ABB solar inverters

Product manual
UNO-7.6-8.6-TL-OUTD-S-US-A
(7.6 to 8.6 kW)

Power and productivity
for a better world™

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

UNO-7.6-8.6 string inverters

Contents

002TC

Introduction and safety

1

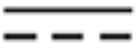
Warnings in this document

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 UNO 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)	Ø	Phase
	Direct current (DC)		Grounding (earth)

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General installation warnings

The UNO 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.

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 UNO grid-tied 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 and/or any prevailing local codes and regulations.

All photovoltaic source and output circuit conductors MUST have disconnects complying with the NEC, Section 690, Part III. All models listed in this manual include an integrated DC disconnect switch.

Output circuits must be isolated from the enclosure. System grounding, required by Sections 690.41 - 690.43 of the National Electric Code, ANSI/NFPA 70, is the responsibility of the installer.

Connect only to a dedicated branch circuit provided with the maximum branch Over Current Protection Device (OCPD) in accordance with the CSA document available online and listed on the technical data sheet found in 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 installer and/or operator must properly protect the installation from access by the public and/or highlight with signs or notices the potential hazards of the equipment, e.g., magnetic fields, hazardous voltages, high temperatures, possibility of discharges, generic hazard, etc..

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.

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.

Do not use the equipment if any operating anomalies are found. All repairs should be carried out using only qualified spare parts, which must be installed in accordance with their intended use and by a licensed contractor. Liabilities arising from commercial components are delegated to their respective manufacturers.

Thermal and voltage hazards

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.

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 at least five minutes 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.

