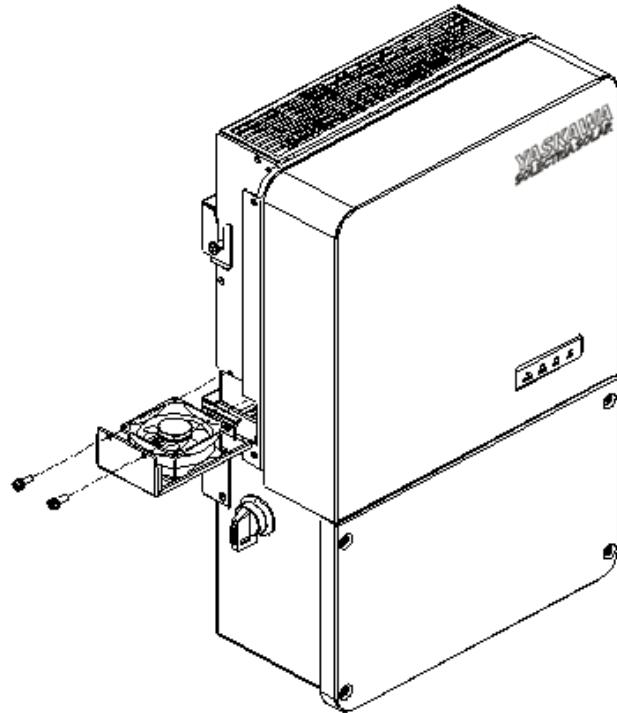


Figure 7-1 Replacing Cooling Fans

7.1.4 Replace the Inverter

Please confirm the following items before replacing the inverter:

- The AC breaker of inverter is turned off.
- The DC switch of the inverter is turned off.

Now replace the inverter according to the following steps:

- Unlock the padlock if one is installed on the inverter.

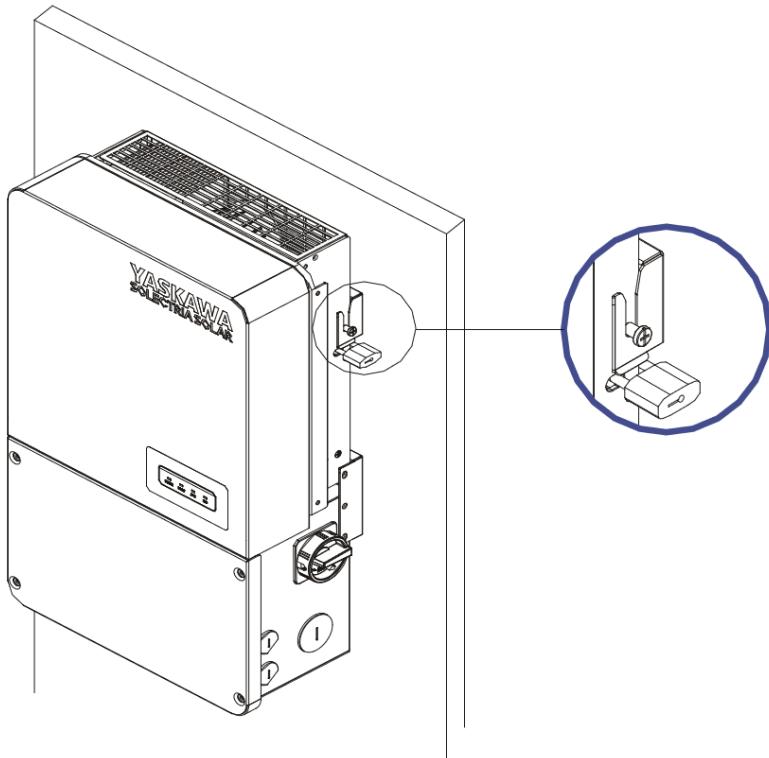


Figure 7-2 Unlock the Padlock

- Use a No. 3 Phillips head screwdriver to unscrew the 2 screws on both sides of the inverter.

