

ABB solar inverters

Product manual

PVI-5000-6000-TL-S-US (-A)

(5 to 6 kW)



List of related manuals

UNO manuals and guides	Code (English)
PVI-5000-6000-TL-OUTD-US (-A) Quick Installation Guide	BCM.00163.1



IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety instructions that must be followed during installation and maintenance of the inverter.



SAVE THESE INSTRUCTIONS!

Keep this document in a safe place near the inverter for easy access during installation and maintenance.

THE INSTALLER MUST READ THIS DOCUMENT IN ITS ENTIRETY BEFORE INSTALLING OR COMMISSIONING THIS EQUIPMENT.

The purpose of this document is to support the qualified technician, who has received training and/or has demonstrated skills and knowledge in construction, to install and maintain this inverter.

This manual does not cover any details concerning equipment connected to the inverter such as the solar modules. Information concerning the connected equipment is available from the respective manufacturers.



Warranty conditions can be found on the UNO product page of the website.

NOTE: Any changes or modifications not approved by the responsible party could void the user authority to operate the equipment.

FCC REMARKS

The equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.



However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Product Manual

PVI-5000/6000 string inverters

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2 - Installation location



3 - Mounting and wiring



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Introduction and safety

1

Warnings in this document

This is a list of special safety symbols used in this manual that highlight potential safety risks and/or useful information. The symbol usage is described below:

**CAUTION**

The reader should stop, use caution and fully understand the operations explained before proceeding.

**DANGEROUS VOLTAGE**

The product works with high voltages. All work on the inverter must follow the described documentation and must comply with all prevailing codes and regulations associated with high voltages.

**HOT TEMPERATURE**

Some surfaces may become hot; do not touch the product while it is in operation.



UL1741 Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources. CSA-C22.2 No. 107.1-01 - General Use Power Supplies.

Equipment safety warnings

In addition to the safety and hazard symbols, the following symbols are also used in this installation guide



System earth conductor (equipment ground, protective earth)



Alternating current (AC)



Phase



Direct current (DC)



Grounding (earth)

General installation warnings

The ABB transformerless inverter is designed and tested according to international safety requirements (UL1741/IEEE1547); however, certain safety precautions must be observed when installing and operating this inverter. Read and follow all instructions, cautions and warnings in this installation manual.

All operations regarding transport, installation start up, and maintenance, must be carried out by qualified, trained personnel and in compliance with all prevailing local codes and regulations.

Assembly warnings

Prior to installation, inspect the unit to ensure absence of any transport or handling damage, which could affect insulation integrity or safety clearances; the failure to do so could result in safety hazards.

Assemble the inverter per the instructions in this manual. Use care when choosing the installation location and adhere to specified cooling requirements.

Unauthorized removal of necessary protection features, improper use, incorrect installation or operation may lead to serious safety and shock hazards and/or equipment damage.

Electrical connection warnings

This grid-tied inverter system operates only when properly connected to the AC utility grid. Before connecting the inverter to the AC utility grid, contact the local power distribution company to receive the appropriate approvals. This connection must be made only by qualified technical personnel.



Wiring methods used should be in accordance with the National Electric Code, ANSI/NFPA 70 (NEC), Canadian Electric Code (CEC), and/or other local codes and regulations.

WARNING: To reduce the risk of fire, connect only to a circuit provided with 25A, 30A, 35A for PVI-5000-OUTD-US(-A) or 30A, 35A, 40A for PVI-6000-OUTD-US(-A) maximum branch circuit overcurrent protection in accordance with the National Electric Code (ANSI/NFPA 70). See Maximum AC OCPD requirement in Appendix, section 7.



The inverter should be connected only to a dedicated branch circuit. ABB DOES NOT provide AC output overcurrent protection; it is the responsibility of the end user to provide protection for the AC output circuit.

Connect only to a circuit provided with the maximum branch OCPD in accordance with the CSA document available on the website and listed in the technical data of the appendix, section 7.

Safety instructions

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions. Be sure all flammable materials including construction items are away from the unit. Do not install the inverter in or near potentially explosive areas.

The inverter is designed without an isolation transformer and is intended to be installed per NFPA 70, 690.35 with an ungrounded PV array. These models have no grounded input conductors.



General information

The equipment has been manufactured in accordance with the strictest accident-prevention regulations and supplied with safety devices suitable for the protection of components and operators. Inform ABB about non-standard installation conditions.

It is essential to provide operators with correct information. They must read and comply with the technical information given in the manual and any other attached documentation. The instructions given in the manual do not replace the information and warnings on the safety labels mounted on the product. They do not replace the safety regulations enforced in the country of installation.

Maintenance operations must be carried out according to the maintenance section 6 of this manual. Do not use the equipment if any operating anomalies are found. Liabilities arising from commercial components are delegated to their respective manufacturers.

Thermal and voltage hazard



WARNING: Depending upon ambient temperatures during operation and immediately following shut down, surface temperatures on the cooling fins (heat sink) and some areas of the chassis may be extremely hot to the touch.

Prior to touching any part of the inverter use care to ensure surfaces and equipment are at touch-safe temperatures and voltages before proceeding.

The customer and/or installer must appropriately instruct all personnel who may come near the equipment, and highlight, if necessary with notices or other means, the hazardous areas or operations: magnetic fields, hazardous voltages, high temperatures, possibility of discharges, generic hazard, etc.

Anytime the inverter has been disconnected from the AC utility grid, use extreme caution as some components can retain charge sufficient to create a shock hazard and may need time to dissipate the charge. To minimize occurrence of such conditions, comply with all corresponding safety symbols and markings present on the unit and in this manual.

Clothing and protective devices

Appropriate Personal Protective Equipment (PPE) must be worn at all times when servicing this equipment under any conditions which may subject personnel to hazardous voltages or temperatures that are not touch-safe.

All operations on the equipment should be performed with properly electrically insulated instruments.

Location of safety notices and labels

Note the location of safety notices on the inverter for notification and protection. Labels must not be hidden with external objects or parts such as rags, boxes, or other such equipment. They should be cleaned periodically and always maintained in view.

Appropriate usage

The inverter is a photovoltaic inverter that converts direct current of a connected PV array into alternating current and feeds that power into the AC utility grid. This inverter is designed for outdoor use, but can be used indoors if installed to specified environmental and mounting parameters stated in this manual, and adherence to the National Electric Code. (See environmental conditions below and environmental checks in section 2.)

Conditions of Use



WARNING! This inverter utilizes a transformerless design and requires connected array(s) to be floating with respect to ground; it can be used only with photovoltaic modules that do not require one of the terminals to be grounded.

- The DC and AC operating currents **MUST NOT** exceed the limits documented in the technical specifications.
- The inverter is certified for use only with photovoltaic arrays connected to its input channel(s). Do not connect batteries or other types of power sources.
- The inverter can only be used if all the technical requirements in this manual are observed and applied.

Environmental conditions

Adverse environmental conditions can lead to a reduction in performance. The equipment should be installed outdoors, but only in environmental conditions indicated in this manual. Care must be taken to provide adequate ventilation if installed indoors.

Improper or prohibited use

The following actions are dangerous and not consistent with acceptable practice under the terms of the warranty:

- Installing the equipment in environments with flammable conditions.
- Using the equipment with safety devices not working or disabled.
- Using the equipment or parts of the equipment by connecting it to other machines or equipment, unless otherwise expressed.
- Modifying areas that are operator restricted and/or altering parts of the equipment in order to vary the performance or change its protection.
- Cleaning with corrosive products that may corrode parts of the equipment or with products that might generate electrostatic charges.
- Using or installing the equipment or parts of it without having read and correctly interpreted the contents of this manual.
- Blocking airflow to the cooling fins (e.g., warming or drying rags) on the unit or accessory parts is dangerous and could compromise the inverter operation.



Arc fault detection (AFD)

The 2011 National Electric Code (NEC) and 2013 Canadian Electric Code (CEC) includes a new condition that requires a photovoltaic system with a DC voltage greater than 80V, and which is on a building or whose DC conductors enter a building, be equipped with a Listed device which can detect a DC arc fault and interrupt the circuit. This functionality is commonly referred to as a DC Arc Fault Current Interruption.

The ABB DC ARC FAULT DETECTOR and INTERRUPTOR (AFDI) solution is based on Digital Signal Processor (DSP) technology. The AFDI module has two independent channels, designed to accommodate the two independent MPPT channels associated with all ABB String inverters, and has two current sensors and associated circuitry to identify the presence of a series DC arc fault at the input of either inverter MPPT channel.

The DC AFDI module performs a self-test every time the system is started and the inverter display shows the result, which can only be pass or fail. If it fails, an error code will be displayed and the inverter will not connect to the grid. If it passes, the inverter connects and works normally.

If a DC arc fault is detected during normal operations, the inverter disconnects from the AC grid. The DC arc fault error is indicated on the inverter display screen and lock out of inverter operation is initiated until the fault is manually reset.



NOTE: Refer to Arc Fault Detection Self-Test Errors (-A Models Only) in section 5 for display error messages and instructions to reset fault conditions or manually start the self-test procedure..

Available versions

This document applies only to the following transformerless inverter models which can be divided into two groups according to their rated output power of 5.0 kW or 6.0 kW.

5.0 kW	PVI-5000-OUTD-US PVI-5000-OUTD-US-A	Unit Weight: 59.5 lbs/27 kg Shipping Weight: 78 lbs/35.4 kg Dimensions H x W x D): 41.4" x 12.8" x 8.6"/ 1052mm x 325mm x 218mm
6.0 kW	PVI-6000-OUTD-US PVI-6000-OUTD-US-A	


For inverters of equal output power, the difference between models is the presence of Arc Fault Detection. A description of the two models can be found below.


Available versions	
PVI-5000/6000-OUTD-US	Wiring box with integrated DC disconnect switch
PVI-5000/6000-OUTD-US-A	DC Disconnect Switch Integrated PV AFCI Type 1 device for arc fault detection (AFD)

Regulatory label

Technical data in this manual does not supersede the data on the labels affixed to the equipment. The nameplate shown is affixed to the inverter and provides the following information:

1. Product origin
2. Model name
3. DC input data
4. AC output data
5. Certification
6. Environmental data
7. Protection
8. Adjustable parameters





www.abb.com/solar
SOLAR UTILITY INTERACTIVE
TRANSFORMERLESS INVERTER
MODEL: PVI-5000-OUTD-US

DC RATING ④	
Nominal Input Operating Voltage	360 V ---
Max. Input Voltage	600 V ---
Range of Input Operating Voltage	90 - 580 V ---
Range of Input Voltage @Full Power	200 - 530 V ---
Max. Input Current	2 x 18 A
Max. Input Short Circuit Current (P.V. Panels)	2 x 22 A

AC RATING ⑤	
Nominal Output Voltage	277 V \sim / 240 V \sim / 208 V \sim 1Ø
Operating Voltage Range	244-304 V \sim /211-264 V \sim /183-228 V \sim
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 (ˆ) - 60.5 (ˆ) Hz
Output Power Factor	>0.995
Max. Output Current	20 A / 23 A / 27 A (rms)
Max. Continuous Output Power	5000 W @ 60°C amb.
Max. Output Overcurrent Protection	25 A / 30 A / 35 A

⑥ Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F), with Output Power Derating
Type of Enclosure: NEMA 4X
⑦ DC Ground Fault Detector/Interrupter is Provided
⑧ (ˆ): Adjustable from 57.0 Hz to 59.8 Hz
(ˆ): Adjustable from 60.2 Hz to 63.0 Hz
For more details about product specifications refer to the Instruction Manual

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Installation location

2

Transportation and handling

Transportation of the equipment, especially by road, must be carried out by suitable ways and means for protecting the components (in particular, the electronic components) from violent shocks, humidity, vibration, etc. During handling, do not make any sudden or fast movements that can create dangerous swinging.

Lifting

ABB packages and protects individual components using suitable means to make their transport and subsequent handling easier. Due to the weight and complexity of this equipment, ABB recommends the process of loading and unloading of this equipment be done by an experienced or specialized staff knowledgeable in material handling. Where indicated or where there is a provision, eyebolts or handles can be inserted and used as lifting points. Do not lift several units or parts of the equipment at the same time, unless otherwise indicated.

Incoming inspection

It is the customer's responsibility to examine the condition of the unit. Upon receipt of the inverter, please check the following:

- Inspect the shipping container for any external damage.
- Inventory the contents against the table below and verify receipt of all items.
- Use care not to discard any equipment, parts, or manuals.
- Call the delivering carrier if damage or shortage is detected.

QTY	Description	QTY	Description
1	Inverter	1	Bag containing hardware:
1	Inverter mounting plate	4	6.3 x 70 screws
1	Quick installation guide	4	S x 10 wall plugs
1	Terms and conditions	1	Red Cable AWG 10
		1	Black Cable AWG 10
		1	6 x 10mm machine screw
		5	6mm flat washer
		1	Torx 20 wrench

Select the installation location

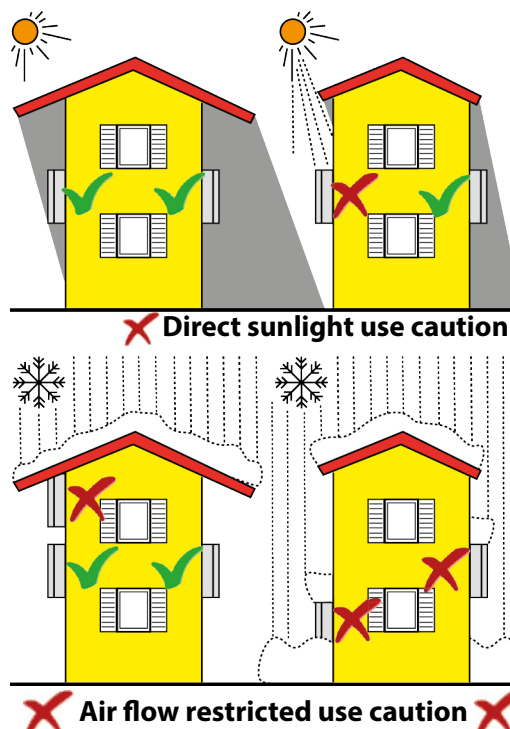


WARNING! The inverter must be installed by qualified installers and/or licensed electricians according to the applicable local code regulations (NEC, CEC, and other).

Once physically mounted, the wiring must be carried out with the equipment disconnected from the grid (power disconnect switch open) and the photovoltaic panels shaded or isolated.

Environmental check

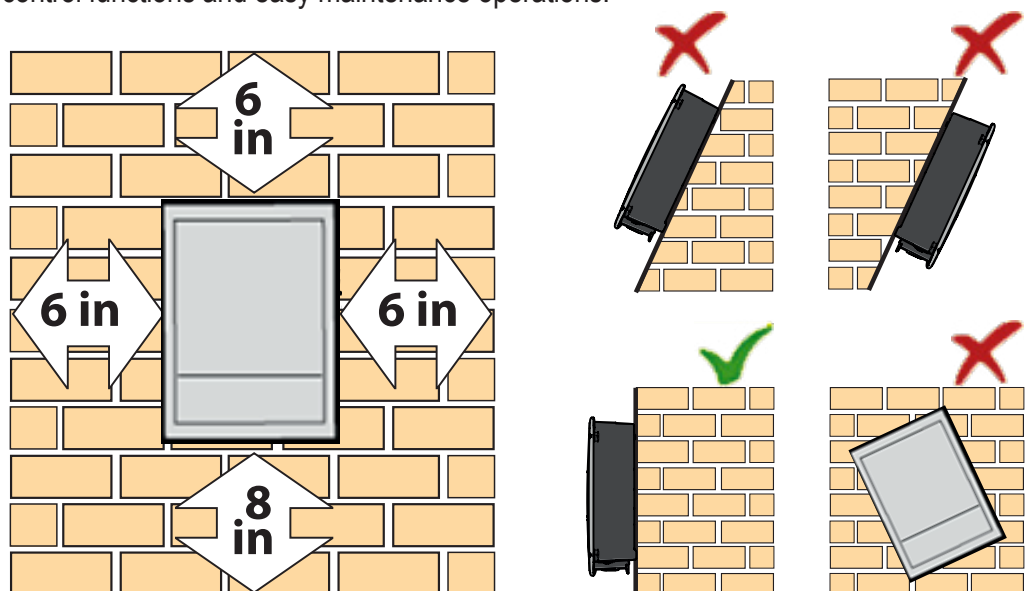
- See technical data in the appendix, section 7, to check the environmental parameters to be observed (degree of protection, temperature, humidity, altitude, etc.).
- The maximum operational ambient air temperature **MUST** be considered when choosing the inverter installation location.
- Installing the inverter where operating temperatures exceed the specifications will result in power limiting. It is recommended the inverter be installed within the specified temperature range.
- Exposure to direct sunlight will increase the operational temperature of the inverter and may cause output power limiting. ABB recommends using a sun shade minimizing direct sunlight when the ambient air temperature around the unit exceeds 104°F/40°C.
- Do not install in small closed spaces where air cannot circulate freely.
- Due to acoustical noise (about 50dBA at 1 m) from the inverter, do not install in rooms where people live or where the prolonged presence of people or animals is expected.
- To avoid overheating, always make sure the flow of air around the inverter is not blocked.
- Do not install in places where gases or flammable substances may be present.



Installation position

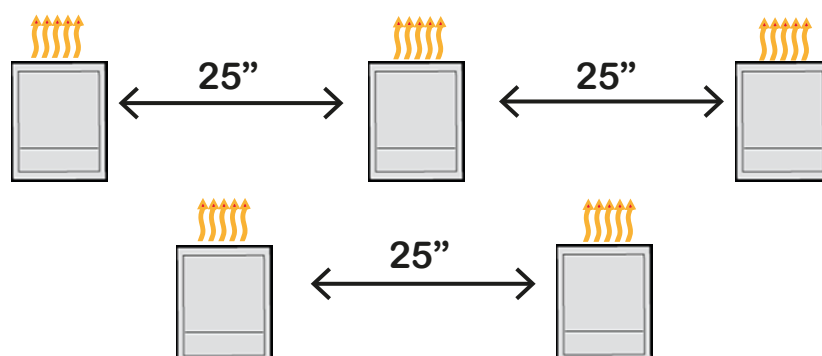
When choosing the installation location and position, comply with the following conditions:

- Install on a wall or strong structure capable of bearing the weight.
- Install vertically with a maximum incline of +/- 5°. If the mounted inverter is tilted to an angle greater than the maximum noted, heat dissipation can be inhibited, and may result in less than expected output power.
- Install in safe place where all switch handles and controls remain easy to reach and meet height requirements of the applicable electrical code. Install at eye level so the display and status LEDs can be easily seen.
- Ensure sufficient working area in front of the inverter to allow removal of the covers and easy access for servicing the inverter.
- When planning the installation, maintain clearance distances shown to allow normal control functions and easy maintenance operations.



For multiple-inverter installations, position the inverters side-by-side, maintaining minimum clearances. If the space available does not allow the side-by-side arrangement, multiple inverters can be placed in a staggered arrangement; this minimizes heat dissipation from lower inverters affecting operation of other inverters.

Minimum clearances illustrated below include width of inverter plus additional allowances for inverters arranged above or below.





Mounting and wiring

3

Wall mounting

The inverter should be mounted vertically as shown in section 2. Follow the steps on the next page for mounting the inverter.

Included in the shipping package is a mounting kit with four screws and four wall plugs provided for mounting the metal bracket to a concrete wall. The screws should be mounted in the four holes present in the bracket (shown as position B at right). Use two additional screws in the two holes shown as position A if needed to ensure stability of the inverter.

If the installation is done on a concrete wall, the wall plugs provided should be used and the mounting holes in the wall should have a 10mm diameter and 75mm depth. When the wall is made of a different material (other than concrete) the installation should be done using adequate mounting material. ABB recommends always using stainless steel screws.