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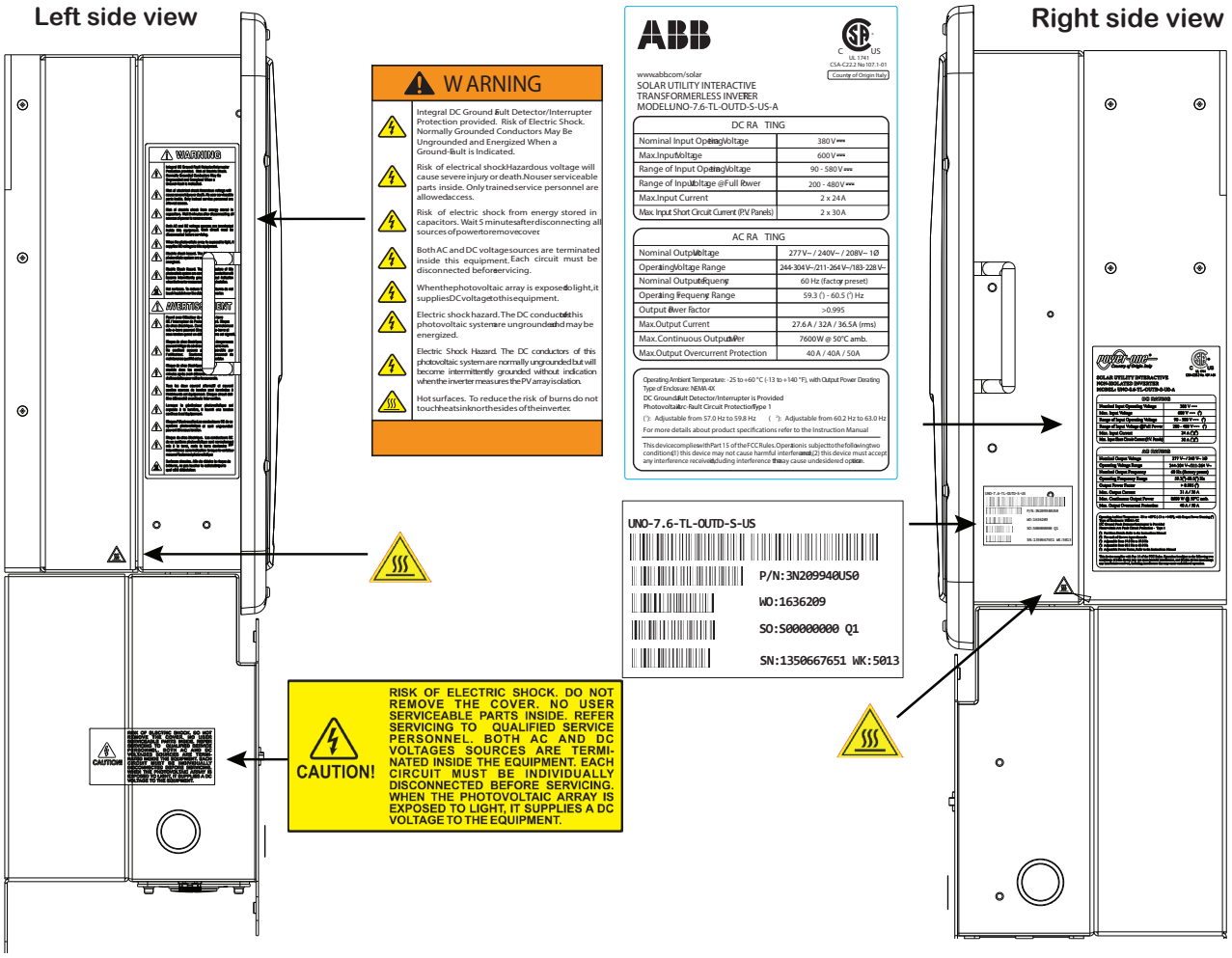
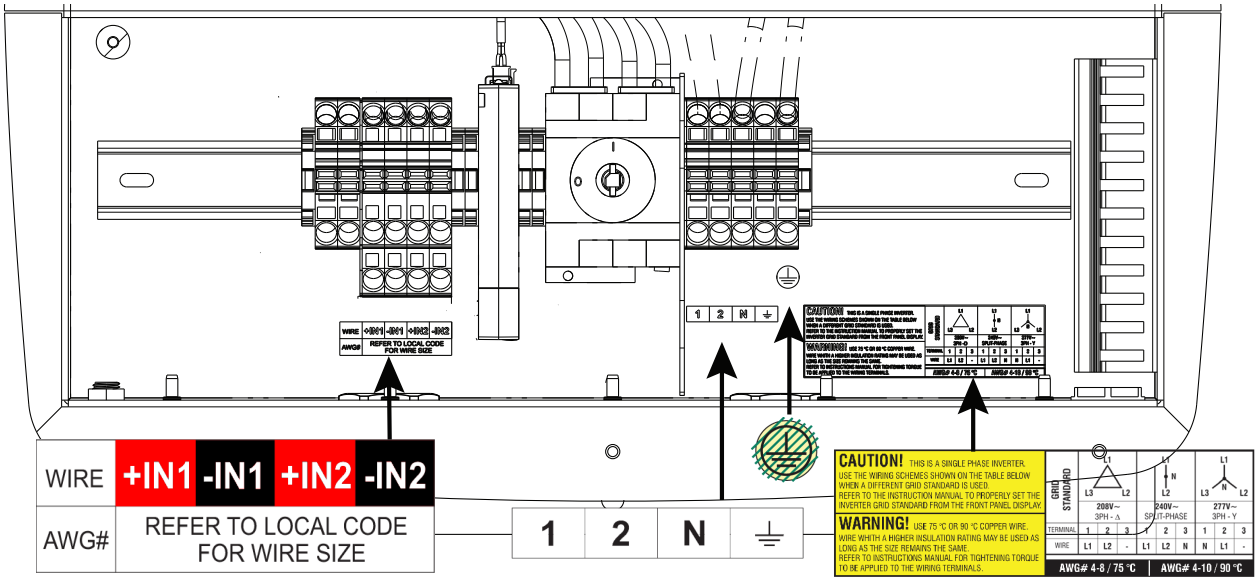
Location of safety notices and labels

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 UNO 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 check in section 2.

Conditions of use

This inverter utilizes a transformerless design and requires connected arrays 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 found in the data table in the appendix, section 7.
- 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.

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) include a 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 AFCI.