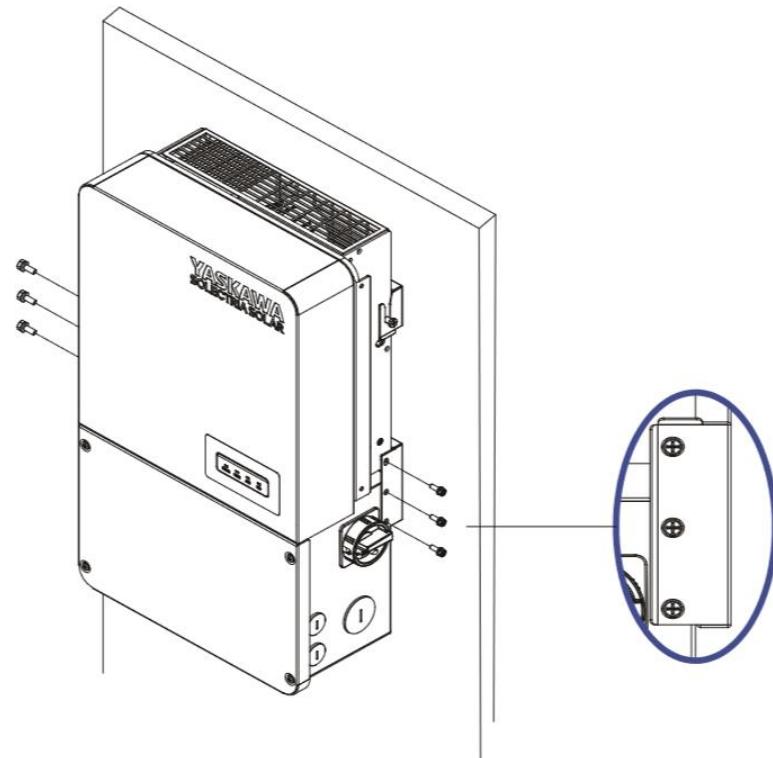


Figure 7-3 Remove the Screws on Both Sides

- Use a No. 10 Hex wrench to remove the 4 screws between the inverter and the wire-box. Lift the inverter enclosure and disconnect from the wire-box.

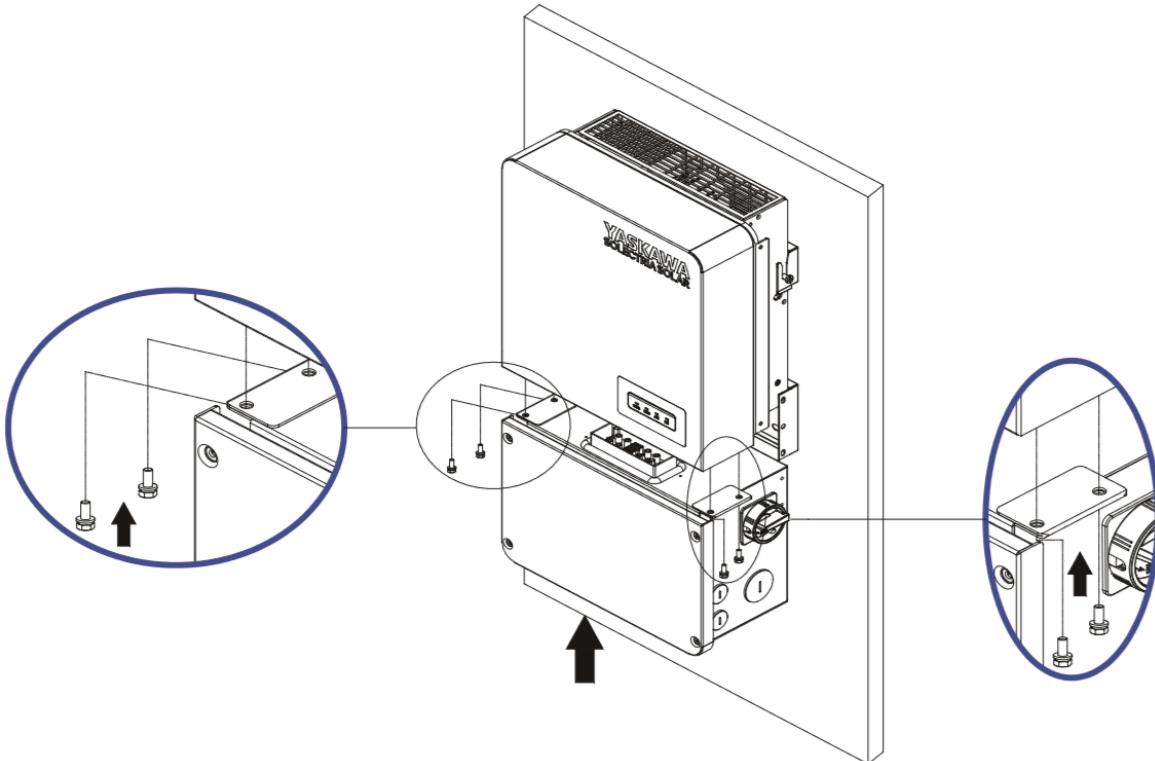


Figure 7-4 Disconnect the Main Housing from the Wire-Box



DANGER

Electric Shock Hazard: Please make sure to follow this procedure in order to avoid inverter failure or possible electrical shock that could result in death.

- If the replacement inverter is to be installed immediately, skip this step and refer to section 3.2.6 for installation of the inverter. Otherwise, use a No. 2 Phillips head screwdriver to remove the 2 screws on the left side of the wire-box, and remove the bulkhead cover. Attach the cover on the connector of wire-box.
 - Torque value: 1.6N.m (14.2in-lbs)