Components included in mounting kit

1 Wall bracket shown at right - 833F2525703-G

1 Hardware bag containing:

4 - 6.3 x 70mm screws, washers, and- S x 10 anchors

4 - 6 x 10mm machine screw 1 - 6mm flat washer

1 - Red cable AWG10 - 9153G038600



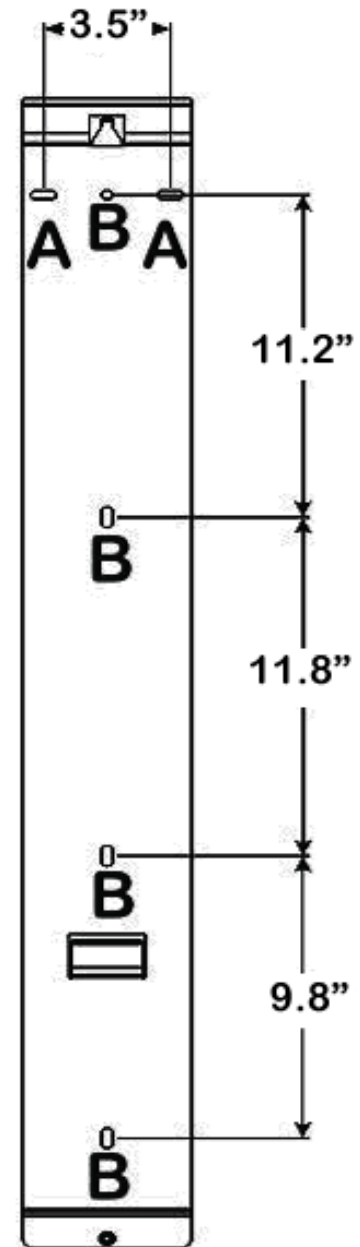
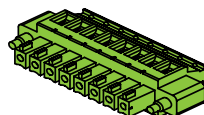
1 - Black cable AWG10 - 9153G038700



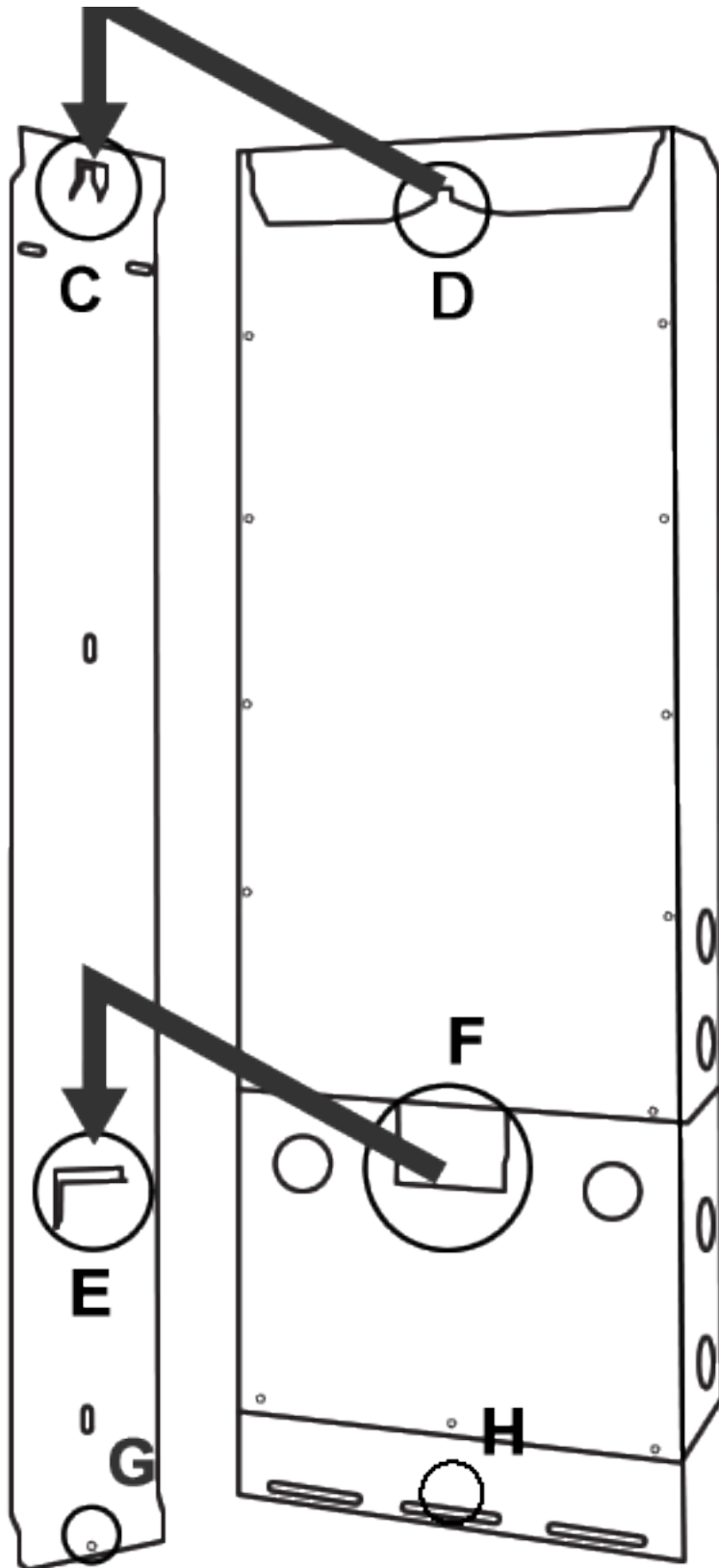
1 - Torx 20 wrench 81510000077



2 - Terminal connectors 82000006439-G



- Using the mounting bracket as a template, locate and mark the desired mounting location.
- Using the four screws provided, level and mount the bracket to the surface using mounting holes B illustrated on previous page.
- Two additional screws can be used if necessary.
- Orient the bracket such that the hooks in position C face outward and upward.
- Hang the inverter on the mounted bracket by lifting the unit up and over the mounting plate.
- Guide the inverter and switchbox brackets engaging the brackets C-D and E-F on the back of the inverter.
- Secure chassis bottom using the machine screw and washer provided through center hole H on the inverter and engaging in the bracket G.
- Add additional screws as necessary through bottom flange securing to mounting surface.



Wiring details



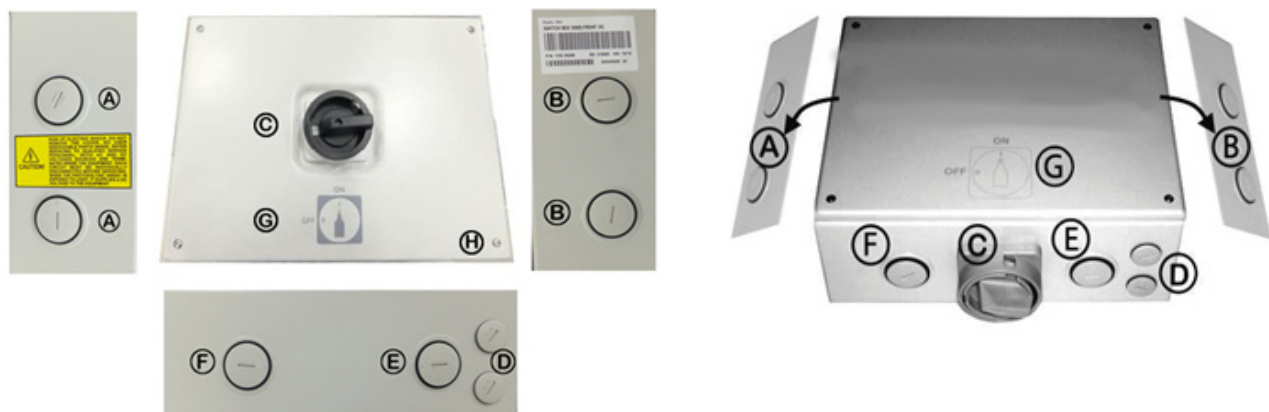
WARNING: Always respect the nominal ratings of voltage and current defined in the Appendix, section 7, when designing the system. Observe the following considerations in designing the photovoltaic system:

- Maximum array DC voltage input to each MPPT circuit: 600 Vdc under any condition.
- The maximum allowable input short circuit current limit of the PV array for each MPPT input channel is 22Adc.

Wiring box components

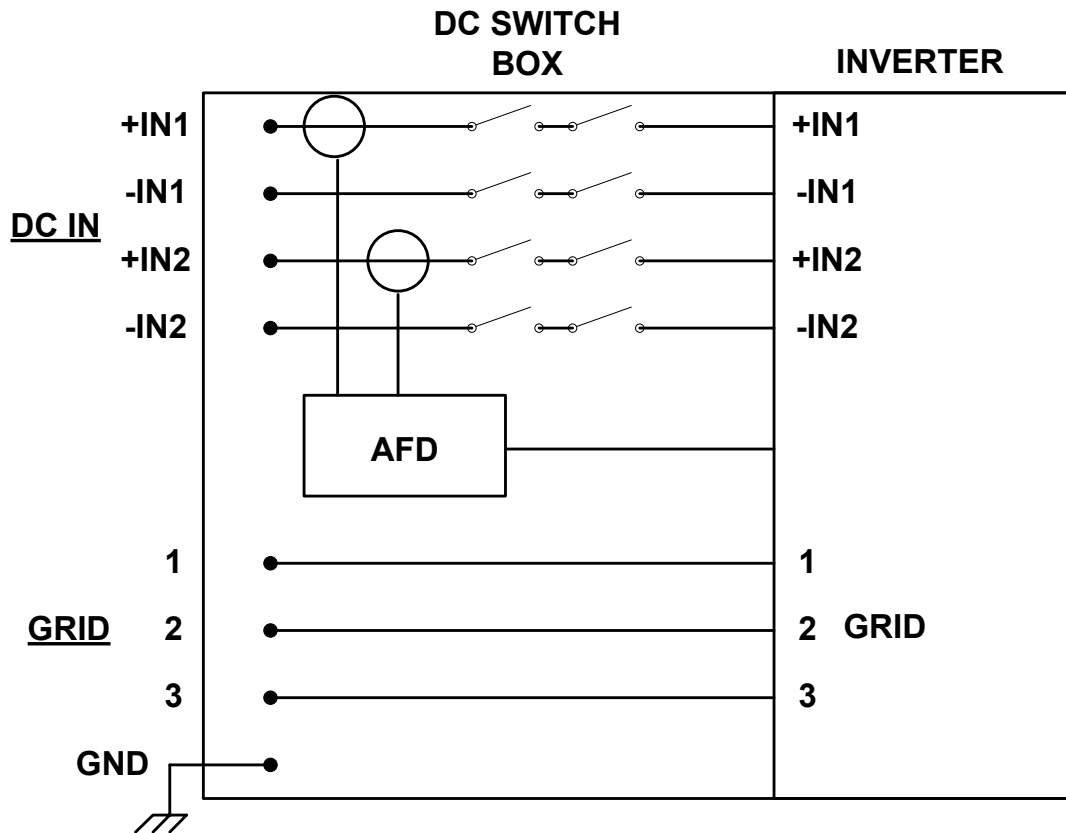
Table 3-1 switchbox external components

Ref.	Description
A	DC conduit entry KO's; trade size 1", 1-1/4"
B	AC conduit entry KOs; trade size 1", 1-1/4"
C	DC disconnect switch
D	Signal conduit entry with plastic threaded plug, 1/2" trade size
E	AC conduit entry with plastic threaded plug; trade size 1", 1-1/4"
F	DC conduit entry with plastic threaded plug; trade size 1", 1-1/4"
G	Silkscreen ON/OFF legend
H	Wiring box front cover screws (4)



The DC switch is a four-pole device rated at 25A/contact. If operating in the parallel mode, feed both sets of input terminals to ensure the total input current is divided between the two sets of switch contacts to guarantee the switch current specifications are not exceeded.

DC electrical schematics for front switchbox, AFD available on –A models only



WARNING! The DC disconnect switch disconnects the DC PV panel current from the photovoltaic panels when the switch is in “OFF” position. The inverter will stop producing power, but it DOES NOT disconnect the AC from the grid.



To disconnect the inverter from the AC grid, an AC switch (not included in the switchbox) must be disconnected. It is the responsibility of the installer to provide external disconnect switches and Overcurrent Protection Devices (OCPD) as required by National Electric Codes and other prevailing regulations.

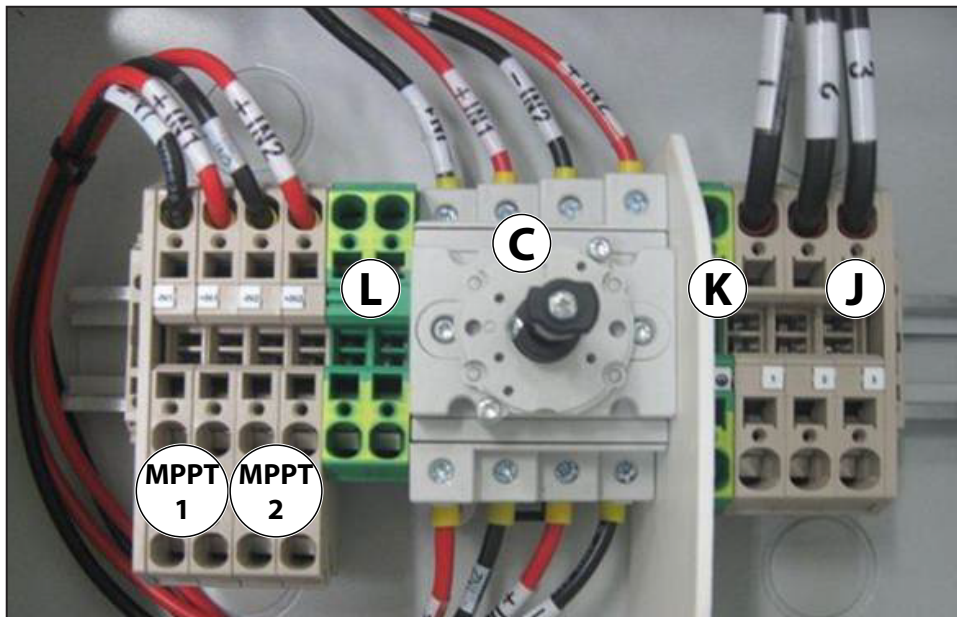
To access the wiring terminals in the inverter and switchbox, the inverter cover and switchbox cover must be removed.

- To remove the front cover of the inverter compartment, loosen the four captive screws indicated using the Torx screwdriver provided.
- To remove the front cover of the switchbox, loosen the four captive screws indicated using the Torx screwdriver provided in the box with the inverter.
- When connection operations are complete and the unit is connected, replace the covers and tighten the cover screws with at least 1.5Nm (13.2 in-lbs) torque to maintain proper waterproof sealing.

Table 3 2: switchbox internal components

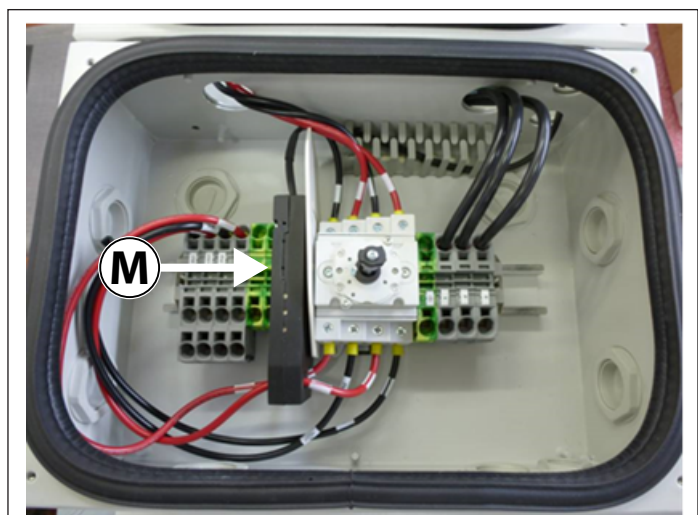
Label	Details	Label	Details
C	DC Disconnect Switch	J	AC grid output terminals, Note 1
D	Signal conduit entry with plastic threaded plug, 1/2" trade size	K	AC main ground, Note 2
E	AC conduit entry with plastic threaded plug; trade size 1"	L	Array PE ground, Note 1
F	DC conduit entry with plastic threaded plug; trade size 3/4" / 1"	M	AFD board (-A models only)
MPPT1	DC Array MPPT 1 input, Note 1	MPPT2	DC Array MPPT 2 input, Note 1

1. Front switch model array wiring and ground terminals are spring pressure type. These terminals accept 16-6 AWG wire. Front switch model AC output terminals are spring pressure type. These terminals accept 14-4 AWG wire.
Bottom switch model array wiring and AC output terminals use a standard terminal block. The wire range accepted is 18-4 AWG wire. There is a copper ground bus bar provided which accepts 14-6 AWG wire.
2. Ground terminals for the front switch model are spring pressure type and accept 16-4 AWG wire. Bottom switch model has two ground connections; copper bus bar accepts 14-6 AWG wire.



For -A models the AFD board is mounted on the din rail of the front switch wiring box.

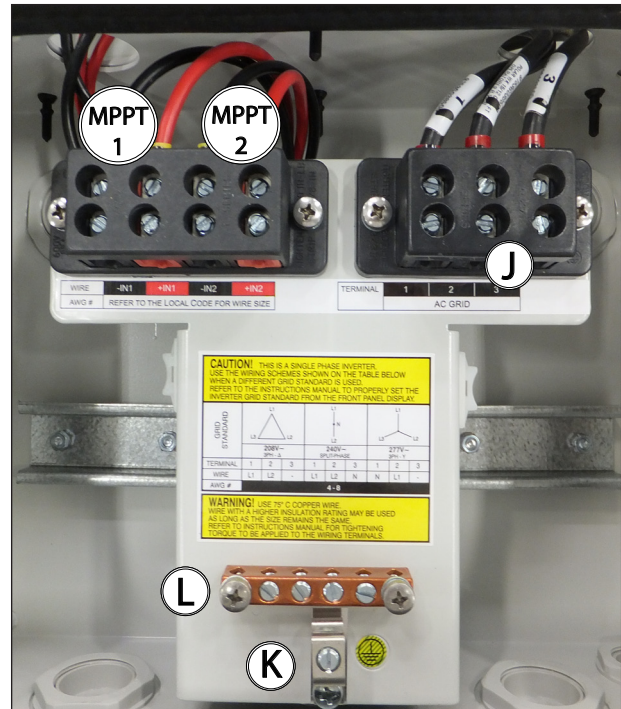
All wiring instructions for models with AFD (-A) are the same as those given for models without AFD, although AFD board (M) may not be shown.



Models with a bottom switch use standard terminal blocks for array wiring and AC output terminals.

AC, DC and GND (L) field wiring terminals should be tightened with 2.26 Nm/20 in-lbs torque.

Grounding electrode (K) should be tightened with 5.08Nm/45in-lbs torque.



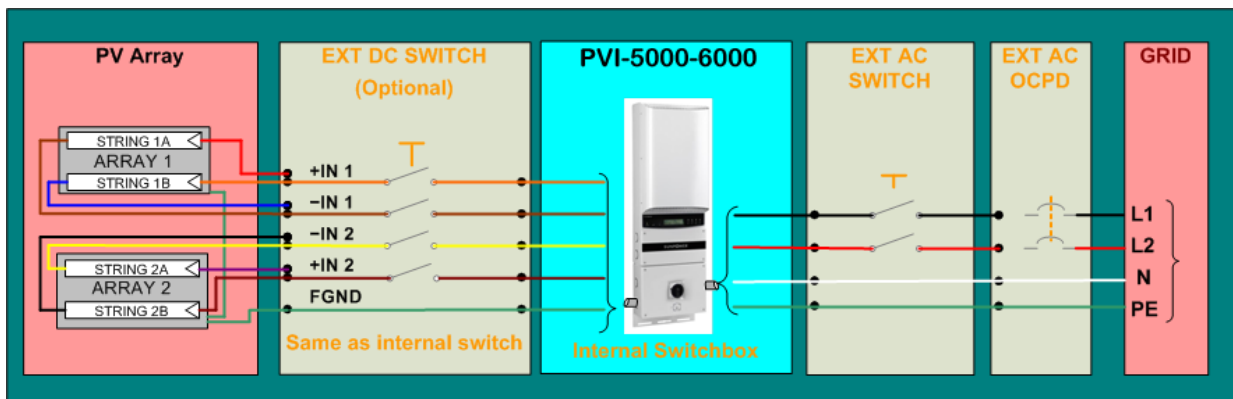
Wiring connections



WARNING! All PV source and output circuit conductors must have disconnects and over-current protection devices (OCPD) complying with NEC, Section 690, Part III and Section 690.9. To prevent electrocution hazards, all the connection operations must be carried out with the external AC disconnect switch downstream of the inverter (grid side) open and locked out

The PV source conductors must be Listed PV wire per NEC 690.35. PV output conductors must consist of sheathed (jacketed) multi-conductor cables or installed in an approved raceway and must be isolated from the enclosure and system grounding, as required by NEC 690.35 and is the responsibility of the installer. The maximum allowable input short circuit current limit of the photovoltaic array for each MPPT input channel is 22 Adc.