The UNO inverter DC ARC FAULT DETECTION (AFD) solution is based on Digital Signal Processor (DSP) technology. The AFD module has two independent channels, designed to accommodate the two independent MPPT channels associated with all UNO 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 AFD 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 operates 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.**

Refer to section 5 for display error messages and instructions to reset fault conditions or manually start the self-test procedure.

Available models

The inverters are divided into two models according to their rated output power of 7.6 kW or 8.6 kW.
Both models include an integrated DC disconnect switch and a built-in PV AFCI Type 1 device for arc fault detection (DC AFD) and are equipped with 2 DC inputs per MPPT channel using non-fused terminal blocks.

The wiring box is designed with room to accommodate three fused DC inputs per MPPT channel resulting in a total of six fused inputs (12 fuses and 12 fuse holders, considering positive and negative inputs). See Optional DC fused inputs in section 3.

7.6 Kw	UNO-7.6-TL-OUTD-S-US-A	**Unit Weight** – 82 lbs/ 37 KG **Dimensions** (H x W x D) – **INVERTER ONLY:** 18.9 x 22.9 x 8.8 in (480 x 620 x 225mm) **INCLUDING DC SWITCH WIRING BOX:** 29.3 x 22.9 x 8.8 (745 x 620 x 225mm)
8.6 Kw	UNO-8.6-TL-OUTD-S-US-A	

Regulatory nameplate

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

1) Product origin
2) Certification
3) Model type and number
4) DC input ratings
5) AC output ratings
6) Environmental data
7) Protection
8) Adjustable parameters

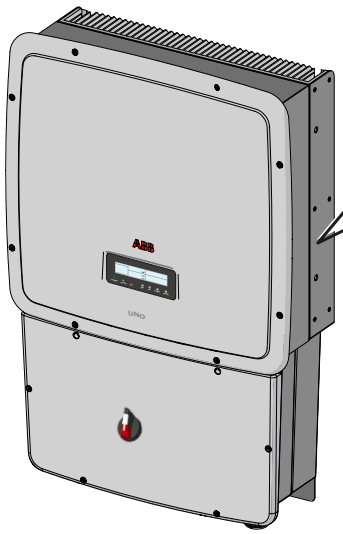


ABB ①

C SA US
UL 1741
CSA-C22.2 No. 107.1-01

www.abb.com/solar ② Country of Origin Italy

SOLAR UTILITY INTERACTIVE
TRANSFORMERLESS INVERTER
MODEL: UNO-7.6-TL-OUTD-S-US-A ③

DC RATING ④	
Nominal Input Operating Voltage	380 V⎓
Max. Input Voltage	600 V ⎓
Range of Input Operating Voltage	90 - 580 V ⎓
Range of Input Voltage @Full Power	200 - 480 V⎓
Max. Input Current	2 x 24 A
Max. Input Short Circuit Current (P.V. Panels	2 x 30 A

AC RATING ⑤	
Nominal Output Voltage	277V~/240V~/208V~ 1Ø
Operating Voltage Range	244-304V~/211-264V~/183-228V~
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 ([1]) - 60.5 Hz ([2])
Output Power Factor	>0.995
Max. Output Current	27.6 A/ 32 A/36.5 A (rms)
Max. Continuous Output Power	7600 W @ 50°C amb.
Max. Output Overcurrent Protection	40 A/ 40 A/ 50 A

⑥ Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F), with Output Power Derating
Type of Enclosure: NEMA 4X
DC Ground Fault Detector/Interrupter is Provided
Photovoltaic Arc-Fault Circuit Protection - Type 1 ⑦

([1]): Adjustable from 57.0 Hz to 59.8 Hz ([2]): Adjustable from 60.2 Hz to 63.0 Hz ⑧

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 ollowing two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesidered operation.

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Installation location

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Transportation and handling

When being transported, the inverter and electronic components must be protected from vibration, mechanical shocks, humidity, etc.