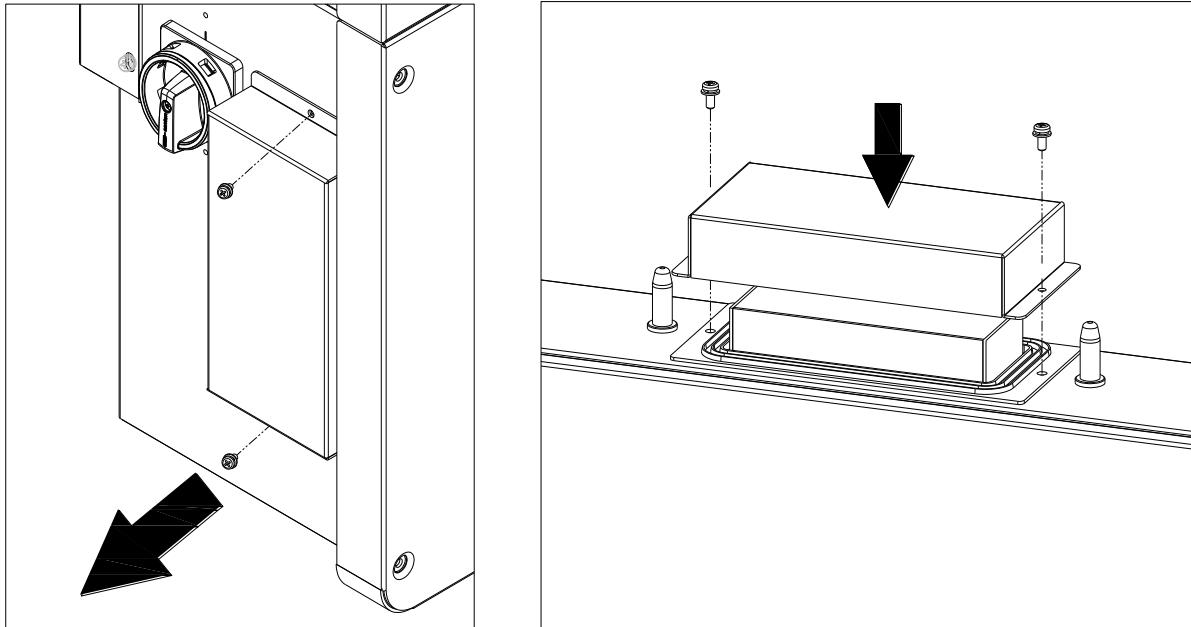


Figure 7-5 Install the cover on the connector of the Wire-Box

7.2 Uninstall the Inverter

Uninstall the inverter and wire-box assembly according to the following steps:

- Turn off the external AC breaker and/or system disconnect switch using lock-out/tag-out procedures.
- Turn off the external DC breaker and/or disconnect switch, if present, and use lock-out/tag-out procedures.
- Switch the inverter's AC disconnect switch to "OFF" position.
- Switch the inverter's DC disconnect switch to "OFF" position.
- Wait for 5 minutes to ensure the internal capacitors have been completely discharged.
- Measure the AC output conductor terminal voltage against the ground. The meter should now read 0V.
- Disconnect the AC and grounding (PE) cables referring to "3 Electrical Installation AC Method".
- Disconnect the DC cables referring to "3.4.6 Electrical Installation DC Method".

CAUTION

Energized conductors

- If PV strings terminate directly into the wire-box and do not pass through a breaker or switch that was opened in Step 2 of Section 7.2 Uninstall the Inverter, these homerun conductors may be energized.

Uninstall the inverter by reversing the installation steps found in section 3.2.

8. Accessories

The Yaskawa Solectria Solar PVI 25TL-480-R inverters have several optional accessories that allow the inverter to support a wide range of real-world applications.

8.1 Roof Racking and Shade Cover Kit (OPT-ROOFKIT-PVI-25TL)

A complete Shade Cover and Roof Mounting Legs Kit ships with the components shown in Figure 8-1 Components of OPT-ROOFKIT-PVI-25TL and described in Table 8-1. The legs are to be mounted onto horizontal strut or roofing blocks not provided in the kit. Since all roofs are different, it is the responsibility of the customer to select the correct roofing block for this application.

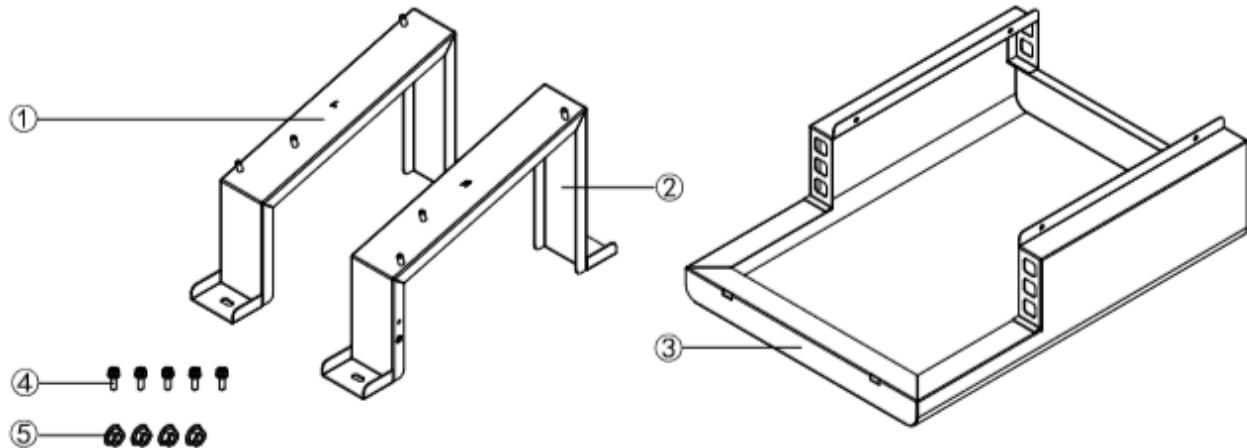


Figure 8-1 Components of OPT-ROOFKIT-PVI-25TL

Table 8-1 Shipped Components with OPT-ROOFKIT-PVI-25TL

IDENTIFIER	PART	QUANTITY	DESCRIPTION
1	Left Rack	1	
2	Right Rack	1	
3	Shade Cover	1	
4	Screws M6 x L18	5	For shade cover and ground
5	Flange Nuts M8	6	For the rack