- The following sections describe installation procedures for DC, AC and communication wiring connections.
- Refer to table 3-1 to locate the designated entry locations for the conduit.
- Make sure the appropriate knockouts are used in order to maintain required spacing between wiring groups
- Relevant wiring connections are shown in table 3-2.
- Typical system connections for this inverter are shown in the figure below.



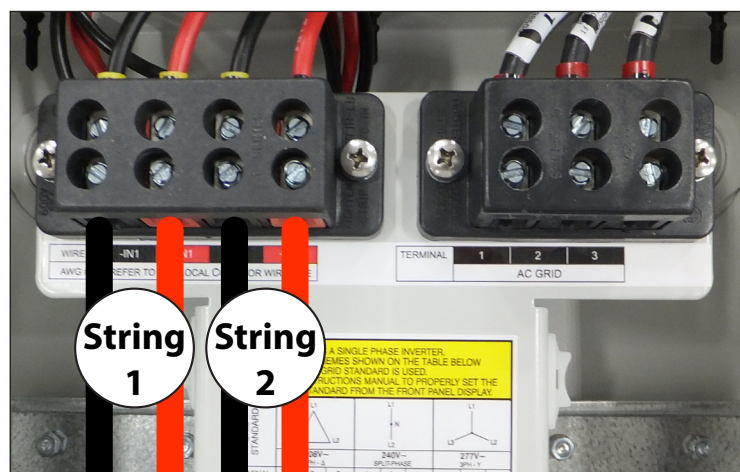
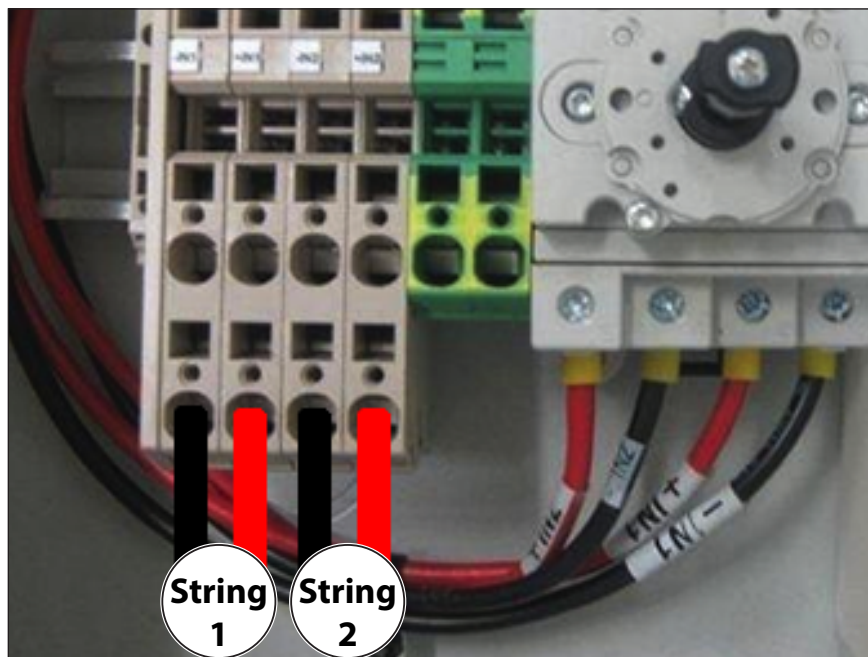
007CC3

DC array connections

WARNING! The DC disconnect switch disconnects **ONLY** the DC current from the photovoltaic panels when the switch is open in the OFF position. It **DOES NOT** disconnect the AC connection to the grid. To disconnect the inverter from the AC grid, an external, customer supplied AC switch must be used.

- To prevent electrocution hazards, all the connection operations must be carried out with the DC disconnect switch turned to the OFF position and locked out.
- When connecting the DC conductors verify polarity prior to terminating. Failure to perform these checks may cause arcing and potential fire.
- The array equipment grounding must be installed per the requirements of the NEC and is the responsibility of the installer.

Connect array to String 1 and String 2 input positions shown below, running separate wires for POS and NEG for each array. The inverter can be configured with an independent MPPT (maximum power point tracking) for each DC input channel or with the two input DC channels connected in parallel (operating with one MPPT) as described on the following pages.



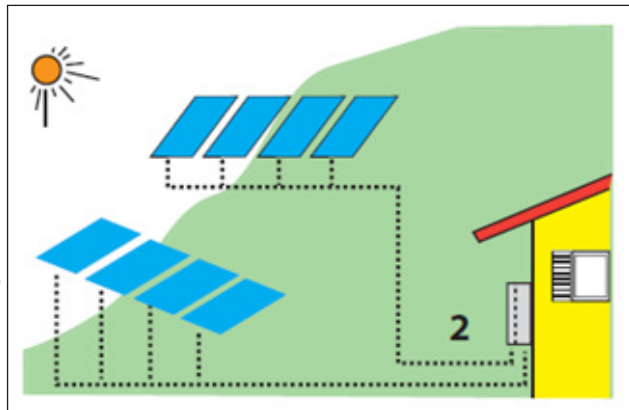
Independent or parallel configuration of inputs

The inverters have dual inputs with independent maximum power point tracking (MPPT) control. When operated in the dual input mode, the inverter can optimize two independent arrays. Each of the inputs is dedicated to a separate array with independent maximum power point tracking (MPPT) control. This means that the two arrays can be installed with different positions and orientation. Each array is controlled by an independent MPPT control circuit.

The two trackers can also be configured in parallel to handle power and/or current levels higher than those a single tracker can handle.

Dual MPPT configuration – independent mode

The dual MPPT structure allows the management of two photovoltaic arrays that are independent of each other (one for each input channel). In the independent mode, the arrays can differ from each other in installation conditions, type and number of photovoltaic modules connected in series.

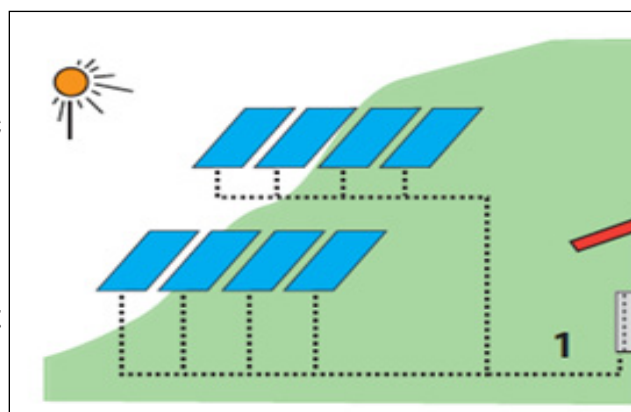


Single MPPT configuration – parallel mode

In the parallel mode, the two channels are connected in parallel and strings of photovoltaic modules having the same type and number of modules in series can be connected in parallel to the single channel. All strings must be identical and oriented to the same sun azimuth.

It is necessary to parallel the two inputs when:

- the current from the photovoltaic array exceeds 22A_{dc},
- or the array power exceeds the limit for the single channel (see Appendix section 7,
- or when there is a consistent unbalance of power between two arrays.



The inverter is set in independent mode at the factory by default. The following sections describe how to connect the inverter in parallel mode.



In order to operate in the parallel mode from a common array, it is necessary to electrically connect the input channels in parallel using the jumper cables provided with this inverter.

In addition, the input mode switch **S1** located on the inverter connection board must also be set to the parallel mode as described below.

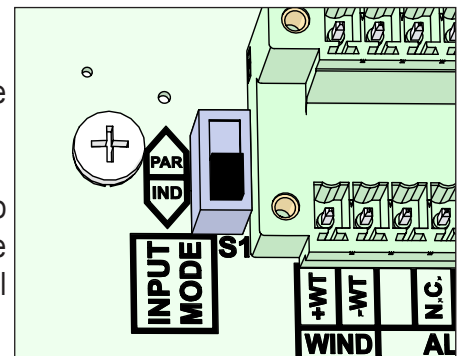
Setting the input mode switch S1

The input mode switch **S1** located on the inverter connection board is used to select the input configuration. The default position of the S1 switch is set in the IND mode (DOWN position).

In this mode up to four strings can be connected (two per input) without need of external combiner fusing

To operate the inverter in the parallel MPPT mode place S1 switch UP in the PAR position.

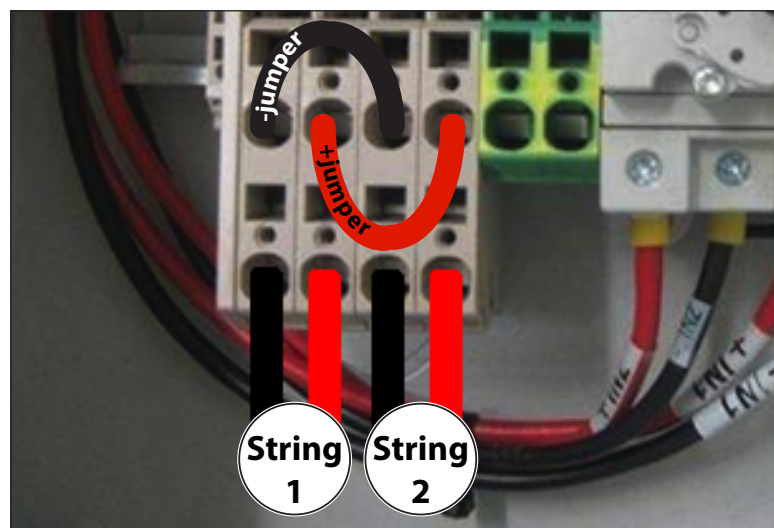
Note that only two strings can be directly connected to the inverter in this mode. If more than two strings are required, all strings must be combined in an external fused combiner box, or the IND mode must be used.



Use the following instructions to electrically connect the input channels in parallel.

Parallel mode front switch wiring box –S versions only without AFD

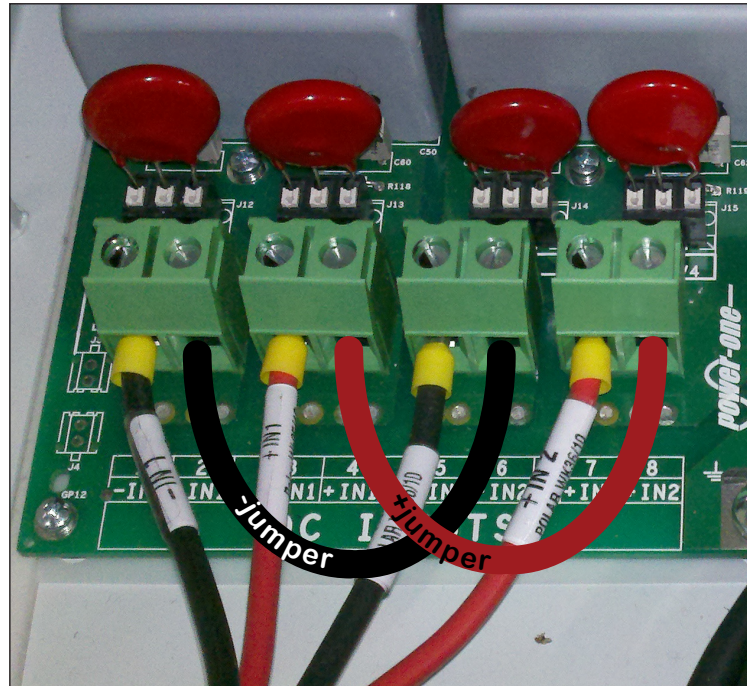
In the switchbox, parallel the two MPPT inputs of terminal [–IN1 and –IN2] and [+IN1 and +IN2] as shown below using the two #10 AWG jumper wires provided (1 black and 1 red cable) to connect the input.



NOTE! When Arc Fault Detection (AFD) is installed, the paralleling must be done inside the inverter as shown on the following page..

Parallel mode bottom switch wiring box and -S version with AFD

In the inverter box, parallel the two MPPT inputs of terminal [-IN1 and -IN2] and [+IN1 and +IN2] as shown below, using the two #10 AWG jumper wires provided (one black and one red cable) to connect the input.



AC grid connection

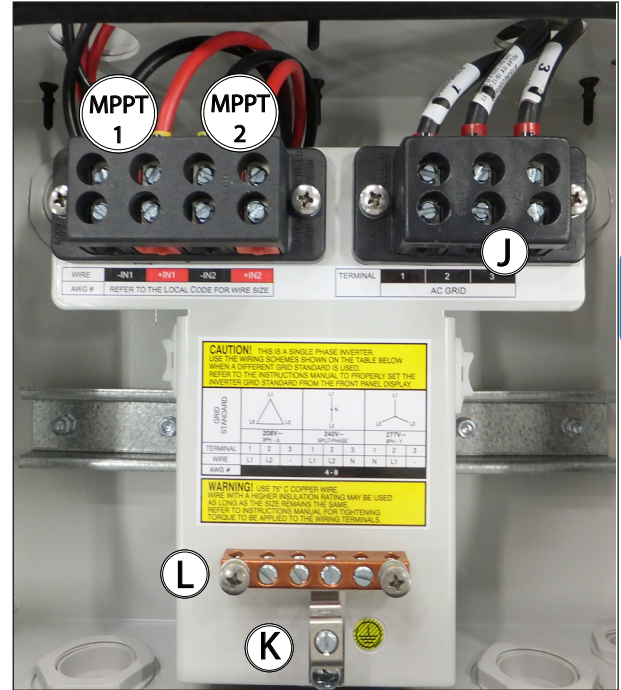
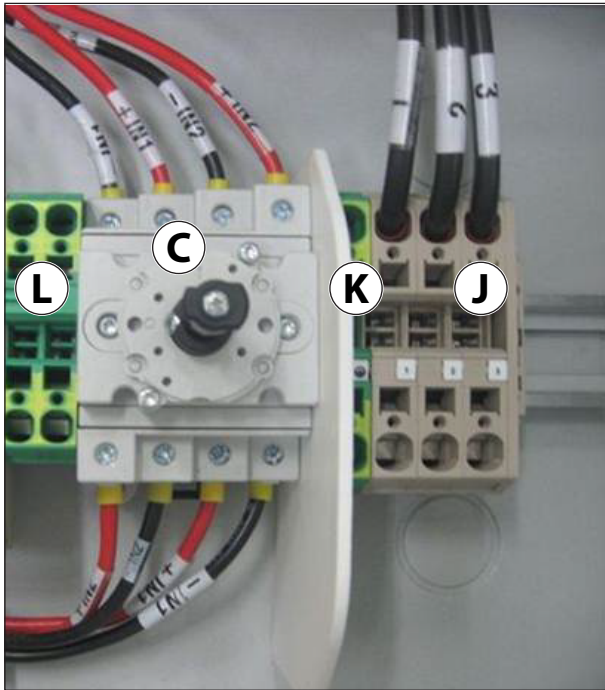
AC output overcurrent protection is not provided with the inverter; it is the responsibility of the end user to provide overcurrent protection for the AC output circuit.



The default AC grid connection, 240VRMS/3W/Split-Phase, requires the neutral terminal to be connected to the grid neutral conductor for proper operation.

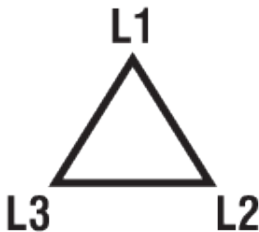

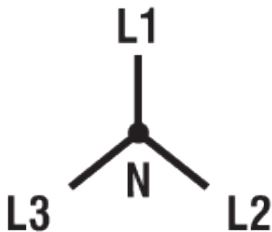
Before connecting the inverter to the grid, the grid type must be selected if it differs from the default 240V-SPLIT PHASE setting. See Operations, section 4 > Set Vgrid, for instructions to change the default.

- AC grid wiring is connected through the inverter switchbox.
- Run an approved raceway between inverter and external AC disconnect switch.
- Make conduit entry through openings (B or E) shown in table 3-1.
- Connect AC wiring to switch box terminal block (J) and the main AC ground cable to switchbox terminal block (K).



The grid standard table below shows AC wiring connections according to the AC grid type.

- Connect wiring to the numbered terminals as shown in the table .
- Size conductors per NEC Article 310; use only 75°C or 90°C. copper wire.
- Terminal block accommodates conductor type shown and wire size range per table 3 2.
- If several inverters are installed to a three-phase AC GRID, always distribute the inverters between the phases in order to reduce power imbalance between the phases.
- Always refer to the local standards.

GRID STANDARD									
	208V~ 3PH - Δ			240V~ SPLIT-PHASE			277V~ 3PH - Y		
TERMINAL	1	2	3	1	2	3	1	2	3
WIRE	L1	L2	-	L1	L2	N	N	L1	-

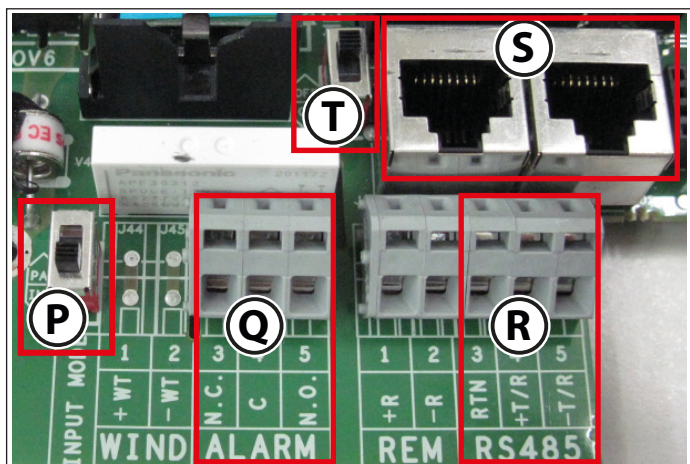
Communication and signal wiring connections

Wiring for the RS-485 communication system and hardwired control options must be routed through the switchbox and into the main inverter chassis for termination. It is necessary to open the inverter cover to access the communication and signal wiring which is located on the inverter board.

- To remove the front cover of the inverter, loosen the four captive screws using the Torx screwdriver provided.
- When connection operations are complete, re-install the front covers and tighten the cover screws with at least 1.5Nm (13.2 in-lbs) torque to ensure proper waterproof sealing.
- Remove the threaded plastic plugs from the service cable openings and replace with the appropriate conduit connector.
- Whether these cables need to be protected by conduit depends on the applicable wiring code.
- If no conduit is used, the cables should be brought into the wiring box via a 1/2" box connector with rubber cable glands to maintain NEMA 4X rating.
- If conduit is used, run the appropriate raceway and terminate it to the wiring box chassis using a conduit connector that matches the raceway.
- The conduit must be terminated at one of the two 1/2" openings show in table 3-1.
- Route the cables through the switchbox and into the inverter keeping close to right wall of the switchbox chassis.
- For versions with a front-facing switch, route the cables through the plastic guides located on the side of the wiring box.
- For versions with a bottom switch, use the plastic clamp to secure to the wall.
- Refer to table 3-3 below to locate the terminals for the alarm and monitoring connections within the inverter.
- The cables are connected to the terminals using the mating connectors supplied in the hardware bag shipped with the inverter.

Table 3 3: communication and signal wiring components

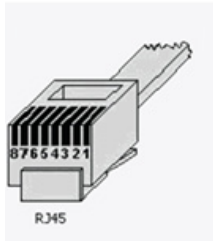
Label	Details
P	Input modes switch S1
Q	External Alarm Out Terminals
R	RS485 bus connection via terminal
S	RS485 bus connection via RJ45 connector
T	Termination resistance switch



CAUTION HAZARDOUS VOLTAGE – The \pm WT (WIND) terminals are not isolated and can have hazardous voltages present. These terminals must not be utilized for any purpose in a PV installation (for use with wind models only).

Serial communication (RS-485)

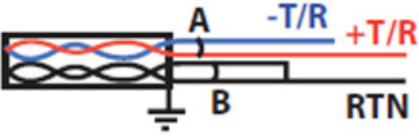
The inverter the communication line cabling can be connected using the RJ45 connectors or using the terminal block. If the terminal blocks are used, the signal RTN, +T/R and -T/R have to be cabled. If the RJ45 plugs are used, the pin-out is reported below.