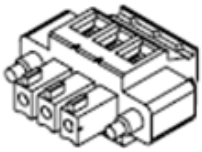
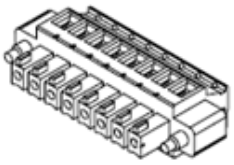
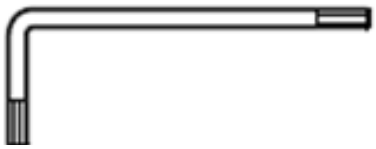
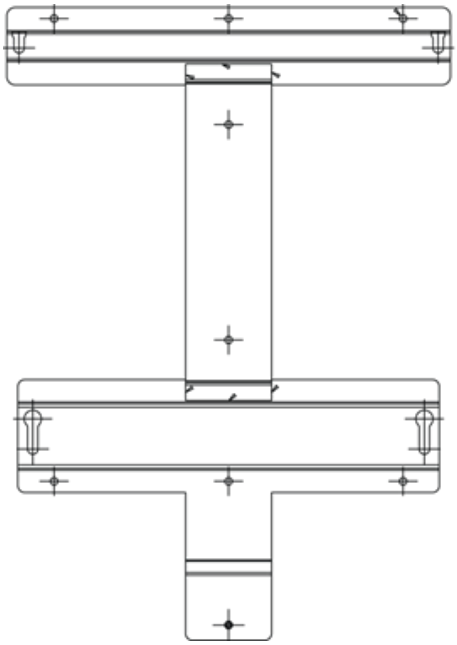
Incoming inspection

It is the customer's responsibility to examine the condition of the unit. Upon receipt of the inverter 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.

If inspection reveals damage to the inverter, contact the supplier or authorized distributor for a repair/return determination and instructions regarding the process. The equipment components supplied are inserted into a cardboard box placed within the packaging of the UNO.

QTY	Description of carton contents
1	UNO Inverter
1	Quick Installation Guide
1	Equipment components (next page)

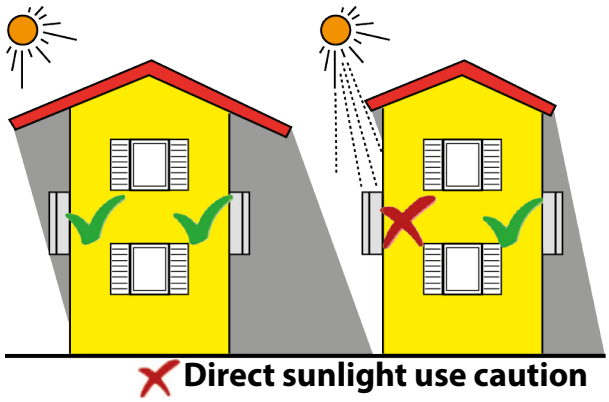
Components for all models	Description	QTY/part#
	3 pin connector for configurable relay	2 82000005907-G
	8 pin connector for communication signals	2 82000005908-G
	L-key tool; TORX WRENCH;90°	1 81510000077
Mounting Kit	Includes items below	XAK.P0101.0
	1 Wall bracket for mounting, 6 screws;3x70mm;DIN 7981 A2 and 6 wall anchors, 1 screw; pan head; M6x16; stainless steel;A2, used for securing inverter to mounting bracket	1 (mounting kit)
	Jumpers for parallel input mode,	2 ZEC.00074
Optional fused kit	**Description**	**QTY/part#**
The wiring box is designed with room to accommodate three fused DC inputs per MPPT channel resulting in a total of six fused inputs. See section 3 for kit installation instructions.	Included in kit: 12 fuse holders, 1000V, 30A, 12 fuses, 12A 4 bus bars, 3 pin, 1000V, 100A, 4 terminal feeders	XAK.P0103.0

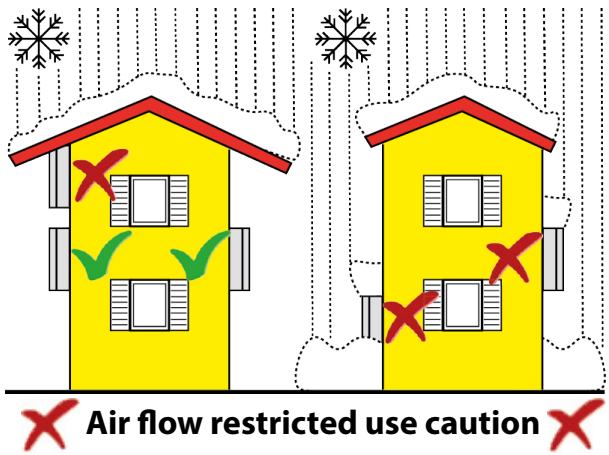
Select the installation location

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 Appendix, part 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.
- Exposure to direct sunlight will increase the operational temperature of the inverter and may cause output power limiting.
- The use of a sun shade minimizing direct sunlight is recommended when the ambient air temperature around the unit exceeds 122°F/50°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.