8.1.1 Roof Mounting Legs (Standoffs)

The Roof Mounting Legs are simple racks that will allow you to mount the inverter at 15° from horizontal, as shown in Figure 8-2 Roof Mounting Legs Provide a 15° Tilt Figure 8-2. It must be placed on level ground and attached to roofing blocks or horizontal struts, not included in the kit. The bracket that holds the inverter mounts neatly on this rack, as shown in Figure 8-3.

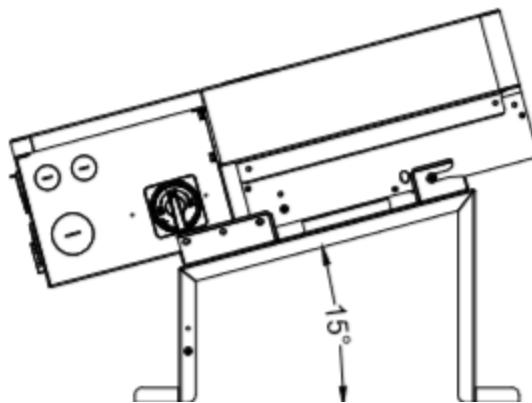


Figure 8-2 Roof Mounting Legs Provide a 15° Tilt

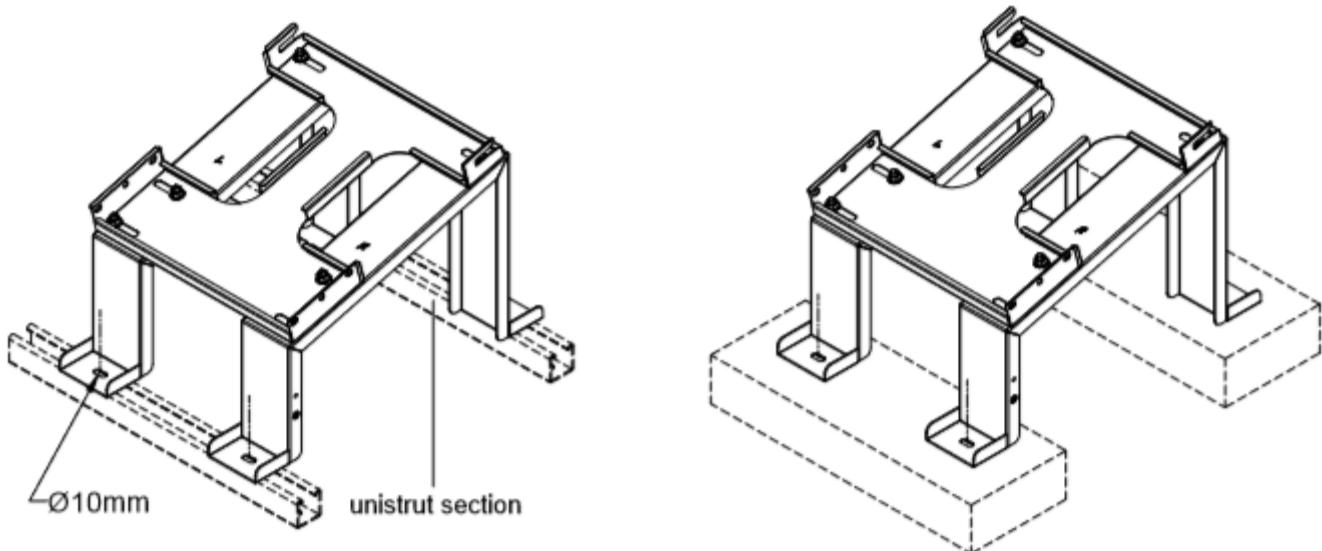
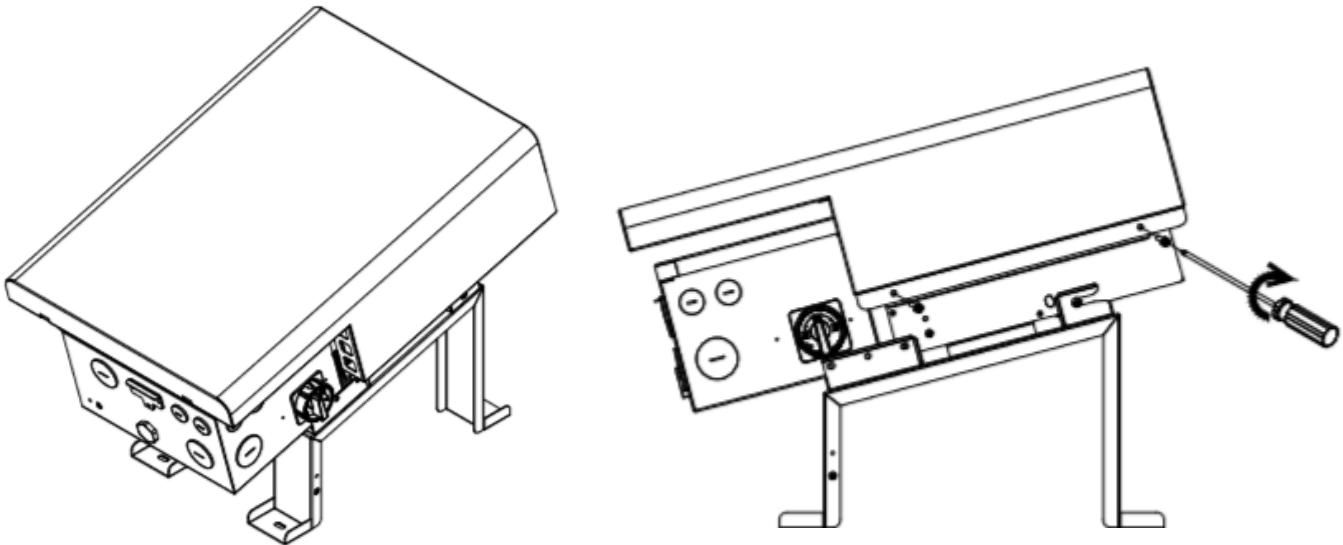