	Pin #	Signal	Description	Notes
	1,2,6,8	N/U	Not Used	-
	3	+TR	+ Data Line	1
	4	+R	DO NOT CONNECT	2
	5	-TR	- Data Line	1
	7	RTN	Signal Return	1

1. Required for RS485 communication.
2. Required for Remote OFF control; DO NOT CONNECT pin #4 when cabling units with AFD installed.



Use a cable designed for use with RS-485 communications such as Belden 3106A, which is a data cable wire with one twisted pair for the +/-T/R signals, one ground conductor, and a shield with drain wire (equivalent). The table below shows connections for a dual twisted pair shielded cable.

	Signal	Symbol	Pair	Cable
	Positive data	+T/R	A	1
	Negative data	-T/R	A	2
	Reference	RTN	B	1+2

Continuity of the shield in the RS-485 cable is important for low noise on the line; this is particularly so for large plants with multiple inverters. For best results the shield must be tied to ground at only one point on the line, typically at one end or the other. The shield wiring must be continuous as it passes from one inverter to the next on a daisy chain, but must not be tied to ground at these junctions.

Daisy chain multi unit configuration

The RS-485 terminal block connectors or RJ45 connectors can be used to connect a single inverter or implement a multi-unit wiring configuration called daisy chain.

- The terminal block has two rows of contacts.
- The upper and lower rows are internally paralleled to allow daisy chain connections.
- The two RJ45 connectors available for the RS-485 communication are equivalent to each other and can be used interchangeably for the input or output of the line when creating a daisy chain connection of the inverters.



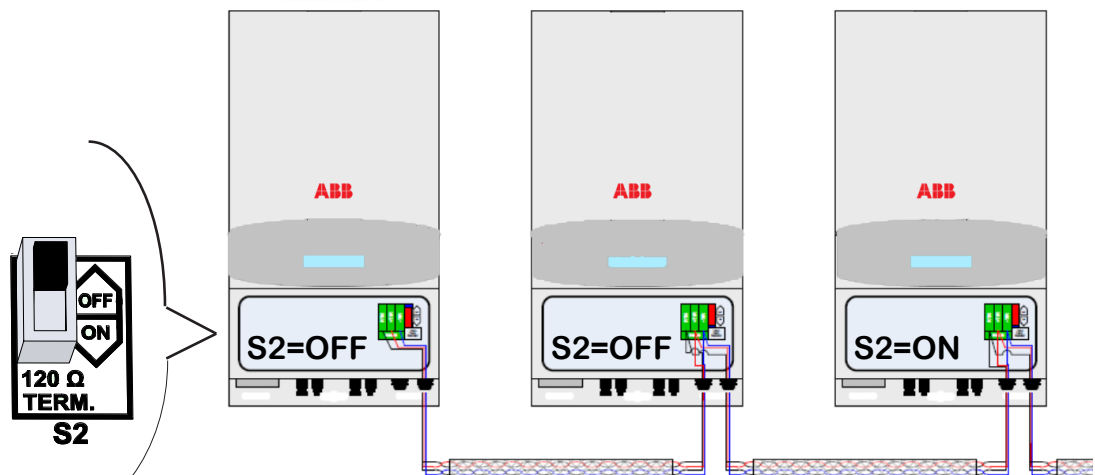
WARNING! If a daisy chain connection is required for AFD installed inverters use standard multiconductor RS-485 cable and connect the three RS-485 leads (-RTN, +T/R, -T/R) using only the mating connector supplied with the inverter. Do not connect pin 4 of RJ45 connector with any AFD installed inverters!

The recommended length of total communication cable line for all inverters in the system is 1,000 meters [1094 yards] or less, and this distance capability depends strongly on the cable type used and installation workmanship.

Depending on the type of computer used, the cable line adaptor can be RS-485 to RS232 or RS-485 to USB. In order to ensure optimum communication on the RS-485 line, it is recommended to connect the RS-485 converter to a location between the first unit in the daisy chain or multi-unit system configuration and the computer; not in between two inverters in the series.

Using the appropriate cable, daisy chain the inverter units RS-485 lines in a series. On the last inverter in a daisy chain, or on a single inverter, activate the termination resistance for the communication line by moving the S2 switch (item T in table 3-3) down into the ON position.

All other inverters in the daisy chain will have the S2 switch placed up in the OFF position.



Addressing each inverter

When multiple inverters are connected on a single RS-485 bus, it is necessary to assign a different RS-485 address to each unit. The address on the inverter is set through the user interface on the display panel. Refer to the Settings menu in section 4.

Address values are assigned manually using any value in the range 2 to 63. Set a different RS-485 address for each inverter of the chain. The default setting for the RS-485 address is 2, and termination switch S2 in the OFF position.



NOTE: No more than 63 inverters can be connected on a single RS-485 link. The number may be less depending on the data logger used. Do NOT to exceed a length of 3,300 ft/1000m for the RS-485 communication line.

Configurable relay connection (Alarm)

The inverter has a multi-function relay accessible at the terminal block labeled item **R** in table 3-3. Use the mating connector supplied with the inverter to simplify connections to the terminal block. The relay output can be configured to activate a visual and/or audible alarm or be utilized by another control such as a building control system. The signal logic can be controlled by the user by using either the normally open (N/O) contact – or the normally closed (N/C) contact.

The relay can be used in four different operating modes which are set using the associated Settings menu of the inverter display. Refer to the Settings menu in section 4 for descriptions and instructions to program the connection. The device to be connected to the relay can be of different types (light, sound, etc.) but must comply with the following requirements:

Alternating current	Max Voltage: 240 Vac	Max Current: 1 A
Direct current	Max Voltage: 30 Vdc	Max Current: 0.8 A



Remote control connection

The connection and disconnection of the inverter to and from the grid can be controlled remotely through an external control. The function must be enabled in the associated Settings menu in section 4.

If the remote control function is disabled, the inverter automatically switches on and off in response to appropriate conditions. If the remote control function is enabled from the menu, the switching on of the inverter also depends on the state of the R_ON/OFF terminal compared to the GND terminal present on the terminal labeled **Q**. in table 3-3.

If the function is enabled as noted above :

- With the +R and -R terminals open (floating) the inverter operates normally.
- With the +R and -R pins shorted together the inverter is disconnected from the grid and a “Remote Control OFF” message is shown on the display.

Since this is a low-level digital input, the wiring to the +R, -R terminals is typically small (18AWG to 24 AWG).

Monitoring system via serial (RS-485)

The RS-485 line can be connected to various monitoring devices that can be in local or remote mode:

- Local monitoring from PC with a PVI-USB-RS485_232 adaptor and Aurora Communicator software.
- Local monitoring from a remote display such as the PVI-DESKTOP device with a PVI-USB-RS485_232 adaptor.

For local monitoring, a PVI-USB-RS485_232 brand adaptor is recommended for connection between the first unit of the daisy-chain and the computer. Equivalent RS-485 to RS-232 adapters found on the market can also be used for the same purpose; however, they have not been specifically tested in order to guarantee correct operation of the connection. These devices may also require external termination impedance, whereas this is not necessary with the PVI-USB-RS485_232.



Monitoring and data transmission



One of the first rules for preventing damage to the equipment and injury to the operator is to have a thorough knowledge of the user interface operations.

ABB cannot be held responsible for damage to the equipment or the operator if caused by incompetence, insufficient qualifications or lack of training.

Normally, the inverter operates automatically and does not require manual intervention. When there is not enough sunlight to supply power for export to the grid, (e.g. during the night) it disconnects automatically and goes into stand-by mode.

The operating cycle is automatically restored when there is sufficient sunlight. At this point, the lights on the LED panel will indicate this state.

Types of data available

The inverter provides two types of data which are accessed through the appropriate interface software and/or the LCD.

Real-time operating data

Real-time operating data can be transmitted on request through the communication lines and are not recorded in the inverter. For data transmission to a computer, download the free Aurora Manager Lite software from the website.

Internally stored data

The inverter internally stores a set of data that is necessary for processing statistical data which includes an error log with time stamps.

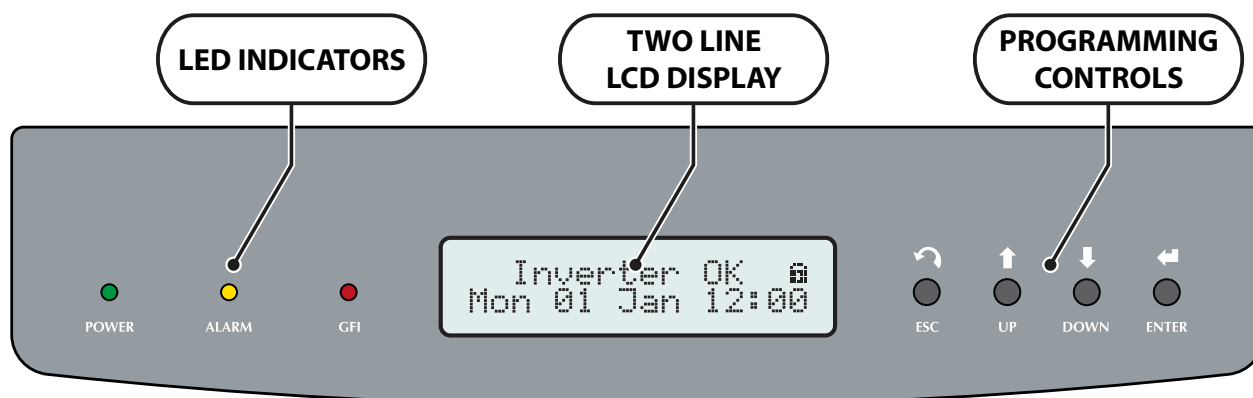
User interface

The inverter is able to provide operation information through the following:

- Warning lights (LEDs).
- Liquid Crystal Display (LCD) for displaying operating data.
- Data transmission on dedicated RS-485 serial line. The data can be collected by a PC (using the signal converter PVI-USB-RS485_232) or a data logger equipped with an RS-485 port (PVI-DESKTOP). Contact customer service with any questions regarding the compatibility of the devices.

Display and keypad

There are three indicators on the LED panel and four buttons on the keypad. LEDs indicate the operating state of the inverter. The keypad is used to review data in the two line display area and access the data logged internally on the inverter, using the menus described in this section.



LED	Description
Green POWER LED	Indicates that the inverter is working correctly. This LED flashes while the grid is being checked during start up . If a valid grid voltage is measured, the LED stays on continuously, provided there is sufficient sunlight to activate the unit. If not, the LED continues to flash until there is sufficient sunlight for activation. During this phase, the LCD shows the “Waiting for Sun” message.
Yellow ALARM LED	Indicates that the inverter has detected an anomaly; the type of problem is shown on the display area b7 .
Red GFI LED	The GFI (ground fault indicator) LED indicates that the inverter has detected a ground fault on the DC side of the PV array. When this fault is detected, the inverter immediately disconnects from the grid and the relevant error warning appears in the display area b7 .
Keypad button	Description
ESC button	Use the ESC button to access the main menus, exit a mode or go back.
UP button	Use the UP button to read the data on the display by scrolling upwards, or to increase the set value during data entry.
DOWN button	Use the DOWN button to read the data on the display by scrolling downwards, or to decrease the set value during data entry.
ENTER button	Press ENTER to confirm the operation or to enter the set data item.

















During operation, the display cycles through available data points, updating every five seconds. Screens may be scrolled manually by pressing the UP and DOWN buttons on the keypad. Activation of cyclical scrolling will be indicated by two arrows in the top left corner of the two-line display. Scrolling can be blocked by pressing the ENTER key until a padlock symbol appears.

Some parameters (e.g., current, voltage, power, partial energy, lifetime energy etc.) are available only after grid connection.

LED indicators

In their various combinations, the LEDs can indicate conditions that are different from the single one. The table below shows the possible combinations of activation of the LEDs in relation to the operating state of the inverter.

Warning and Error messages referenced below are described in Troubleshooting, section 5.

LED BEHAVIOR			
LED off	LED on	LED flashing	any condition
LEDs Status	Operational Status	Remarks	
1 green:  yellow:  red: 	Inverter is not operating	Input voltage less than 50Vdc at the input	
2 green:  yellow:  red: 	Inverter is initializing, loading settings and performing grid check	Transition status while operating conditions are checked	
3 green:  yellow:  red: 	Inverter is powering the grid	Normal operation	
4 green:  yellow:  red: 	Inverter is shut down because of a GFI fault	Ground fault has been detected	
5 green:  yellow:  red: 	Inverter detected a fault	The fault can be inside or outside the inverter. See the alarm code appearing on the LCD	
6 green:  yellow: red:	Installation phase: inverter is disconnected from grid	During installation it refers to setup of the address for RS-485 communication	
7 green: yellow: red:	Inverter is disconnected from grid	Indicates a missing grid connection	



Cyclical display of general information

The two line display area consists of 2 lines with 16 characters per line. When moving through the menu using the buttons of the keypad, the display is used to:

- display the operating state of the inverter and the statistical data
- display the service messages for the operator
- display the alarm and fault messages for the operator
- navigate the menus

Pressing the ESC button allows access to the three main menus, STATISTICS, SETTINGS and INFORMATION. ESC is also used to cancel an entry or return to the previous menus.

The UP and DOWN buttons of the keypad are used to move through a menu and change menu settings by increasing or decreasing the settable values.

The ENTER button is used to open the menu choices, make a selection and confirm a change in adjustable values.

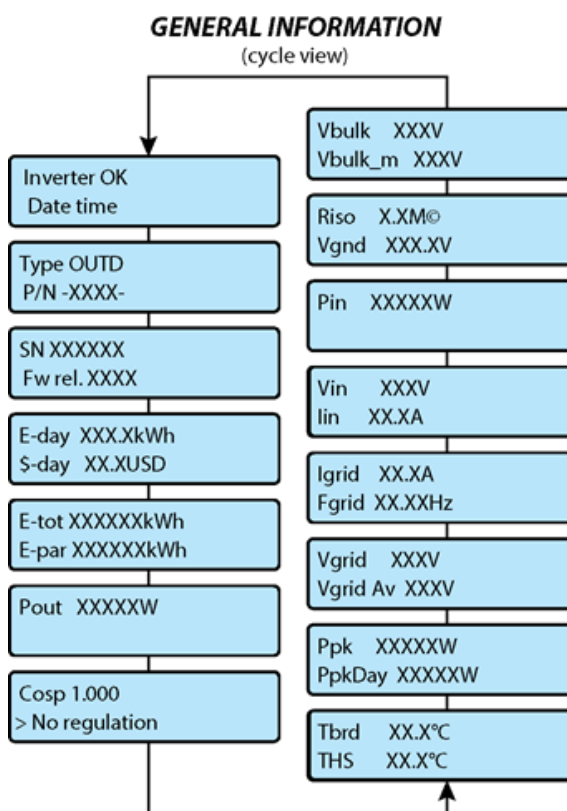
During regular operation the display will cycle through general information shown at right.

Cycling is indicated by two arrows in the top right corner of display area **b7**.

Scrolling can be stopped by pressing the ENTER button until the padlock symbol appears.

When locked, the current information displayed will remain on screen

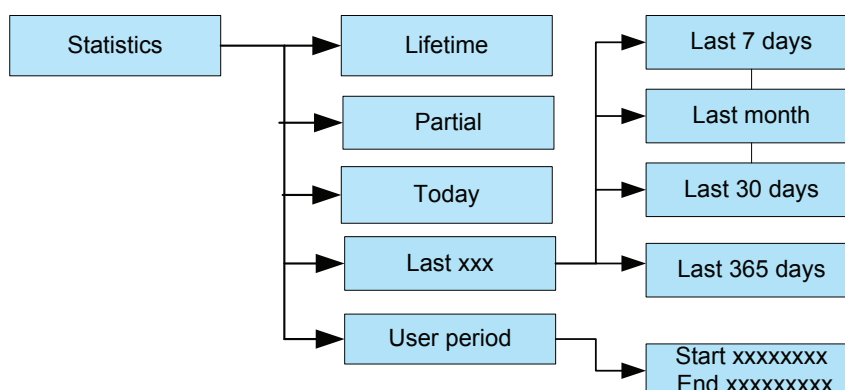
Press and hold the ENTER button until the arrows are displayed to unlock and cycle through the display.



The three main menus that enable monitoring of the inverter's operations are outlined and described on the following pages. Press the ESC button to access the menus from the general information screens. Use the UP and DOWN keys to scroll through the three menus and press ENTER to make a selection.

Statistics menu

The Statistics menu is a view only display of internally logged inverter data.



Lifetime - Displays the total statistics for lifetime operation:

- Time: Total operating time
- E-tot: Total energy produced
- Val. : Total production value, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
- CO2: Amount of CO2 saved



Partial - Displays partial statistics using a counter that can be reset*:

- Time: Partial operating time since the counter was activated
- E-par: Partial energy produced since the counter was activated
- PPeak: Peak power value measured since the partial counter was activated
- Val. : Partial production value calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
- CO2 : Amount of CO2 saved daily since the counter was activated

* To reset all the counters of this submenu, press the ENTER button and hold for 3 seconds until a beep is heard.

Today - Displays the daily statistics:

- E-day: Daily energy produced
- PPeak: Daily peak power value
- Val. : Daily production value calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS
- CO2: Amount of CO2 saved today

Last 7 days - Last month - Last 30 days - Last 365 days -

Select any one of the above time periods to view the following information:

- E-##: Energy produced over the period selected
- Val. : Economic gain over the period selected
- CO2: Amount of CO2 saved for the period selected

User period - Displays the statistics for a period selected by the user. Use the display keys to set the start and end date of the period as follows:

Scroll to User Period and press ENTER to open the Start/End date screen

- Use ENTER to move from one field to the next (from left to right).
- Use ESC to go back to the previous field (from right to left).
- Press ESC repeatedly to go back to the previous menus.

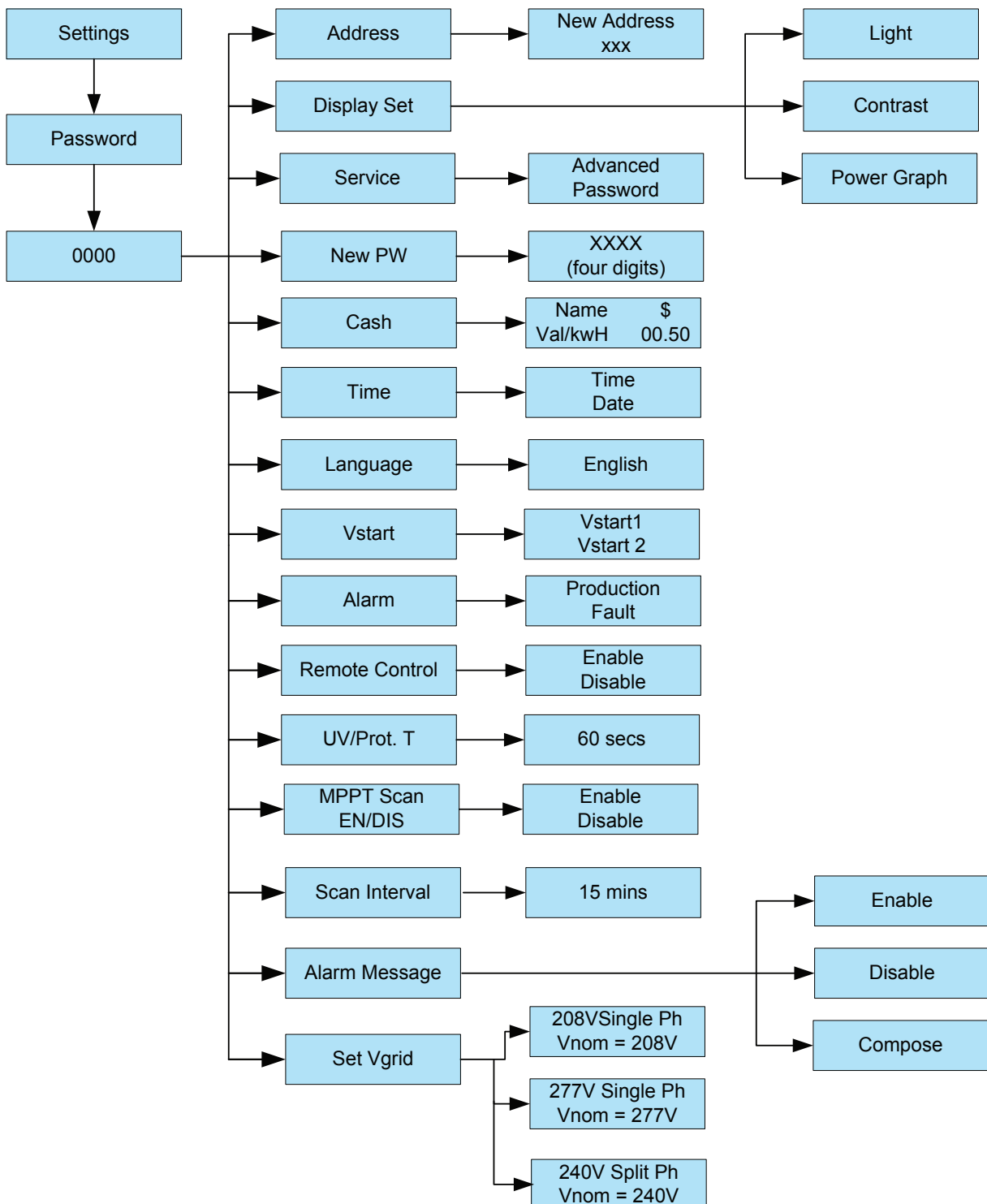
To set the day: Press DOWN to scroll numbers from 31 to 1, UP to scroll from 1 to 31.