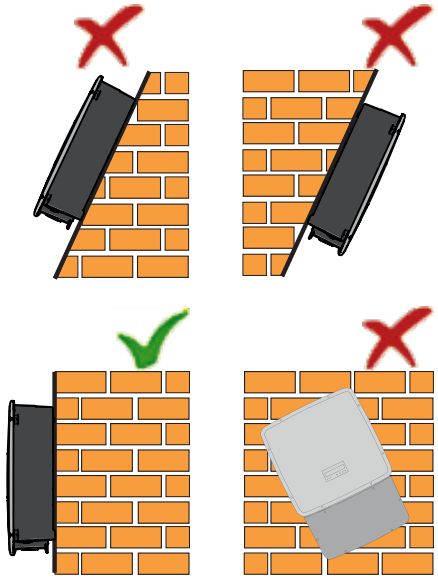


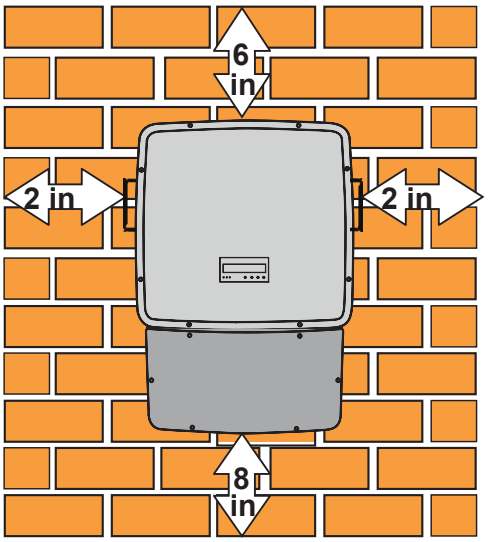


Installation position

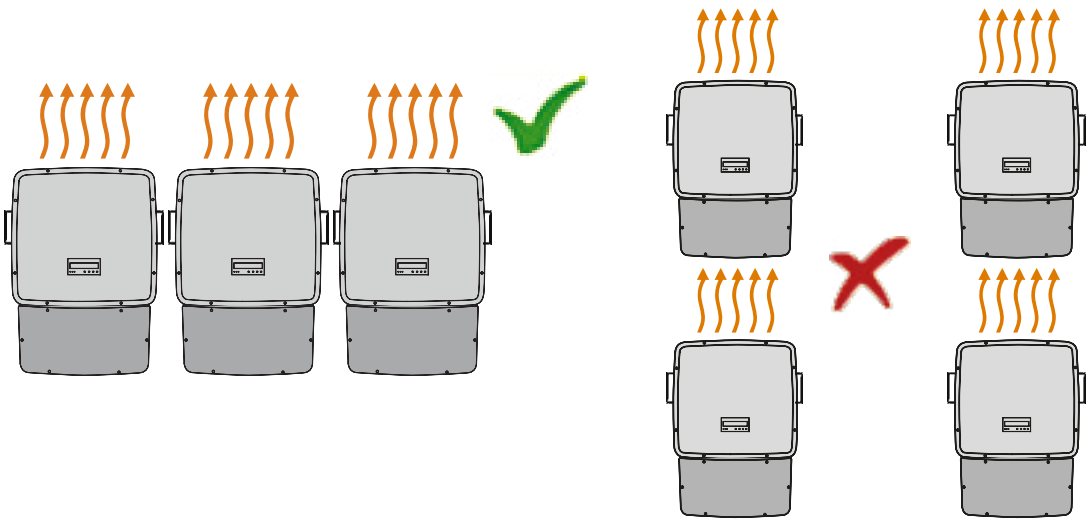
When planning the installation, maintain clearance distances illustrated below to allow normal control functions and easy maintenance operations. When choosing the location and position, comply with the following conditions:

- 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.
- Maintain minimum clearances from walls, roofs, ceilings, and other structures as shown below.