Figure 8-3 Different Customer-Provided Horizontal Roofing Struts Used to Mount the Roof Mounting Legs

8.1.2 Shade Cover

NOTICE!

Inverters at 75° or lower: If the Yaskawa Solectria Solar PVI 25TL-480-R is to be mounted at any angle lower than 75° from horizontal, a shade cover is required.



Shade covers provide added protection for inverters against harsh environmental conditions like direct sunlight, snow, sleet, ice, hail, and reduce soiling from dust and birds.

Depending on the application and environment, shade covers will help to increase energy production by reducing potential power derating due to excessive ambient temperatures. Inverters de-rate in extreme temperatures to protect themselves from over-temperature conditions.

Third party field testing at PVEL showed up to 15% reduction in operating temperatures of inverters with shade covers installed in direct sunlight.

If the Yaskawa Solectria Solar PVI 25TL-480-R is to be mounted at any angle lower than 75° from horizontal, a shade cover is required.

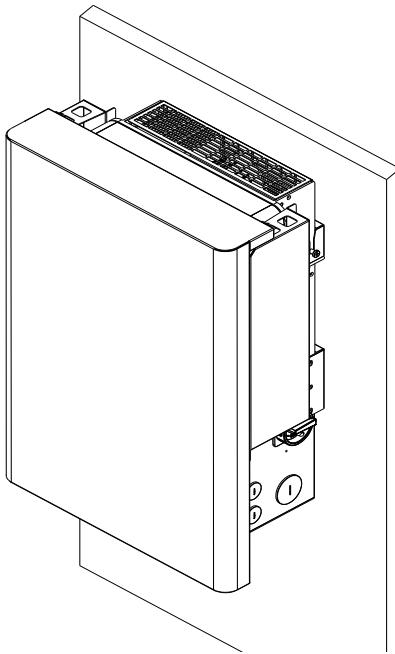


Figure 8-4 Shade Cover as Installed on PVI 25TL-480-R Inverter

9. Technical Data

9.1 Datasheet

Model Name	PVI 25TL-480-R
DC Input	
Max. PV Power	37.5kW (22kW per MPPT)
Max. DC Input Voltage	1000V _{DC}
Operating DC Input Voltage Range	200-950V _{DC}
Start-up DC Input Voltage / Power	330V / 80W
Number of MPP Trackers	2
MPPT Voltage Range	560-850V _{DC}
Max. PV Short-Circuit Current (I _{sc} x 1.25)	45A per MPPT
Number of DC Inputs	6 inputs, 3 per MPPT
DC Disconnection Type	Load-rated DC switch
DC Surge Protection	Type III MOV, 1240V _C , 15kA I _{TM} (8/20μS)

AC Output	
Rated AC Output Power	25kW
Max. AC Apparent Power	25kVA
Rated Output Voltage	480V _{AC}
Output Voltage Range	422-528V _{AC}
Grid Connection Type	3Φ/PE/N (Physical Neutral optional)
Max. AC Output Current @480V _{AC}	30.5A
Max AC OCPD Rating	50A
Rated Output Frequency	60Hz
Output Frequency Range ¹	57-63Hz
Power Factor	>0.99 (± 0.8 adjustable)
Current THD	<3%
Max. Fault Current Contribution (1 Cycle RMS)	28.2A
AC Disconnection Type	Load-rated AC switch
AC Surge Protection	Type III MOV, 1120V _C , 15kA I _{TM} (8/20μS)

Note 1: The “Output Voltage Range” and “Output Frequency Range may differ according to the chosen grid standard.