To set the month: Press DOWN to scroll months from December to January.; UP to reverse'

Settings menu

The Settings menu requires a password which allows access to configuration and modification of the basic inverter settings.

- Press ESC to open the main menus.
- Scroll DOWN to *Settings* and press ENTER.
- The password screen is populated in the display.
- The default password is 0000; pressing ENTER four times loads four zeroes into the display and opens the submenus outlined below.



Address - Used to set the address for the serial communication of inverters connected to the RS-485 line. The addresses that can be assigned are 2 to 63. Use the UP and DOWN buttons to scroll the numerical scale. "Auto" address is equivalent to address=1 and can be used on only one of the inverters in a daisy chain connection

NOTE! No more than 63 inverters can be connected to a single RS-485 link. The number may be less depending on the data logger used.

Display Settings - Used to set the characteristics of the display

1. Light: setting of the mode and adjustment of the brightness of the display
 - Mode:
 - ON: Light always on
 - OFF: Light always off
 - Auto: Automatic light control. The light comes on whenever a button is pressed and stays on for 30 sec, after which it gradually goes out.
 - Intensity: adjustment of display brightness (scale from 0 to 9)
2. Contrast: adjustment of display contrast (scale from 0 to 9)
3. Buzzer: button sound setting
 - ON: the sound of the buttons is activated
 - OFF: the sound of the buttons is deactivated
3. Power Graph: Time range: 8 H, 16 H, 24 H



Service - This section of the menu is reserved for installers and it is necessary to have a dedicated password. See Troubleshooting, section 5, for instructions to obtain the service level password.

The Service menu can be used to adjust the Voltage and Frequency Trip Limit and Trip Time Parameters according to the grid requirements of the installation locale. This inverter has been factory programmed to automatically disconnect from the utility distribution system in compliance with UL 1741 and IEEE1547 specifications. Default voltage and frequency trip limit and trip time settings to comply with these standards are shown in the table on the following page.

The table lists the default and adjustable parameters available in the Service submenu. Using the UP and DOWN keys on the inverter display panel, scroll to select the values for modification.

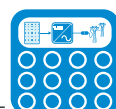


WARNING! ABB cannot be held responsible for any negative effects resulting from modifications of inverter set points. The set points in the table below should only be changed with the written permission of the local utility.

Changes to the voltage and frequency trip limit and trip time parameters **MUST** be done by a qualified contractor or authorized personnel. Improper values entered could cause bodily harm and cause the inverter to shut down.

Parameter	Definition	Default Value	Adjustable Ranges
SET U>>	Indicates the value of the absolute over voltage set point beyond which the inverter disconnects from the grid. [120% of Nominal line to neutral Voltage]	120% of Nominal line to neutral Voltage	Fixed
SET U<<	Indicates the value of the absolute under voltage set point below which the inverter disconnects from the grid [50% of Nominal line to neutral Voltage]	50% of Nominal line to neutral Voltage	Fixed
SET F>>	Indicates the value of the absolute over frequency set point beyond which the inverter disconnects from the grid	60.5 Hz	Fixed
SET F<<	Indicates the value of the absolute under frequency set point below which the inverter disconnects from the grid	57 Hz	Fixed
SET U>	Indicates the value of the intermediate over voltage set point beyond which the inverter disconnects from the grid [110% of Nominal line to neutral Voltage]	110% of Nominal line to neutral Voltage	Fixed
SET U>(10 min)	Inverter disconnects from the grid after 10 minutes in case the average grid voltage overcomes the threshold value(305V)	110% of Nominal line to neutral Voltage]	(110% x V_{LN}) to (115% x V_{LN})
SET U<	Indicates the value of the intermediate under voltage set point below which the inverter disconnects from the grid [88% of Nominal line to neutral Voltage]	88% of Nominal line to neutral Voltage]	Fixed
SET F>	Indicates the value of the intermediate over frequency set point beyond which the inverter disconnects from the grid	60.5 Hz	60.2 Hz to 63.0 Hz
SET F<	Indicates the value of the intermediate under frequency set point below which the inverter disconnects from the grid	59.3 Hz	59.8 Hz to 57 Hz
SET U Conn>	Indicates the value of the intermediate over voltage (line to neutral) set point to allow the inverter to connect to the grid for the first time.	110% of Nominal line to neutral Voltage]	(110% x V_{LN}) to (115% x V_{LN})
SET U conn<	Indicates the value of the intermediate under voltage (line to neutral) set point to allow the inverter to connect to the grid for the first time.	88% of Nominal line to neutral Voltage	(50% x V_{LN}) to (88% x V_{LN})
SET F conn>	Indicates the value of the intermediate over frequency set point to allow the inverter to connect to the grid for the first time.	60.5 Hz	60.2 Hz to 63.0 Hz

Parameter	Definition	Default Value	Adjustable Ranges
SET F conn<	Indicates the value of the intermediate under frequency set point to allow the inverter to connect to the grid for the first time.	59.3 Hz	59.8 Hz to 57 Hz
SET TIME U>>	Indicates the value of the countdown timer associated with the Absolute Over Voltage setpoint U>>	0.16 sec	Fixed
SET TIME U<<	Indicates the value of the countdown timer associated with the Absolute Under Voltage setpoint U<<	0.16 sec	Fixed
SET TIME F>>	Indicates the value of the countdown timer associated with the Absolute Over Frequency setpoint F>>	0.16 sec	Fixed
SET TIME F<<	Indicates the value of the countdown timer associated with the Absolute Under Frequency setpoint F<<	0.16 sec	Fixed
SET TIME U>	Indicates the value of the countdown timer associated with the Intermediate Over Voltage setpoint U>	1 sec	0.16 sec to 5 sec
SET TIME U<	Indicates the value of the countdown timer associated with the Intermediate Under Voltage setpoint U<	2 sec	0.16 sec to 5 sec
SET TIME F>	Indicates the value of the countdown timer associated with the Intermediate Over Frequency setpoint F>	0.16 sec	0.16 sec to 300 sec
SET TIME F<	Indicates the value of the countdown timer associated with the Intermediate Under Frequency setpoint F<	0.16 sec	0.16 sec to 300 sec
SET TIME Conn 1	Indicates the time the inverter takes to connect to the grid for the first time (not after grid fault).	30 sec	1 sec to 3600 sec
SET TIME Conn 2	Indicates the time the inverter takes to connect to the grid after a grid fault.	300 sec	1 sec to 3600 sec
DISABLE U>>	Provides ability to enable/disable the Absolute Over Voltage Set point U>>	Enable	Disable or Enable
DISABLE U<<	Provides ability to enable/disable the Absolute Under Voltage Set point U<<	Enable	Disable or Enable
DISABLE F>>	Provides ability to enable/disable the Absolute Over Frequency Set point F>>	Enable	Disable or Enable
DISABLE F<<	Provides ability to enable/disable the Absolute Under Frequency Set point F<<	Enable	Disable or Enable
DISABLE U>	Provides ability to enable/disable the Intermediate Over Voltage Set point U>	Enable	Disable or Enable



Parameter	Definition	Default Value	Adjustable Ranges
DISABLE U> (10 min)	Provides ability to enable/disable the parameter "SET U>(10 min)"	Disable	Disable or Enable
Disable U<	Provides ability to enable/disable the Intermediate Under Voltage Set point U<	Enable	Disable or Enable
Disable F>	Provides ability to enable/disable the Intermediate Over Frequency Set point F>	Enable	Disable or Enable
Disable F<	Provides ability to enable/disable the Intermediate Under Frequency Set point F<	Enable	Disable or Enable
U>(10 min) Der.	Provides ability to limit the power for 10 minutes due to the high average voltage value set by the parameter "SET U>(10 min)"	Disable	Disable or Enable
Slow Ramp	Provides ability to slowly ramp the Output Power at connection(Soft start)	Disable	Disable or Enable
OF Derating	Provides ability to limit the Output Power due to the high grid frequency	Disable	Disable or Enable
Reset Country S	Provides ability to reset the country code	Not Applicable	Not Applicable

New PW - Used to change the password for accessing the SETTINGS menu. The default password is 0000 and can be changed using the display keyboard.

- Use ENTER to scroll the digits (from left to right)
- Use ESC to return to the previous digit (from right to left)
- Press ESC several times to return to the previous menus
- Use DOWN to progressively scroll the numerical scale downwards (from 9 to 0)

Be careful to memorize the new password. For security purposes there is no reset function. If the password is misplaced it will not be possible to access the inverter.

Cash - Used to set the name of the currency and the value given to 1 kWh of energy produced. The correct setting of these parameters displays the actual earning/saving given by the system.

- Name: the chosen value is set (default is \$, USD).
- Val/KWh: indicates the cost/incentive of 1 kWh expressed in the chosen currency (default is 0.16).

Time – Used to set the current date and time (daylight saving time not included).

Language – Used to set the menu language.

Vstart – Used to set the Vstart voltage (separately for both channels if they are configured in independent mode). Change the activation voltage only if necessary. A configuration program that can help to correctly size the photovoltaic system is available on the website.

Alarm - This section of the menu allows programming of the alarm relay function (available as a normally open contact – N/O, and also as a normally closed contact – N/C). This contact can be used, for example, to activate a siren or a visual alarm, control the disconnect device of an external transformer, or control an external device. Maximum ratings of the alarm contact: 240Vac/1A and 30Vdc/0.8A.

The switching of the relay can be set in four different modes:

- **PRODUCTION:** the relay switches when the inverter connects to the grid.
- **ALARM:** the relay switches when there is an alarm (code E).
- **ALARM (configurable):** the relay switches if there are alarms (code E) or warnings (code W) chosen by the user from a list (the list may also show choices that are not available for the specific model).
- **CREPUSCULAR:** the relay switches only when the input voltage exceeds the input voltage set for connection to the grid.

The operating modes are described in further detail below:

Production: the relay switches when a connection to (or disconnection from) the grid occurs. When N/O (or N/C) contact is chosen, it will stay open (or closed) until the inverter is connected to the grid. Once the inverter starts to export power, the relay changes state and closes (or opens).

When the inverter disconnects from the grid, the relay contact returns to its position of rest, open (or closed).

Alarm: the relay switches when there is an alarm (Error) on the inverter. No switching occurs when there is a Warning. When N/O (or N/C) contact is chosen, it will stay open (or closed) until the inverter reports an error; once an error is reported, the relay switches state and closes (or opens). The contact remains switched from its rest condition until normal operation is restored.

Alarm (configurable): the relay switches when there is an alarm (Error or Warning), which has been selected by the user through the programming menu. If N/O (or N/C) contact is chosen, it will stay open (or closed) until the inverter reports an error or a warning out of those selected from the menu. At that point the relay switches state and closes (or opens) the contact. The relay remains switched from its rest condition until the alarm or warning has disappeared.

Crepuscular: (meaning - twilight) the relay usually switches when the voltage from the PV array exceeds/falls below the threshold set for grid connection. If N/O (or N/C) contact is chosen, it will stay open (or closed) until the inverter has an input voltage higher than the one selected for grid connection. The contact remains switched from its rest condition for as long as the inverter is switched ON (even if it is not connected to the grid).

Remote Control ON/OFF - Selecting this function accesses the remote ON/OFF function used to disable the inverter operation by an external switch or an external controller. Set as follows:

- **Disable:** disables the ON/OFF function, so that inverter operation will operate normally, depending only on grid access and external solar radiation, (default).
- **Enable:** Activates the ON/OFF function, requiring an external contact closure to activate the inverter.



Hardware access to the ON/OFF function is via terminals +R and -R, describe in section 3. When the function is active,

- Turn OFF the inverter terminals by shorting terminals +R and -R.
- Turn ON the inverter by removing the short between terminals +R and -R.
- With the function enabled, the ON/OFF input status is indicated on the inverter display

UV Prot. T - This section of the menu allows programming of a time interval for which the inverter stays connected to the grid in a situation where the input voltage has dropped below the undervoltage limit (set at 70% of Vstart).

The default time is set at 60 sec. The user can set it from 1 to 3600 sec. Example: with the UV Prot.time set at 60 seconds, if the VIN drops below 70% of Vstart at 9:00, the inverter stays connected to the grid (taking power from it) until 9:01.

MPPT - This section of the menu allows setting the parameters of the maximum power point tracking (MPPT) function. This function is useful when there are shaded areas on the PV array that can create several maximum power points in the work curve.

- MPPT amplitude: the amplitude of the interference introduced in DC is chosen through the setting of this parameter to establish the optimal working point. There are three settings to choose from (LOW, MEDIUM, and HIGH). The default setting is MEDIUM.
- Multi-max scan: by setting this parameter, the user can enable/disable the scan, decide the frequency with which the scan is carried out, and override it manually.
 - a. Enable/Disable: Enables/Disables the scan for identifying the maximum power point of the system.
 - b. Scan Interval: this allows setting the interval of time between scans. The shorter the interval between scans, the greater will be the loss of production due to the fact that, during the scan, energy is transferred to the grid but not at the maximum power point. Each scan takes 2 seconds.

*The curves can be edited using the Aurora Manager LITE software available on the webpage.

Set Vgrid – Selecting this menu opens a sub-menu which allows access for setting the grid type of the inverter connection.

- Grid types available are: 240V split phase, 277V single phase, or 208V single phase.
- Default grid setting is 240V split phase.
- Use the UP or DOWN key to scroll through list of grid types
- Press ENTER to select a new grid type
- A second display screen will ask for confirmation; press ENTER to confirm, ESC exit

If inverter is connected to grid, unit will restart upon completion of grid change, If unit is not connected to grid, turn the DC disconnect switch to OFF to save changes.



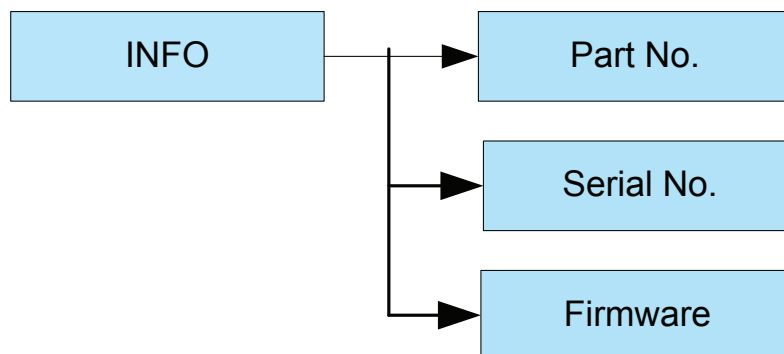
Information menu

The INFO menu provides information about the inverter and access to modify the country standard for grid connection.

Part No. - Displays the inverter part number.

Serial No. - Displays the inverter serial number and the week (from 1 to 52) and year of manufacture.

Firmware - Displays the revision of the firmware installed in the equipment.



Commissioning



WARNING! Do not place any items on the inverter during operation. Do not touch the heat sink when the inverter is operating, as some parts may be hot and cause burns.

The incoming voltage must not exceed the maximum values shown in the technical data in order to prevent damage to the equipment. Consult technical data table in the Appendix for further details.

Start-up procedure:

1) Set the AC disconnect switch (external or part of switchbox depending on version) to the inverter to ON.

2) Set the inverter's DC disconnect switch (external or part of switchbox version) to ON.

3) Once both switches are closed, the inverter starts the grid connection sequence.

- The check routine may take from 30 seconds up to several minutes, depending on grid condition.
- The routine is indicated by the flashing green LED marked POWER.

• Three screens are shown on the display during the check routine:

- a) Measuring isolation resistance: "Measuring Riso..." , connection in progress with progress indication.
- b) Grid voltage value and status compared to specified values (within/outside range).
- c) Grid frequency value and status compared to specified values (within/outside range).

4) When the connection sequence is completed, the inverter starts operating.

- Normal operation is indicated by a warning sound and the green LED staying permanently ON, (sunlight is sufficient to export power to the grid).
- If the check routine gives a negative result, the inverter will repeat the procedure until all grid voltage and frequency parameters and grid configuration are found to be in the specified range.
- During this process, the green LED will keep flashing.

Connection of system to the grid

The two-line Liquid Crystal Display (LCD) is located on the front panel and shows:

- Inverter operating status and statistics;
- Service messages for operator;
- Error messages and fault indications.

During regular operation, the display will cycle through available data. The display changes to a different screen every 5 seconds or screens may be scrolled manually by pressing the UP and DOWN buttons located to the right of the display.

1) The following screen is displayed upon inverter start-up:

Initializing . . .
Please wait

2) The following screens may appear while waiting for the connection to be established:

Missing Grid . . .

Waiting Sun . . .

- While the system checks for grid connection to be established (“Missing Grid”), the yellow LED next to the display turns on continuously, while the green LED is flashing.
- When waiting for the input voltage to exceed 50Vdc (“Waiting Wind”), the green LED turns on steady.
- When the “Missing Grid” and “Waiting Sun” conditions are verified, the inverter is connected.

For -A models only, as soon as *Waiting Sun* conditions are met, the inverter display shows the AFD board self-test running. The results are displayed in the two-line graphic display area.



If a problem on the AFD board is detected, the self-test will result in an error. Refer to troubleshooting, section 5, to clear the error and possible solutions.

If there are no irregularities after checking the grid voltage and frequency parameters, the grid connection sequence starts and the inverter displays the following screens:

- 3) Time (seconds) to complete output voltage and frequency check.
It takes from 30 seconds to several minutes to complete the operation.



Next connections
2 secs

- 4) Shows instant output voltage value and within/outside range status.

Vgrid 223.8V
In range

- 5) Shows instant output frequency value and within/outside range status.

Fgrid 60.17Hz
In range

6) If measured instant values of voltage (step 4) and frequency (step 5) are outside of the allowed range, the following screens are shown alternately

- Next connections (screen 3)
- Vgrid (screen 4)
- Fgrid (screen 5)

Error messages

After the connection is established, the inverter runs a test cycle. If wrong data are found, the cycle is interrupted and an error code is displayed. Error codes and their meaning are shown in section 5.

Once the error has been corrected, the inverter resets all functions in progress and re-starts the connection.

First phase - electric parameter monitoring

If the parameters measured in start up are correct, the system will proceed to the next checks.

1A) inverter part number.

1A	Type OUTD PN -----
----	-----------------------

2A) inverter serial number and firmware revision level.

2A	SN ----- xxxxxx FW rel. C.0.1.1
----	------------------------------------

3A) **E-tod** : Daily energy output.

\$-tod: Daily energy savings. Value is expressed in the set currency.

3A	E-tod 0 Wh \$-tod 0.0 USA
----	------------------------------

4A) **E-tot** : Lifetime energy output since first installation .

E-par : Partial energy output during selected period.

4A	E-tot ----- E-par 0 KWh
----	----------------------------

5A) **P-out** : Measured instant output power.

The second line of the display shows the higher of two temperatures:

5A	P-out 0 W T-inv °C
----	-----------------------

- **T-inv**: inverter temperature.

- **T-boost**: heatsink temperature.

6A) **Ppk**: Maximum peak power achieved since partial counter was activated.

6A	Ppk W Ppk Day W
----	--------------------

Ppk Day: Maximum peak power achieved during the day. Counter will reset when unit is powered off.

7A) **Vgrid**: Measured instant grid voltage.

7A	Vgrid 197 Vgrid Avg 0
----	--------------------------

Vgrid Avg: Average grid voltage during the last 10 minutes of operation.

8A) **Igrid**: Measured instant grid current.

8A	Igrid 0.8 A Fgrid 60.18 Hz
----	-------------------------------

Fgrid: Measured instant grid frequency.

9A) **Vin**: input voltage value.

9A	Vin 0 V I in 0.0 A
----	-----------------------

Iin1: Instant input current value.

10A) **Pin**: Measured instant input power

10A	Pin 0 W
-----	---------

11A) **Riso**: Measured insulation resistance.

Unlike the parameters discussed above, this is not an instant value but a measurement taken one time during inverter start-up.

11A	Riso 0.0 Mohm Ileak 73 mA
-----	------------------------------

12A) When all items described above test OK, the inverter shows a corresponding message in the display top line along with date and time in the bottom line.

12A	Inverter OK Wed 17 May 11:23
-----	---------------------------------

Clock malfunctioning or other non function-related faults

(faults that do not affect the inverter's ability to generate energy) will be shown in the bottom line of the display in place of date and time.

The following error messages may be displayed instead of date and time:

- CLOCK FAIL - indicates clock malfunction, contact service.
- BATTERY LOW
- SET TIME - appears the first time the unit is powered up or after the battery has been replaced.
- FAN FAIL - contact service.
- MEMORY FAIL - data logging malfunction; contact service.

Arc fault detection self-test errors

For -A models only, an autotest circuit is included in the module design of the DC ARC FAULT DETECTOR and INTERRUPTOR (AFDI) solution. The AFDI performs a self-test when the system is started, (i.e. every morning when sunlight is sufficient for grid connection). The inverter display shows the results of the self-test:

If the self-test results are OK, the inverter will continue to AC grid connection.

Test Arc Sensor
OK

If a potential problem on the AFD board is detected, the self-test will result in an error. Refer to the display message and error code table in this section for possible solutions to the error.

Arc Self Test
E053

During normal operation, (while the inverter is connected to the grid), the input current is continually measured and analyzed. If a DC arc fault is detected during operation, the inverter is disconnected from the AC grid and an error will be shown on the inverter display.

Arc Fault
E050

Press and hold the ESC key for three seconds to clear the error which will start the self-test. If self-test results are OK, the inverter will reconnect to the AC grid.

If the DC arc fault is still present, the self test will result in error E053. Refer to table 5 in this section to clear the error and possible solutions.

It is recommended to complete an accurate check of DC and AC connections when the AFD protection trips continuously as an arc has occurred.

The AF self-test can be manually started anytime using the following procedure:

1. Turn off the inverter (switching off both DC and AC switches) and,
2. Turn on both the DC and AC switches waiting for display communication of the self-test result.

Obtaining the service level password

An advanced password can be provided to authorized installers to allow access to the service menu upon completion of required documentation. Contact customer service at 877-261-1374 to request this password. The password obtained is valid for a period of 15 days.

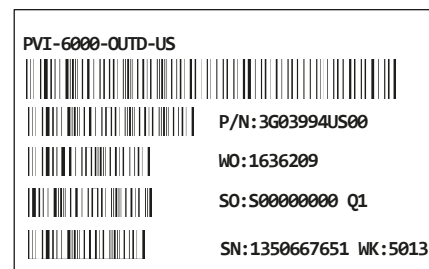


NOTE! Because the service level password is date sensitive, it is necessary to have the correct date and time set on the inverter display to successfully use the password. Refer to the Settings menu in section 4 for instructions to set the date and time.

The password to access the Service menu is to be used by trained service personnel only. It is based on data associated with a specific serial number and different for every inverter.

Locate the following information, which is necessary to generate the password, from the product label of the inverter as shown at left.

- Serial number - SN
- Week of manufacture -WK



The same data can also be found on the INFO menu on the inverter display.

Display messages and error codes

The equipment indicates errors/warnings on the display only if the input voltage is higher than the Vdcmn voltage (POWER LED flashing or on; see Operations, part 4). Next to each state of the inverter, (indicated through the steady or intermittent lighting of the relevant LED), a message that identifies the operation it is carrying out or the detected fault/anomaly, is also indicated in the two-line display. Messages identify the current status of the inverter and do not relate to a fault.

When a (W) with a number after it appears in the display, it indicates a Warning Code and is usually cleared through an orderly shutdown/re-set or a self-corrective action performed by the inverter. Alarms or (E) codes identify a possible equipment failure, fault, or incorrect inverter setting or configuration. Some of the (E) codes may require technical support to assist in correcting a fault. Any and all attempts to correct or clear a fault must be performed by qualified personnel. Typically, the (E) code can be cleared once the cause or fault is removed. Some of the (E) codes may indicate a fatal error and require technical support for diagnostics and/or a product replacement.

When the red LED comes ON, try to reset the warning using the multi-function ESC button on the panel. If the inverter reconnects to the grid, the fault was due to temporary phenomena.

WARNING! In the event of malfunction, it is extremely dangerous to try to eliminate the fault. Follow the instructions given below or contact a specialized technician if you do not have the experience and necessary qualifications to work safely.

Display Message	Causes	Solution
Ground Fault Red LED	The alarm is generated when ground leakage current is detected in the DC section of the system. The alarm is accompanied by the lighting up of the red LED on the front of the inverter.	If possible, measure the insulation resistance using a megohmmeter positioned between the photovoltaic field (positive terminal short-circuited to the negative pole) and ground. If the measured value is less than 1 megohm, the photovoltaic array must be checked by a technician/ installer to identify and eliminate the problem. If the measured value is greater than 1 megohm and the error warning continues to be present, contact customer service.
E001 Input OC Input Overcurrent	The alarm appears when the inverter input current exceeds the set overcurrent threshold.	Check whether the composition of the PV array allows an input current that exceeds the maximum threshold allowed by the inverter and that the configuration of the (independent or parallel) inputs is carried out correctly. If the configuration of the PV array and the setting of the input channels are suitable, contact customer service.
E002 Input OV Input Overvoltage	This alarm is indicated when the inverter input voltage (coming from the PV array) exceeds the operating threshold. The alarm is triggered before reaching the absolute threshold beyond which the inverter will be damaged. When the inverter input voltage exceeds the Over Voltage threshold, the inverter will generate the alarm and not start.	Measure the input voltage in the inverter with a voltmeter. If it is higher than the maximum voltage of the operating interval, the alarm is real. Check the configuration of the PV array. If it is lower than the maximum voltage of the operating interval, the alarm is caused by an internal malfunction; contact customer service.
E003 No Parameters Internal Parameters Error	The main microcontroller is unable to correctly initialize the two DSPs (boost stage and inverter stage). This is usually due to communication problems on the internal bus of the inverter.	This is an error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E004 Bulk OV Bulk Overvoltage	Error inside the inverter. The alarm is raised when the voltage at the ends of the bulk capacitors exceeds the Over Voltage threshold.	The alarm can be triggered by causes external to the inverter: an excessive inverter input voltage can be detected as a bulk overvoltage condition. In this case, it is advisable to check the inverter input voltage and, if this value is near the input OV threshold, re-examine the configuration of the photovoltaic array. The alarm can be triggered by causes internal to the inverter; If input voltage is O.K. and alarm is still present contact customer service.



Display Message	Causes	Solution
E005 Comm.Error Internal Communication Error	The alarm occurs when there are communication problems between the control devices inside the inverter.	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E006 Output OC Output Overcurrent	The alarm appears when the inverter output current exceeds the output overcurrent threshold of the inverter.	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E007 IGBT Sat IGBT Saturation	The alarm appears when one of the active devices of the inverter is in saturation state.	Once the error appears, the inverter attempts to resume normal operation. If the error occurs sporadically, it may be caused by a sharp transition of the grid voltage or the input voltage but is not attributable to inverter malfunctioning. If the error is associated with an internal fault, it will continue to appear; contact customer service.
E009 Internal error	Error inside the inverter	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E010 Bulk Low Low Bulk Voltage	Voltage at a specific part of inverter input circuit is not sufficient for grid connection. The alarm can be triggered by causes external to the inverter: a low inverter input voltage (just above the activation voltage) that is not accompanied by sufficient availability of power from the photovoltaic array (typical condition of periods of insufficient sunlight).	If the error warning appears sporadically, it can be attributed to causes external to the inverter (insufficient sunlight, and therefore little power available from the PV array). If the problem appears systematically even in conditions of high sunlight and with input voltage significantly higher than the activation voltage, contact customer service.
E011 Ramp Fail Bulk ramp timeout	Error inside the inverter regarding the time for starting steady state operation of the DC-DC circuit part (Boost). It can be caused by an external string voltage too low or due to reduced power from PV arrays (typically in the morning).	If the alarm is present early in the morning it could be useful to increase the starting voltage to allow the grid connection of the inverter when more power is available from the PV array. If the problem persists (after switching the inverter off and then on again), contact customer service.
E012 DcDc Fail Boost module error	Error inside the inverter regarding the operation of the DC-DC circuit part (Boost).	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.



Display Message	Causes	Solution
E013 Wrong Mode Wrong Input Mode (parallel instead of independent)	The alarm is generated only when the inverter is configured with parallel inputs. In this particular configuration, the inverter carries out the input voltage check of each of the two channels, and the alarm is raised if the two voltages differ by more than 20Vdc.	Make sure the setting of the “IN MODE” switch has been intentionally positioned on “PAR” and that the jumpers have been inserted between the two input channels. If the configuration of the inverter is correct, check that the input strings have the same number of panels in series, of the same make and with the same inclination/orientation. If both the configuration of the inverter and the characteristics of the PV array comply with the specifications, contact customer service.
E014 Over Temp. Over-temperature	Internal inverter temperature above maximum temperature allowed. Lack of adequate ventilation in location where inverter is installed can be the cause. If ambient temperature is within the allowed range for inverter operation, the error could be due to a problem in the temperature sensors inside the inverter.	Wait for the temperatures to which the inverter is exposed to return within operating range and for the inverter to cool down. If the problem persists (once the ambient temperature has returned within the range), contact customer service. Remember to wait for the time necessary to allow the inverter to cool down.
E015 Bulk Cap Fail Bulk capacitor failure	Error inside the inverter regarding a problem in the bulk capacitors.	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E016 Inverter Fail Inverter module error revealed by Boost	The alarm is generated when a problem is detected in the inverter circuit part (DC/AC).	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E017 Start Timeout Inverter module start-up timeout	Error inside the inverter regarding the time for starting steady state operation of the DC-AC circuit part (Inverter). It can be caused by an external string voltage too low or due to reduced power from PV arrays (typically in the morning).	If the alarm is present early in the morning it could be useful to increase the starting voltage to allow the grid connection of the inverter when more power is available from the PV array. Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.



Display Message	Causes	Solution
E018 Ground Fault Leakage current fail	The alarm is generated when, during normal operation of the inverter, a ground leakage current is detected in the DC section of the system. The alarm is accompanied by the lighting up of the red LED on the front of the inverter. The inverter may even also generate the E018 alarm message for AC leakage currents associated with the capacitive nature of the photovoltaic array compared to ground.	If possible, measure the insulation resistance using a megohmmeter positioned between the photovoltaic field (positive terminal short-circuited to the negative pole) and ground. If the measured value is less than 1 megohm, the PV array must be checked by a technician/installer to identify and eliminate the problem. If the measured value is greater than 1 megohm and the error warning continues to be present, contact customer service.
E019 Self-Test Error 3 Leakage current sensor self-test fail	Before connecting to the grid, the inverter carries out an autotest that tests the leakage current sensor. The test is carried out by “forcing” a current of known value in the leakage current sensor: the microprocessor compares the read value with the known value. The error is generated if the comparison between the read value and the known value during the test is not within the allowed tolerance.	This is an error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service. By its nature, the alarm appears only before connection to the grid.
E020 Self-Test Error 1 Booster relay self-test fail	Before connecting to the grid, the inverter carries out some internal tests. One of these tests regards the correct operation of the booster relay. The test is carried out by “forcing” the switching of the relay and checking its functionality. The error is generated if a problem is found with the operation of the relay.	This is an error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service. By its nature, the alarm appears only before connection to the grid.
E021 Self-Test Error 2 Inverter relay self-test fail	Before connecting to the grid, the inverter carries out a test that regards the operation of the inverter relay. The test is carried out by “forcing” the switching of the relay and checking its functionality. The error is generated if a problem is found with the operation of the relay.	This is an error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service. By its nature, the alarm appears only before connection to the grid.



Display Message	Causes	Solution
E022 Self-Test Error 4 Relay self- test timeout	Time taken to execute the autotest carried out on the relays of the DC_AC circuit part (inverter) is too long. This may indicate a problem associated with the aforesaid relays.	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
E023 DC inj error Dc-Injection out of range	The error is generated if the direct component of the current supplied to the grid exceeds the threshold of 0.5% of the rated operating current. The error does not stop the inverter, instead tries to connect to the grid again. Sporadic repetition of the error is a sign of large grid distortions or sudden changes in sunlight, whereas systematic repetition of the error warning will be a sign of an inverter fault.	If the grid voltage is strongly distorted, report this anomaly to the utility company for the resolution of the problem. If there is an inverter fault, contact customer service.
E024 Internal error	Error inside the inverter	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.



Display Message	Causes	Solution
E025 Riso Low Low insulation resistance	<p>Before connecting to the grid, the inverter measures the insulation resistance of the PV array compared to ground. If the insulation resistance measured by the inverter is less than 1 MOhm, the inverter does not connect to the grid and shows the "Riso Low" error. The causes may be:</p> <ul style="list-style-type: none"> - Damaged PV panel(s). - Junction box(es) not properly sealed, allowing water and /or damp seepage ; - Loose connections between panels allowing humidity leakage; - Poor quality cable junctions; - Presence of unsuitable (trigger voltage lower than the characteristics of the PV array strings) or damaged overvoltage surge arresters outside the inverter in the DC section. - Presence of damp inside the field panel, if there is one. 	<p>If possible, measure the insulation resistance using a megohmmeter positioned between the photovoltaic field (positive terminal short-circuited to the negative pole) and ground (as described in the relevant section: "checking the ground insulation of the PV array"). If the measured value is less than 1 mega ohm, the photovoltaic array must be checked by a technician/installer to identify and eliminate the problem. If the measured value is greater than 1 mega ohm and the error warning continues to be present, contact customer service.</p> <p>(Damp increases leakage and can therefore be the cause of a reduction in insulation resistance).</p>
E026 Vref Error Bad internal reference voltage	Wrong measurement of the reference voltage inside the equipment.	Internal error that cannot be checked externally. If the problem persists (even after switching the inverter off and then on again), contact customer service.
E027 Error Meas V VGrid Measures Fault	Error in the internal measurement of the grid voltage (imposed by regulations) to have a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).	This is an error inside the inverter that cannot be checked externally. If the problem is persistent (even after switching the inverter off and then on again), contact customer service.
E028 Error Meas F FGrid Measures Fault	Error in the internal measurement of the grid frequency (imposed by regulations) to have a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).	This is an error inside the inverter that cannot be checked externally. If the problem is persistent (even after switching the inverter off and then on again), contact customer service.



Display Message	Causes	Solution
E029 Error Meas Z ZGrid Measures Fault	Error in the internal measurement of the insulation resistance of the PV array compared to ground (imposed by regulations) to have a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).	Error inside the inverter that cannot be checked externally. The error occurs if the internal measurement is carried out before connection to the grid) If the problem is persistent (even after switching the inverter off and then on again), contact customer service.
E030 Error Meas ILeak ILeak Measures Fault	Error in the internal measurement (carried out when the inverter is connected to the grid) of the leakage current of the DC side (PV array) compared to ground (imposed by regulations) to have a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).	This is an error inside the inverter that cannot be checked externally. If the problem is persistent (even after switching the inverter off and then on again), contact customer service.
E031 Error Read V Wrong V Measure	Measurement of the internal voltage at the ends of the output relay out of range. There is too great a difference in voltage between the input and the output of the output relay that can be caused by grid voltage instability.	Check the grid conditions for instabilities caused by switch of heavy loads or reactive loads (like motors, welding machines etc.). If the problem appears repeatedly, contact customer service.
E032 Error Read I Wrong I Measure	Measurement of the output voltage unbalance (carried out between the three phases) out of range (only in three-phase models).	This is an error inside the inverter that cannot be checked externally. If the problem appears repeatedly contact customer service.
E033 UTH Under Temperature	Alarm is triggered when internal temperature is below low temperature threshold. Depending where the inverter is located, ambient temperature can reach values below UT limits. In case in which ambient temperature is above that UTH limits, a failure of the temp sensing circuitry is occurred.	Wait for the temperatures to which the inverter is exposed to return within operating range. If the problem persists, contact customer service. Remember to wait for the time necessary to allow the inverter to warm up.
E034 Interlock fail IGBT not ready	Error inside the inverter	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.



Display Message	Causes	Solution
E035 Remote Off Waiting remote ON	The inverter has been switched off remotely (remote OFF) and remains in waiting state for the signal that will switch it on again (remote ON).	Switch on the inverter remotely. If the unit does not switch on, disable the remote on/off function and switch the equipment off completely and then switch it on again. If the problem persists (after re-enabling the Remote ON/ OFF function from the display), contact customer service.
E036 Vout Avg error Average Vout out of range	The average grid voltage value (every 10 minutes) does not fall within the allowed ranges. The grid voltage at the point connected to the inverter is too high. This may be caused by grid impedance that is too high. Towards the end of the timeout, the inverter limits the power to check whether the grid voltage stabilizes within the normal parameters. If this does not happen, the inverter disconnects from the grid.	Check the grid voltage at the inverter connection point. If the grid voltage diverges from the range because of grid conditions, ask the grid company to adjust the grid voltage. If the grid company authorizes a change to the inverter parameters, arrange the new limits with customer service.
E037 Riso Low Low insulation resistance (amorphous mode only)	This error can appear only if the "Amorphous" mode is enabled. This function is enabled only in inverters equipped with grounding kit and is used to monitor the voltage at the ends of the grounding resistor. The error appears when the voltage at the ends of the resistor connected between ground and pole of the photovoltaic array exceeds 30V for more than 30 minutes or 120V for more than one second.	Check for the presence and correct contacting of the two terminals of the grounding resistor installed inside the inverter. If possible, measure the insulation resistance using a megohmmeter positioned between the PV field (positive terminal short-circuited to the negative pole) and ground (as described in the operation chapter). If the measured value is less than 1 mega ohm, the photovoltaic array must be checked by a technician/ installer to identify and eliminate the problem. If the measured value is greater than 1 mega ohm and the error warning continues to be present, contact customer service.
Mid Bulk OV E038 Mid bulk OV	NA	NA
E050 Arc Fault (-A version ONLY) DC Arc detected	An electrical arc has been detected on DC cables. This error latches the inverter in a disconnected state	Check DC cables and connections to identify the source of possible arcing. Press ESC as indicated in the display in order to unlatch the inverter.
E053 AF Self-Test (-A version ONLY) Arc fault detector (AFD) sensor Self-test failed	Self-Test performed by AFD board failed. The board will try another self-test after user turns inverter off and on.	Press ESC as indicated in the display in order to unlatch the inverter. If the problem persists (after switching the inverter off and on), contact customer service.