System	
Topology	Transformerless
Max. Efficiency	98.5%
CEC Efficiency	98.0%
Stand-by / Night Consumption	<5W
Environment	
Enclosure Protection Degree	NEMA Type 4X
Cooling Method	Variable speed cooling fans
Operating Temperature Range	-22°F to +140°F / -30°C to +60°C (derating from +113°F / +45°C)

Non-Operating Temperature Range	No low temp minimum to +158°F / +70°C maximum
Operating Humidity	0-100%
Operating Altitude	13,123.4ft / 4000m (derating from 9842.5ft / 3000m)
Audible Noise Emission	<60dBA @ 1m and 25°C
Display and Communication	
User Interface and Display	LED, FOMlink Dongle (Bluetooth, Wi-Fi)
Inverter Monitoring	SunSpec, Modbus RS485
Site Level Monitoring	Ethernet Network Card (1 per 32 inverters)
Modbus Data Mapping	Solectria Proprietary, Complies with SunSpec Modbus
Remote Diagnostics / FW Upgrade Functions	Standard / with Ethernet Network Card
Mechanical Data	
Dimensions (WxHxD)	Powerhead: 400mm(W)*200mm(D)*405mm(H) Wire-box: 400mm(W)*200mm(D)*260mm(H)
Weight	Inverter: 48.5 lbs (22kg); Wire-box: 13 lbs (6kg)
Mounting / Installation Angle	15 to 90 degrees from horizontal (vertical, angled)
AC Termination	Screw Clamp (Wire range: #8 - #2 AWG CU/AL)
DC Termination	Screw Clamp, Wire range: #14 - #8AWG CU
Fused String Inputs (5 per MPPT)	15A standard fuse value (Fuse values up to 30A acceptable)
Safety	
PV Arc-Fault Circuit Protection	Type 1
Safety and EMC Standard	UL1741SA-2016, UL1699B, CSA-C22.2 NO.107.1-01, IEEE1547a-2014; FCC PART15

Grid Standard and SRD	IEEE1547a-2014; FCC PART15
Smart-Grid Features	Volt-Ride Through, Freq-Ride Through, Ramp-Rate, Specified-PF, Volt-VAr, Freq-Watt, Volt-Watt

9.2 Measurement Tolerances

The data supplied by the inverter may differ from measurements taken by certified measuring instruments (e.g. output meters, multimeters and grid analyzers). The inverter is not a measuring instrument and has wider tolerances for the measurements it makes.

Inverter tolerances are generally:

- $\pm 5\%$ for real-time measurements with output power below 20% nominal power
- $\pm 3\%$ for real-time measurements with output power above 20% nominal power
- $\pm 4\%$ for all statistical data

Yaskawa Solectria Solar PVI 25TL-480-R inverter tolerances are specified below:

- | | |
|---------------------------|-----------------------|
| • Voltage tolerances: | $\pm 1\%$ |
| • Current tolerances: | $\pm 2\%$ |
| • Frequency tolerances: | $\pm 0.5\%$ |
| • Power tolerances: | $\pm 3\%$ |
| • Time tolerances: | $\pm 1\%$ |
| • Temperature tolerances: | $\pm 2^\circ\text{C}$ |

9.3 Production Graphs

The following sections illustrate the inverter production/derating in terms of DC voltage, ambient temperature, altitude and grid voltage.

9.3.1 DC Voltage Derating Graph

While the Solectria PVI 25TL-480-R inverter has the ability to operate from 200-950 V_{dc} (Operating Voltage Range), it will only be able to output full rated power (25kW) from 560-850Vdc (Maximum Power Voltage Range). It is recommended to design the PV array so that the source circuits will have a V_{mp} that lies within the Maximum Power Voltage Range. If this is not possible, please refer to Figure 9-1 to see the effect of V_{mp} on output power.