Display Message	Causes	Solution
E056 Over Temp. (from external box)	Excessive temperature measured inside the inverter's wiring box: High internal temperature. This error relates to the temperature measured on external boxes.	Check that the inverter is not exposed to direct sunlight. Wait for the temperatures to which the inverter is exposed to return to the operating range and for the inverter to cool down. If the problem persists (once the ambient temperature has returned to the range), contact customer service.
E057 Vbulk reading error	Input voltage (Vin) higher than booster voltage (Vbulk): The error occurs if the input voltage exceeds the Bulk voltage (voltage on the DC-DC circuit inside the inverter)	Measure the input voltage inside the inverter with a voltmeter. If it is higher than the maximum voltage of the operating range, it is necessary to check the configuration of the PV array. If the voltage has also exceeded the maximum input threshold the inverter could be damaged. If it is lower than the maximum voltage of the operating range, the alarm is caused by an internal malfunction and it is necessary to contact customer service.
E058 Pin vs. Pout check error	The error occurs if the difference between the measured value of input power and that of output power is greater than the limit imposed internally to the inverter.	Error inside the inverter that cannot be checked externally. If the problem persists (after switching the inverter off and then on again), contact customer service.
W001 Sun Low (Low input voltage during switch-on of the inverters)	Insufficient sunlight. Wrong configuration of the PV array or a configuration "at the limit" as regards the minimum input voltage of the inverter.	Check the inverter input voltage. If it does not exceed the Vstart, check that there is sufficient sunlight and that the composition of the system is correct. If it exceeds the Vstart, contact customer service.
W002 Input UV (Low input voltage during switch-off)	Insufficient sunlight Wrong configuration of the photovoltaic array or a configuration "at the limit" as regards the minimum input voltage of the inverter.	Check the inverter input voltage. If it does not exceed the Vstart, check that there is sufficient sunlight and that the composition of the system is correct. If it exceeds the Vstart, contact customer service.
W003 Grid Fail Grid Fail (grid voltage parameters outside the limits)	This error warning appears during normal operation of the inverter when the grid parameters fall outside the limits set by the grid company. No grid voltage (after the warning, the inverter goes on "No Vac") Unstable grid voltage (downwards and upwards) Unstable grid frequency.	Check the grid voltage on the inverter. If absent, check for the absence of grid voltage on the supply. If the voltage tends to rise (when the inverter is connected), it means there are high line or grid impedances. Check the grid voltage on the supply as well; if it is high, it means there is high grid impedance. In this case, ask the grid company to adjust the grid voltage. If the grid company authorizes a change to the inverter parameters, arrange the new limits with the customer service. If the voltage at the supply point is much lower than that measured on the inverter, the line must be adjusted (inverter- counter). If the grid voltage and frequency fall within the limits (even when the inverter is connected to the grid), contact customer service.



Display Message	Causes	Solution
W009 Table fail	NA	NA
W010 Fan Fail (Alarm not shown on the display; there is only a flashing yellow LED)	This error appears when there is malfunctioning of the fan(s) inside the inverter. In this condition, the yellow LED on the front panel flashes.	Error inside the inverter that cannot be resolved with external operations. If the alarm is persistently repeated, contact customer service.
W011 Bulk UV	Reading of the internal voltage on the bulk capacitors carried out when the inverter is connected to the grid.	
W012 Battery low Low internal clock battery voltage	Internal battery for maintenance of the date/time settings is discharged or damaged.	Replace the battery with the inverter completely switched off (disconnect AC side and DC side) and be sure to observe the correct polarity.
W013 Clk fail Internal clock failure	The alarm appears when the time shown on the display differs by more than 1 minute from the internal time of the microprocessors and indicates clock circuit malfunctioning.	This is an error inside the inverter that cannot be resolved with external operations. If the alarm is persistently repeated, contact customer service.
W017 Jbox fail Fuse-control board fail (DC string fail)	Fuse(s) on the fuse boards is/are damaged.	Using a multimeter, check the condition of the fuses (situated on the fuse boards). Replace any open fuses and check that the input current on the string(s) does not exceed the rating of the fuses (if string parallels have been made outside the inverter). If there are no damaged string fuses and the inverter continues to display the alarm message, check whether the settings to be made through the Aurora Manager software are correct (presence or absence of one or more input strings).
W018 SPD DC protection open	Overvoltage surge arresters situated on the DC side are damaged.	Look at the inspection window present on each surge arrester (DC side). If it is red, the surge arrester is damaged and the cartridge must be replaced. If the alarm status continues to be present even though all the surge arresters have a green inspection window, contact customer service.



Display Message	Causes	Solution
W019 SPD AC protection open	Overvoltage surge arresters situated on the AC side are damaged.	Look at the inspection window present on each surge arrester (AC side). If it is red, the surge arrester is damaged and the cartridge must be replaced. If the alarm status continues to be present even though all the surge arresters have a green inspection window, contact customer service.
W022 Reactive power mode changed notification only	Variation in the means of managing reactive power; this change is made through the display or advanced configuration software.	Notification of change that is saved in the historical log of inverter events.
W023 Date/time changed notification only	Variation of the inverter's date and time; this change is made through the display or advanced configuration software.	Notification of change that is saved in the historical log of inverter events.
W024 Energy data reset notification only	Zeroing of the statistical energy data stored in the EEPROM: Reset of the energy data saved in the inverter; this operation can be handled through the display or advanced configuration software.	Notification of change that is saved in the historical log of inverter events. The notice may also occur on substitution of the Memory Card where the statistical production data is saved.



Making a service call

The following information is necessary to initiate a call with technical support at 877-261-1374. The model number, serial number, and week of production can be found on the INFORMATION menu of the inverter display and also on the product label.

Model number
Serial number
Week of production

State of LED:

- Status of light(s)
- Steady or flashing
- Error message or code

Identify the System structure:

- Information on the Photovoltaic Field
- Brand and model of photovoltaic panels
- Maximum array voltage and current values
- Number of strings in the array
- Number of panels for each string

Provide a description of the conditions:

- Can the fault be reproduced? If so, how?
- Is the fault cyclical in nature? If so, how often?
- Was the fault apparent at the time of installation? If so, has it worsened?
- Describe the atmospheric conditions at the time the fault appears/appeared



Maintenance

6

Maintenance operations are required to be carried out by personnel familiar with and specifically trained in the operations of this inverter. ABB recommends personnel having appropriate NABCEP certification and/or other professional licensing and/or having received training through ABB or other authorized organizations.

DO NOT allow the equipment to be used if problems of any kind are found



WARNING! Maintenance operations must be carried out with the equipment disconnected from the grid, unless otherwise indicated.

After shutdown, wait at least 10 minutes before removing guards or covers in order to allow devices inside the unit to cool and allow any electrostatic charges and parasitic voltages to dissipate.

For cleaning, DO NOT use rags made of filamentary material or corrosive products that may damage parts of the equipment or materials which may generate electrostatic charges. Avoid temporary repairs. All repairs should be carried out using only genuine spare parts. The maintenance technician is under an obligation to promptly report any anomalies.

Always use the personal protective equipment provided by the employer and comply with the safety conditions in section 1 of this manual. ABB accepts no liability if the periodic checks and maintenance cycles indicated in this manual and in the attached documentation are not complied with correctly, or if maintenance is entrusted to unqualified staff.

Routine maintenance

Routine maintenance operations can be carried out by the user or by the installer.

	Clean the equipment at least annually; in particular, the lower grill on the wiring box through which the air for cooling the heatsink passes and the heatsink itself. If possible, use an extractor or suitable pipe cleaners.
	Annually or in the event of malfunction, check that the environmental conditions have not changed drastically (exposure to weather conditions); also check that the inverter chassis has not been isolated by foreign bodies such that airflow may be affected.
	Annually or in the event of malfunction, check the tightness of the cable opening plugs, the fitting of the connectors and front covers. Loose fittings can allow water seepage into the cabinet possibly leading to short circuit conditions due to high humidity.

Recommended system maintenance

If not performed more often, ABB recommends having the systems checked after about 5 years of activity to maintain the correct working performance.



Clean the photovoltaic panels every six months, at the change of season or as necessary. The performance of the system depends on the condition of the PV panels. To clean, follow the specifications of the PV panel supplier.

Preventative maintenance

These maintenance operations **MUST** be carried out by the installer or trained maintenance personnel. If repairs to the inverter are required for any reason, recheck all items after repairs are completed

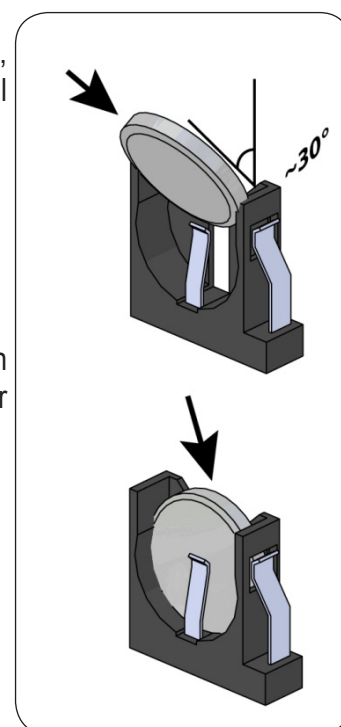
INTERVAL	INVERTER MAINTENANCE ITEM
Annually	Check the cooling air path and heatsink for blockages
Annually	Check internal cooling fan operation (monitor start-up for warning)
Annually	Check all electrical connections using an IR camera or equivalent to determine hot spots. Check torque value for any connection indicated*
Annually	Check AC pressure connectors
Annually	Check torque of screws on chassis access covers to insure NEMA4X compatibility*
Annually	Check all connections terminals for discoloration or signs of high temp/current*
1 year	Remove and replace the memory back-up battery, see instructions in this section.

*ABB recommends checking this item after first six months of operation, and then annually; refer to torque tables in appendix, section 7.

CR2032 battery replacement

The CR2032 battery, located in the inverter on the main connection board, powers the time of day clock. When this battery is at end-of-life a message will be appear in the display alerting the need for replacement.

- Remove the inverter front cover.
- Remove the old battery.
- Insert the new battery into its holder, sliding in at a 30° angle.
- The battery should seat into the correct position within the holder.
- After battery replacement is complete, replace the front cover and tighten cover screws with at least 1.5Nm (13.2 in-lbs) torque to ensure proper waterproof sealing.



Storage and dismantling

If the equipment is not used immediately or is stored for long periods, check that it is packaged correctly and contact customer service for storage instructions. The equipment must be stored in well-ventilated indoor areas in a noncorrosive environment. Restarting after a long period requires the removal of oxidation and dust that may have settled inside the equipment if not suitably protected.

ABB CANNOT be held responsible for disposal of the equipment, displays, cables, batteries, etc. The customer must dispose of these substances, which are potentially harmful to the environment, in accordance with the regulations in force in the country of installation.

If the equipment is dismantled, follow the regulations in force in the country of destination and avoid causing any kind of pollution upon disposal. Use dumps suitable for disposal of the various types of materials listed below.

COMPONENT	MATERIAL OF CONSTRUCTION
Frame, brackets, supports	Carbon steel or stainless steel
Casing or covers	Aluminum
Paint	Epoxy based powder coat
Plugs and seals	Rubber / (Neoprene and/or Butadiene) / Polyimide PA6
Electrical cables	Copper / PVC jacket
Cable trays	Polyethylene / Nylon
Backup battery	Nickel / Lithium
Component parts	May contain small amounts of lead; product uses lead free solder.





System description

ABB grid-tied inverters provide the capability to supply the utility grid with energy obtained from photovoltaic panels. To use the DC generated by a photovoltaic field efficiently, it must be transformed into alternating current (AC) via a conversion process known as DC-AC inversion.

This process is the basis of all grid-tied inverters and is achieved very efficiently by the inverter without the use of rotating elements. When the inverter output is connected in parallel to the utility power grid, the alternating current output from the inverter flows directly into the distribution circuit, and is connected in turn to the public distribution utility grid.

The photovoltaic energy system can thus feed all the connected user electrical loads:

- If the energy supply from the photovoltaic system is lower than the user's load requirement, the quantity of energy necessary to guarantee normal functioning of the connected appliances is taken from the public distribution network.
- If the energy supply from the photovoltaic system is greater than the user's load requirement (i.e. an excess of energy is produced) it is sent directly into the public network, becoming available to other users.

Depending on prevailing codes and regulations of the installation area, the energy produced can be sold to the utility or credited against future consumption, producing energy savings.

STRINGS AND ARRAYS

A photovoltaic panel consists of many photovoltaic cells mounted on the same support. A string consists of a certain number of panels connected in series. An array consists of two or more strings connected in parallel.

Large photovoltaic systems can be made up of several arrays, connected to one or more inverters. By maximizing the number of panels inserted into each string, the string output voltage is increased, which reduces the cost and complexity of the photovoltaic system. The current of each array must fall within the limits of the inverter.

Notes on the sizing of the system

Decisions about how to structure a photovoltaic system depend on a certain number of factors and considerations to make, such as for example, the type of panels, the availability of space, the future location of the system, energy production goals over the long term, etc.

A configuration program that can help to correctly size the photovoltaic system is available on the website.

Protective devices within the inverter

Anti-Islanding

In the event of a local grid outage from the utility company, or when the equipment is switched off for maintenance operations, the inverter must be physically disconnected safely, to ensure protection of people working on the grid, all in accordance with the relevant national standards and laws. To prevent possible islanding, the inverter is equipped with an automatic protective disconnection system called an Anti-islanding system.

Grounding/differential protection fault

The inverter has a sophisticated ground protection circuit that continually monitors the ground connection for significant changes in fault current. When a ground fault current sufficient to cause safety hazards is detected, this circuit shuts down the inverter and illuminates a red LED on the front panel indicating a ground fault condition. The inverter is equipped with a terminal for the system ground conductors.

Arc Fault Detection (AFD)

This safety function allows the inverter to recognize electrical arcing on DC cables. Once the arcing has been detected the inverter will fall into secure state. The inverter will remain in this disconnected state even after turning it off and on again.

It is possible to unlatch the unit by pressing the 'ESC' button on the display after a complete check of DC cables. The AFD board performs a safety Self-Test at each start-up providing the result of the test on the inverter display.

Additional protective devices

The inverter is equipped with additional protective devices to guarantee safe operation in any circumstance. These protective devices include:

- Continuous monitoring of the grid voltage to ensure the voltage and frequency values stay within operating limits.
- Control of internal temperatures to automatically limit the power if necessary to ensure the unit does not overheat (derating).

Topographic diagram of the equipment

The input of a photovoltaic (PV) inverter is intended to be connected to a PV array. The input circuitry includes Maximum Power Point Tracking (MPPT) circuitry, which maximizes the output of the PV array under all allowable environmental conditions.

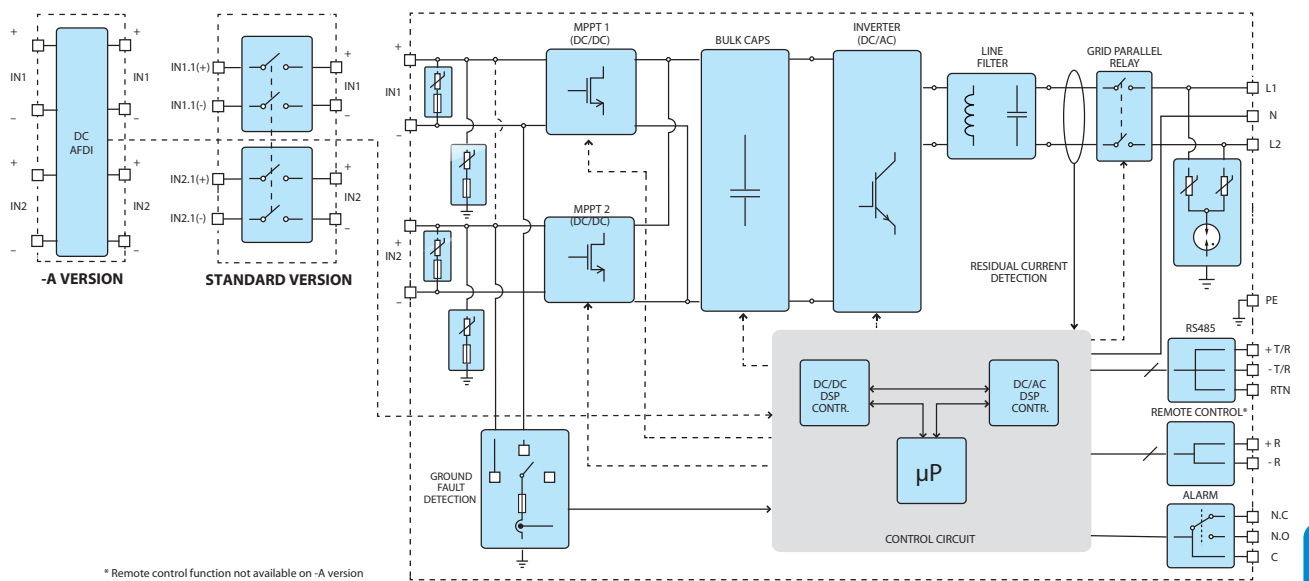
All models are provisioned with two independent inputs, each equipped with its own MPPT circuit that enables the inverter to be connected to two independent arrays that are maximized for output power individually. See block diagram figure on next page. The main segments of the design are the independent input DC-DC converters (termed 'boosters', one for each MPPT channel) and the main output inverter. Both of the DC-DC converters and the output inverter operate at a high switching frequency to enable a compact design and low weight.

These versions of ABB inverters utilize "high-frequency switching" transformers, to provide a high-level of galvanic isolation between inverter input (array) and output (grid). This circuitry provides galvanic isolation from the secondary (AC side), while maintaining very high performance in terms of energy yield and export. An inverter with two independent input DC-DC converters; each converter is typically dedicated to a separate array and has independent Maximum Power Point Tracking (MPPT) circuitry and control. This means that the two

arrays can be installed with different positions, facing different directions and with different string lengths; each array is controlled by an MPPT control circuit.

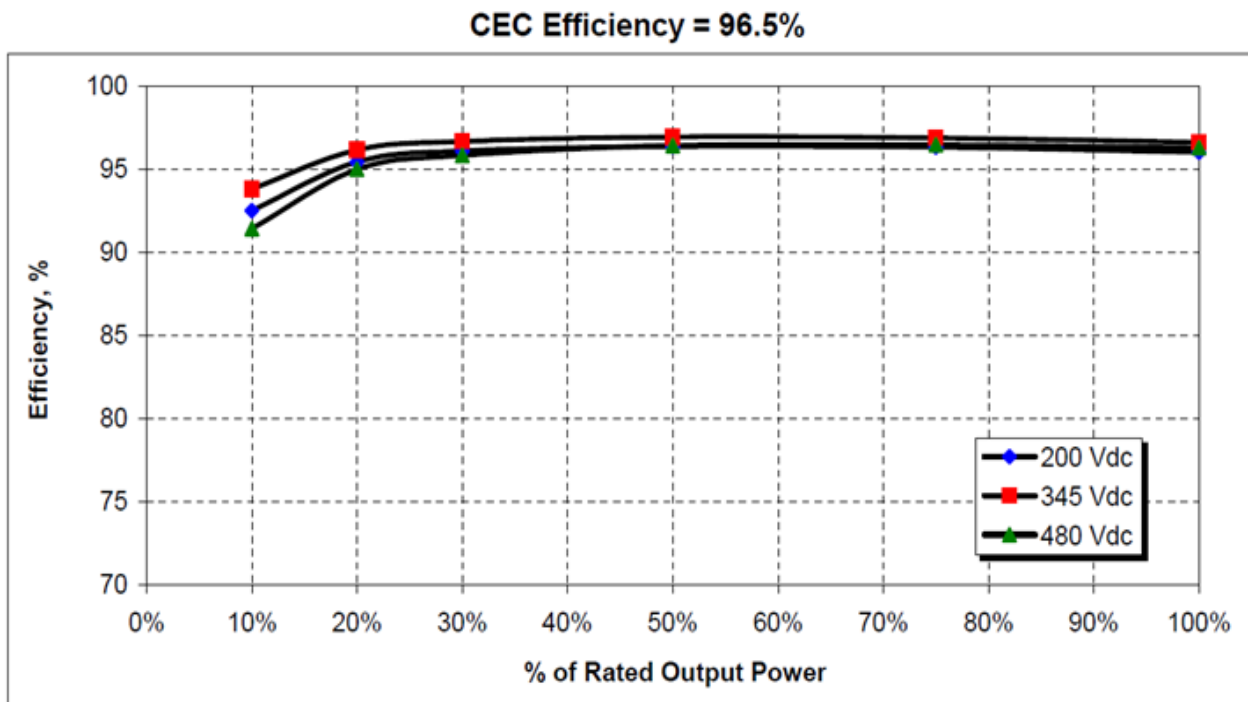
The high efficiency and extra large heat dissipation system enables operation at maximum power over a broad range of ambient temperatures. Two independent Digital Signal Processors (DSP) and one central microprocessor control the inverter; and therefore, two independent computers control the grid connection in full compliance with safety standards and regulations.

The Inverter operating system (program) communicates with all of the sub-systems within the inverter performing necessary data processing, calculations to guarantee optimal performance levels of the system and high-power harvesting in all installation and load conditions, while maintaining full compliance with prevailing safety directives, laws and regulations.

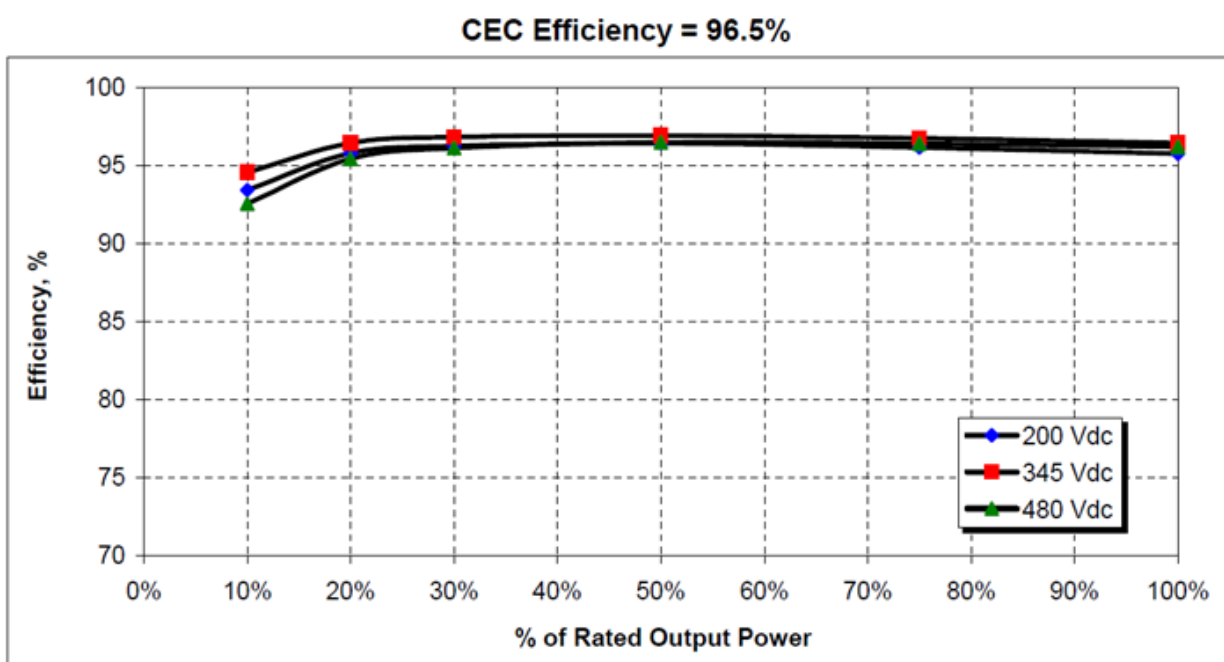


Efficiency curves

The equipment was designed in compliance with energy conservation standards to avoid waste and unnecessary leakage. Graphs of the efficiency curves of the inverters are shown below. The efficiency curves are affected by technical parameters that are continually being developed and improved and should be considered approximate.



PVI-5000-OUTD-US (240V)



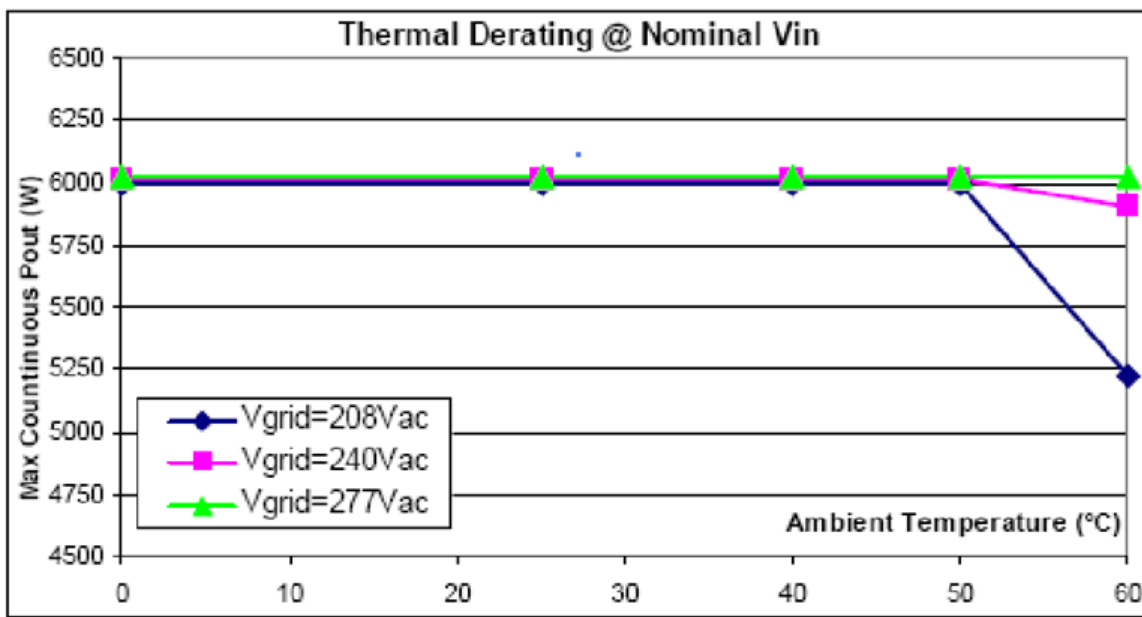
PVI-6000-OUTD-US (240V)

Automatic power reduction

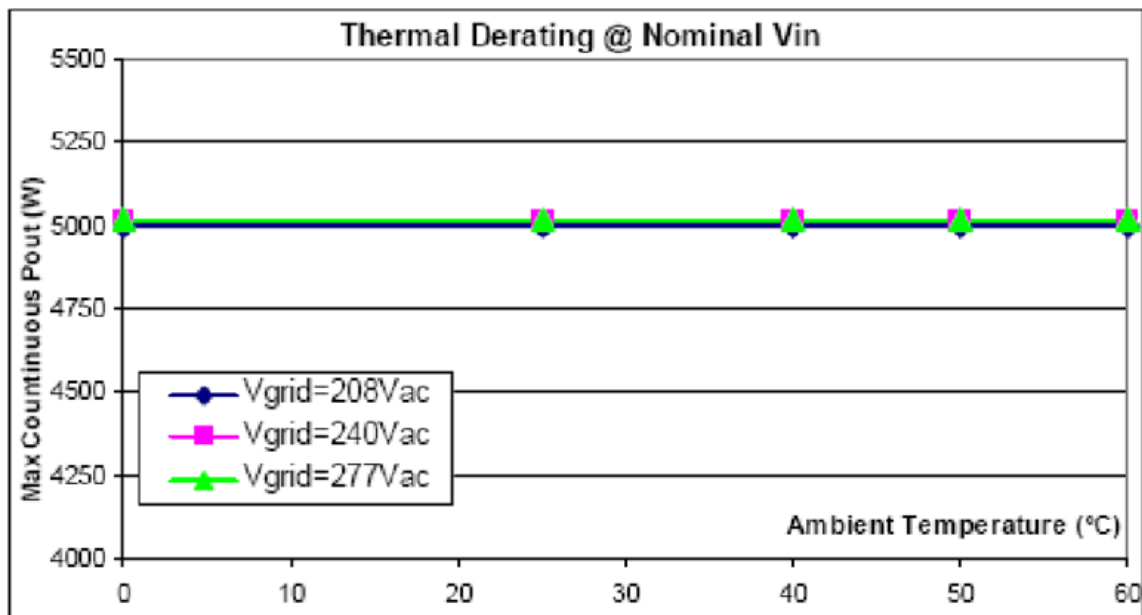
In order to maintain safe inverter operation under adverse environmental conditions or due to improper input voltages, the unit automatically reduces the amount of power it feeds to the grid. The conditions for power reduction due to environmental conditions and input voltage can occur at the same time, but the power reduction will always be determined by the more severe factor.

Power reduction due to temperature

Power reduction due to ambient or inverter temperature depends on many operating parameters, such as input voltage, grid voltage and power available from the photovoltaic arrays. The inverter may reduce its output power during the day according to the value of these parameters. The following graphs show the automatic reduction in output power in relation to ambient temperature.



PVI-6000-OUTD-US operating ambient temperature at full power (without derating)

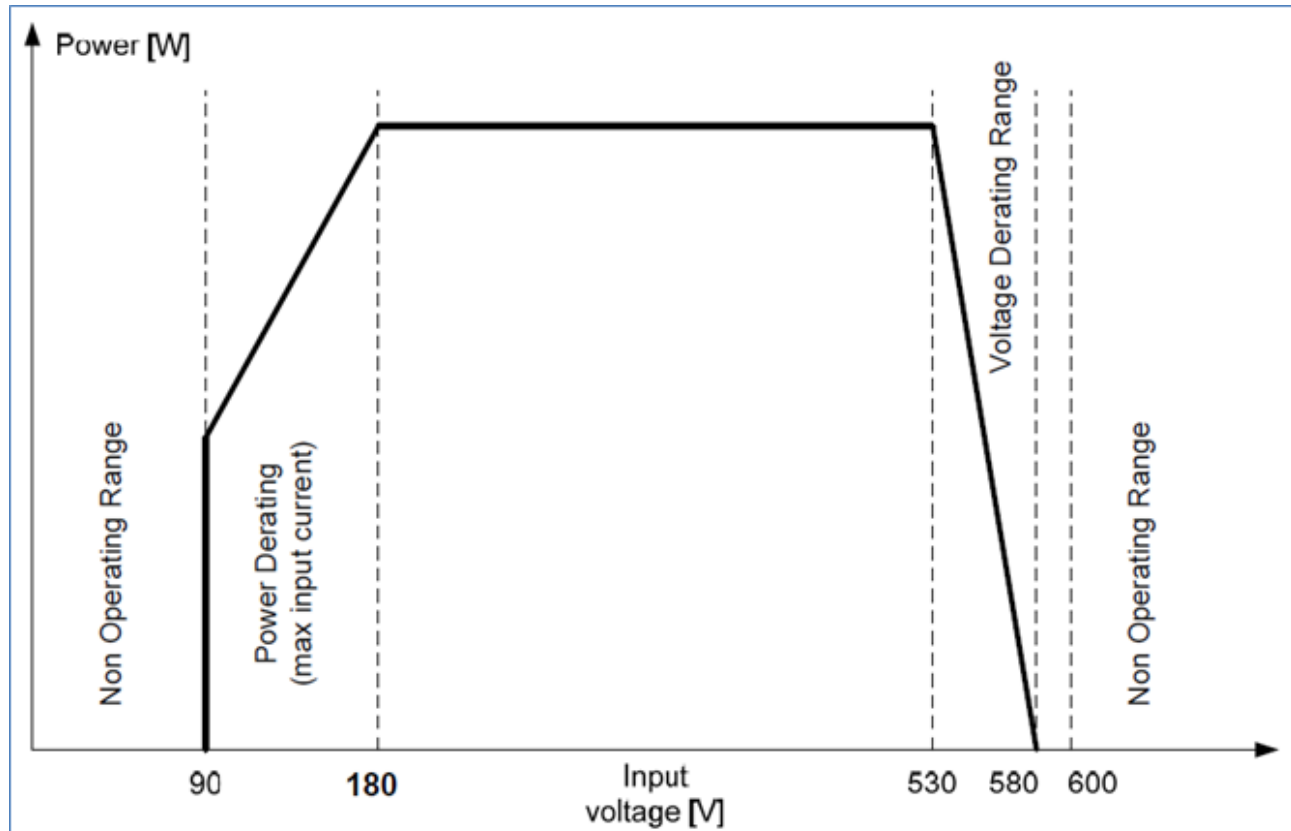


PVI-5000-OUTD-US operating ambient temperature at full power (without derating)

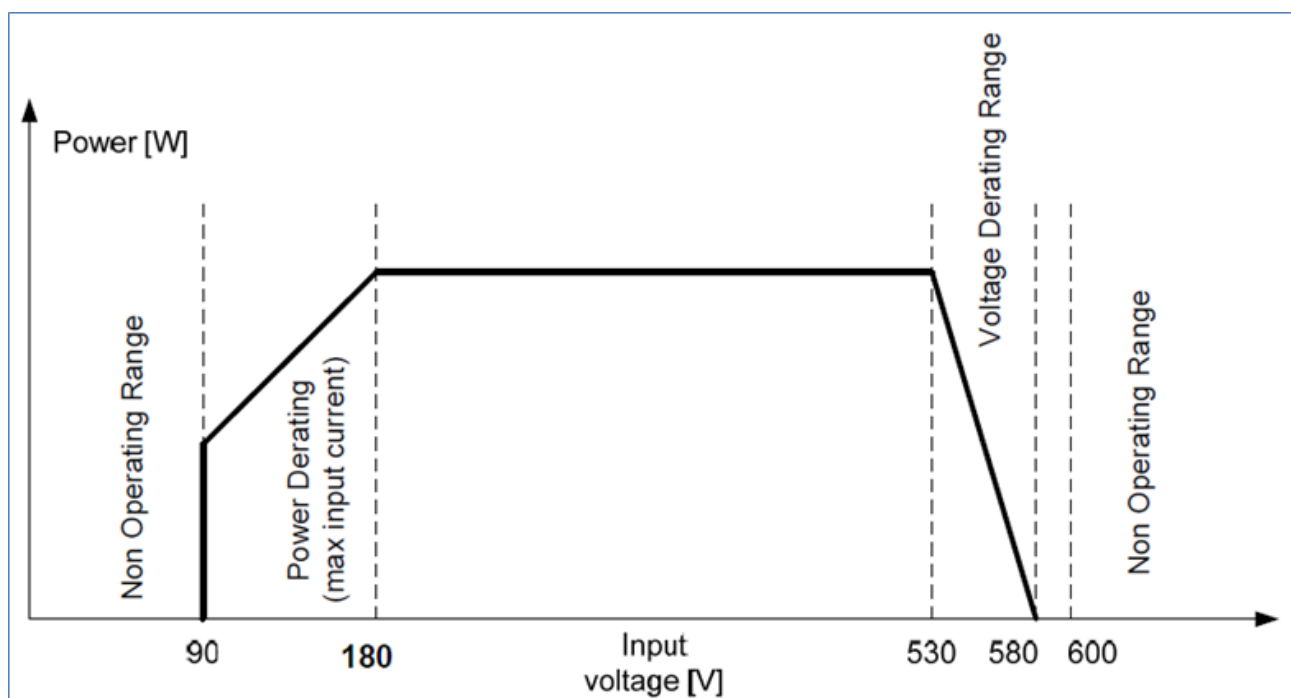


Power reduction due to input voltage

The graphs below show automatic power output derating when input or output voltage is too high or too low. Necessary conditions for power derating due to environmental conditions and to input voltage can occur at the same time, but in this instance power derating will always consider the lowest value detected.



Output power with two DC sections operating



Output power with one DC section operating

Technical data and types

Type code	PVI-5000-OUTD-US			PVI-6000-OUTD-US		
Input side						
Nominal output power	5000W			6000W		
Maximum output power	5000W			6000W		
Rated grid AC voltage	208V	240V	277V	208V	240V	277V
Input side (DC)						
Number of independent MPPT channels	2			2		
Maximum usable power for each channel	4000W			4000W		
Absolute maximum voltage (Vmax)	600V			600V		
Start-up voltage (Vstart)	200V (adj. 120-350)			200V (adj. 120-350)		
Full power MPPT voltage range	200 - 530V			200 - 530V		
Operating MPPT voltage range	0.7 x Vstart - 580V			0.7 x Vstart - 580V		
Maximum current (I _{dc,max}) for both MPPT in parallel	36A			36A		
Maximum usable current per channel	22A			22A		
Number of wire landing terminals per channel	2 Pairs			2 Pairs		
Array wiring termination	Terminal block, pressure clamp, AWG16-AWG6					
Output side (AC)						
Grid connection type	1Ø/2W	Split-Ø/3W	1Ø/2W	1Ø/2W	Split-Ø/3W	1Ø/2W
Adjustable voltage range (V _{min} -V _{max})	183V-228V	221V-264V	244V-304V	183V-228V	211V-264V	244V-304V
Grid frequency	60Hz					
Adjustable grid frequency range	57-60.5Hz					
Maximum current (I _{ac,max}) A _{RMS}	27A _{RMS}	23A _{RMS}	20A _{RMS}	30A _{RMS}	28A _{RMS}	24A _{RMS}
Power factor	> 0.995					
Total harmonic distortion at rated power	< 2%					
Contributory fault current ¹	36.25 A _{pk} / 25.63A _{RMS}	36.5 A _{pk} / 25.81A _{RMS}	31.75 A _{pk} / 22.45A _{RMS}	36.25 A _{pk} / 25.63A _{RMS}	36.5 A _{pk} / 25.81A _{RMS}	31.75 A _{pk} / 22.45A _{RMS}
Grid wiring termination type	Terminal block, pressure clamp, AWG14-AWG4					
Input						
Reverse polarity protection	Yes					
Over-voltage protection type	Varistor, 2 for each channel					
PV array ground fault detection	Pre start-up Riso and Dynamic GFDI (requires floating arrays)					
Output						
Anti-islanding protection	Meets UL 1741/IEEE1547 requirements			Meets UL 1741/IEEE1547 requirements		
Over-voltage protection type	Varistor, 2 (L ₁ - L ₂ / L ₁ - G)			Varistor, 2 (L ₁ - L ₂ / L ₁ - G)		
Maximum AC OCPD Rating	35A	30A	25A	40A	35A	30A
Efficiency						
Maximum efficiency	97.1%					
CEC efficiency	96%	96.5%	96.5%	96%	96.5%	96.5%
User interface	Graphic display			Graphic display		
Operating performance						
Stand-by consumption	<8W _{RMS}			<8W _{RMS}		
Night time consumption	<0.6W _{RMS}			<0.6W _{RMS}		
Communication						
User-interface	16 characters x 2 lines LCD display					
Remote monitoring (1xRS485 incl.)	VSN700 Data Logger (opt)					
Wired local monitoring (1xRS485 incl.)	PVI-USB-RS485_232 (opt.)					
Environmental						
Ambient air operating temperature range	-13°F to +140°F (-25°C to +60°C)			-13°F to +140°F (-25°C to +60°C) with derating above 122°F (50°C)		
Ambient air storage temperature range	-40°F to +176°F (-40°C to +80°C)			-40°F to +176°F (-40°C to +80°C)		
Relative humidity	0-100% RH condensing			0-100% RH condensing		
Acoustic noise emission level	< 50 db (A) @1m			< 50 db (A) @1m		
Maximum operating altitude without derating	6560 ft (2000 m)			6560 ft (2000 m)		
Mechanical specifications						
Enclosure rating	NEMA 4X					
Cooling	Natural convection					
Dimensions (H x W x D)	41.4x12.8x8.6 in (1052 x 325 x 218 mm)					
Weight	<59.5lb (27.0 kg)					
Shipping weight	< 78lb (35.4 kg)					
Mounting system	Wall bracket					
Conduit connections	Trade size KOs: (2ea x 1/2") and (2ea x 1-1/4", 3 places side, front, rear)					
DC switch rating (per contact)	25A / 600V					
Safety						
Isolation level	Transformerless (floating array)					
Safety and EMC standard	UL1741, IEE1547, IEE1547.1, CSA-C22.2N. 107.1-01, UL1998 UL 1699B, FCC Part 15					
Safety Approval	Class B cCSA _{us}					
Warranty						
Standard warranty	10 years					
Extended warranty	15 & 20 years					
Available models						
Standard - with DC switch - floating Array	PVI-5000-OUTD-US			PVI-6000-OUTD-US		
With DC switch, wiring box and arc fault detector and interruptor	PVI-5000-OUTD-US-A			PVI-6000-OUTD-US-A		

1. Inverter can apply that much current - Breaker will open

*All data is subject to change without notice



Further information

For more information on ABB products and services for solar applications, navigate to www.abb.com/solarinverters

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PVI-5000-6000--TL-OUTD-S-US (-A) Product Manual
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