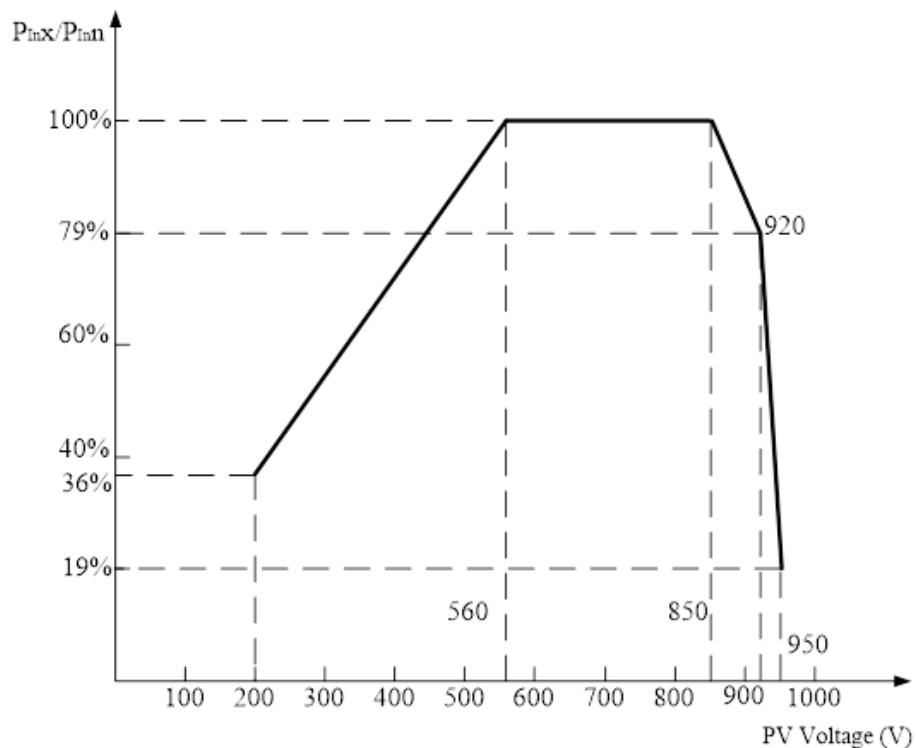


Figure 9-1 PVI 25TL-480-R Derating with respect to DC Voltage

9.3.2 High Temperature Derating Graph

When the ambient temperature is higher than 113°F (45°C), the inverter output power (P_n) will begin to de-rate, as shown in Figure 9-2.

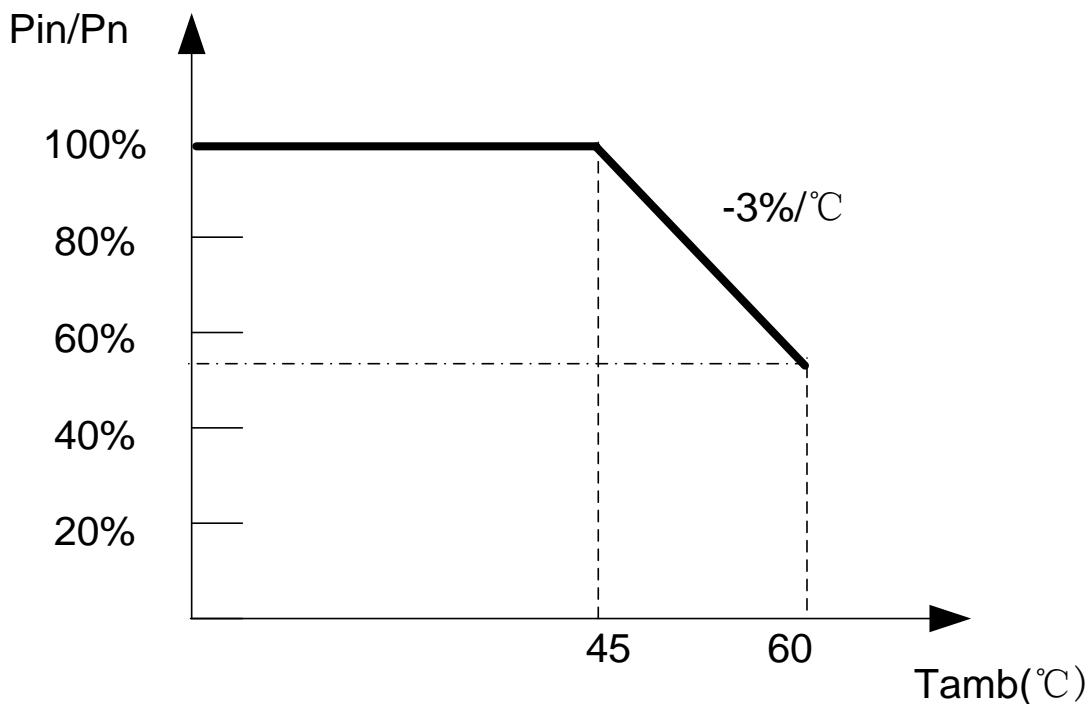


Figure 9-2 PVI 25TL-480-R Derating Curve with High Temperature

9.3.3 Altitude Derating Graph

When the altitude is higher than 8202.1ft (2500m), the rated output power (P_n) of the inverter will decrease, as shown in Figure 9-3.

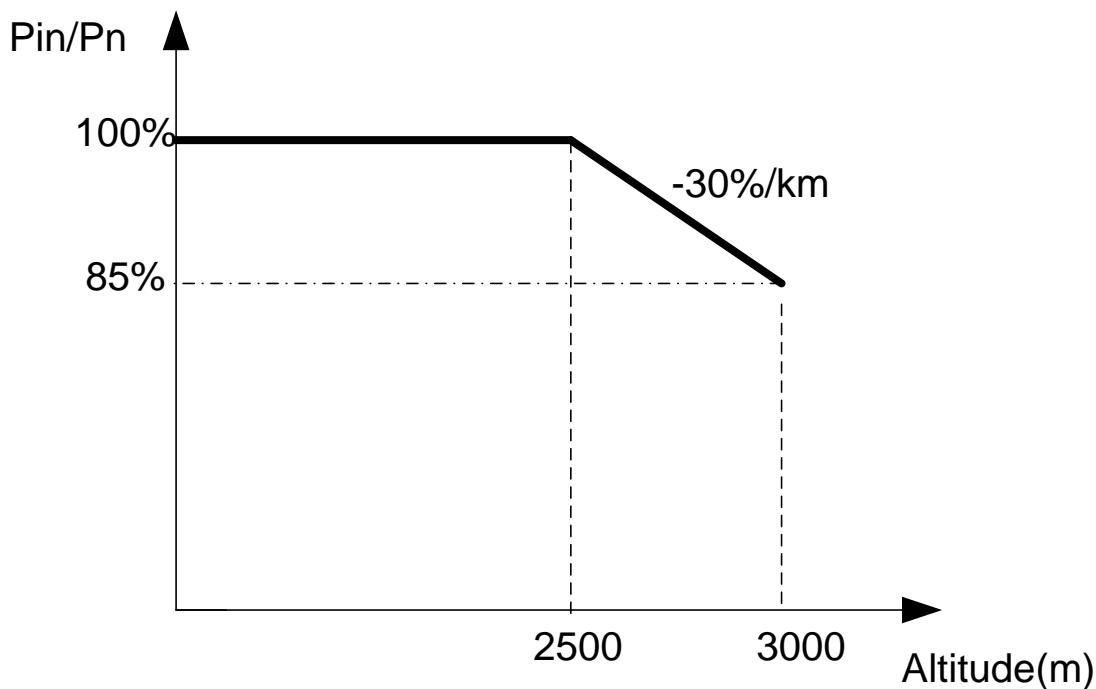


Figure 9-3 PVI 25TL-480-R Derating Curve with High Altitude

9.3.4 Grid Voltage Derating Graph

When the grid voltage is within 100% to $\sim 110\%$ (V_{nom} to $\sim 1.1 \cdot V_{\text{nom}}$) of the Rated Output Voltage, the inverter output power (P_n) may reach 100%. When the grid voltage is lower than the Rated Output Voltage, the inverter will limit the AC Output Current and the output power (P_n) will begin to de-rate, as shown in Figure 9-4.

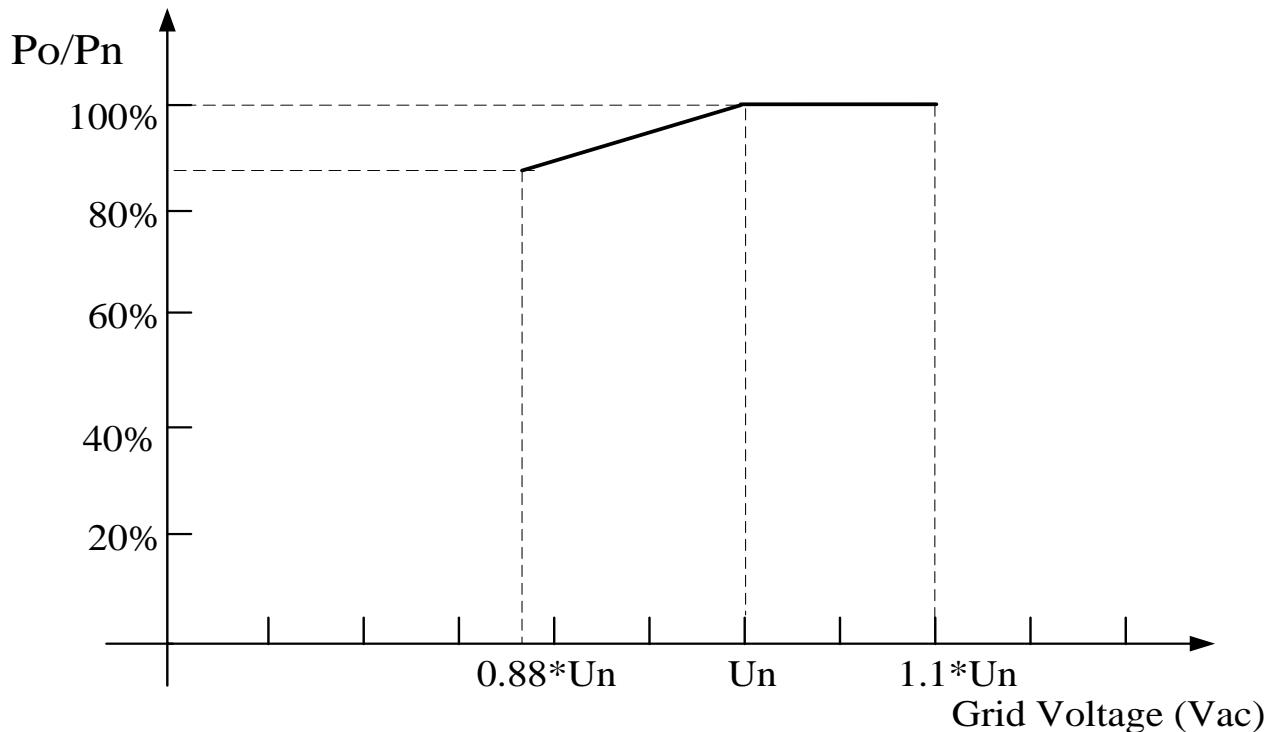


Figure 9-4 PVI 25TL-480-R Derating Curve in Respect to Grid Voltage

10. Appendix

10.1 Warranty and RMA Instructions

For all warranty information, please visit:

<http://solectria.com/support/documentation/warranty-information/grid-tied-inverter-warranty-letter/>

10.2 Datasheet

For the most up to date official datasheet, please visit www.solectria.com.

2.1 Contact Information

Telephone	978.683.9700
Fax	978.683.9702
Sales Support	inverters@solectria.com
Technical Support & Service (After Sales Support)	978.683.9700 extension 2
Website	www.solectria.com