- To avoid overheating, always make sure the flow of air around the inverter is not blocked by walls, roofs, ceilings, and other objects, including other inverters
- Install in safe place where all switch handles and controls remain easy to reach and meet height requirements of the applicable electrical code.
- If possible, 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 wiring box cover and easy access for servicing the inverter.



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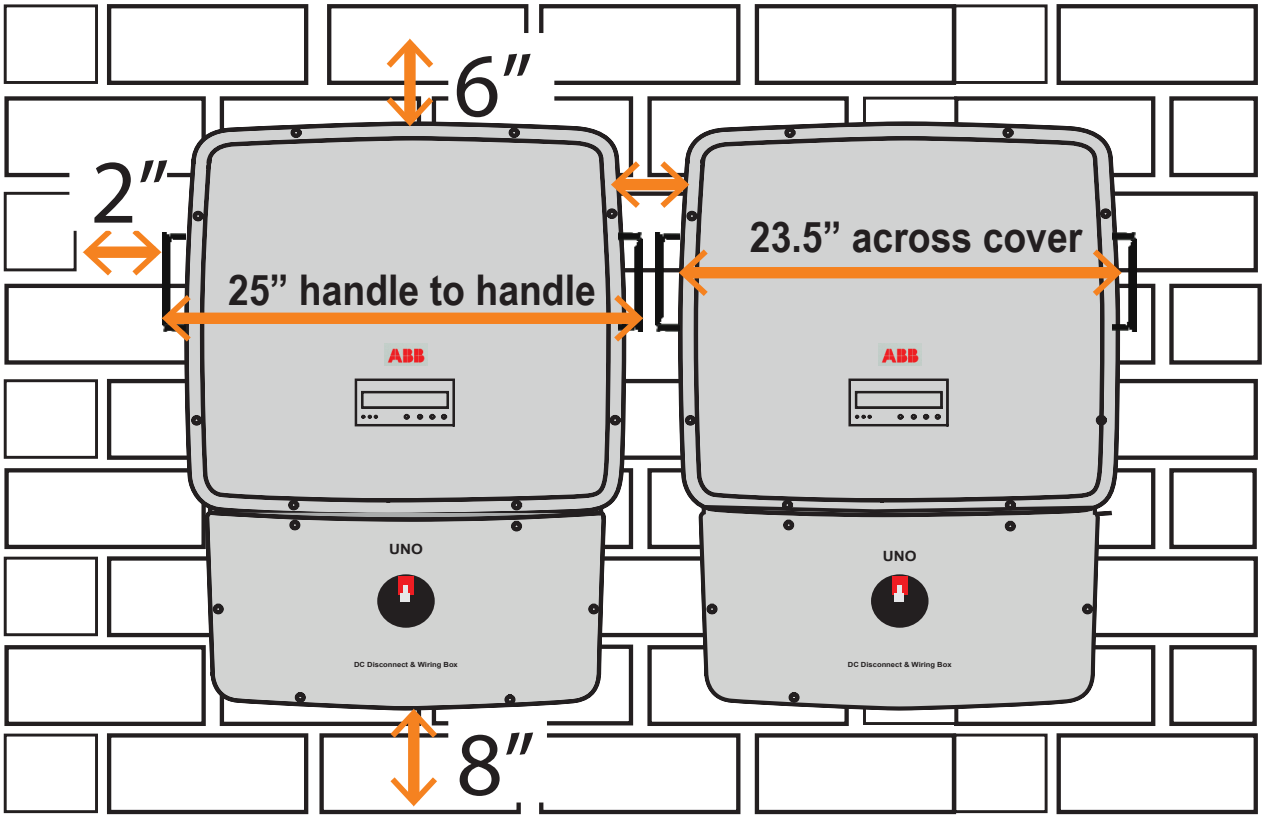
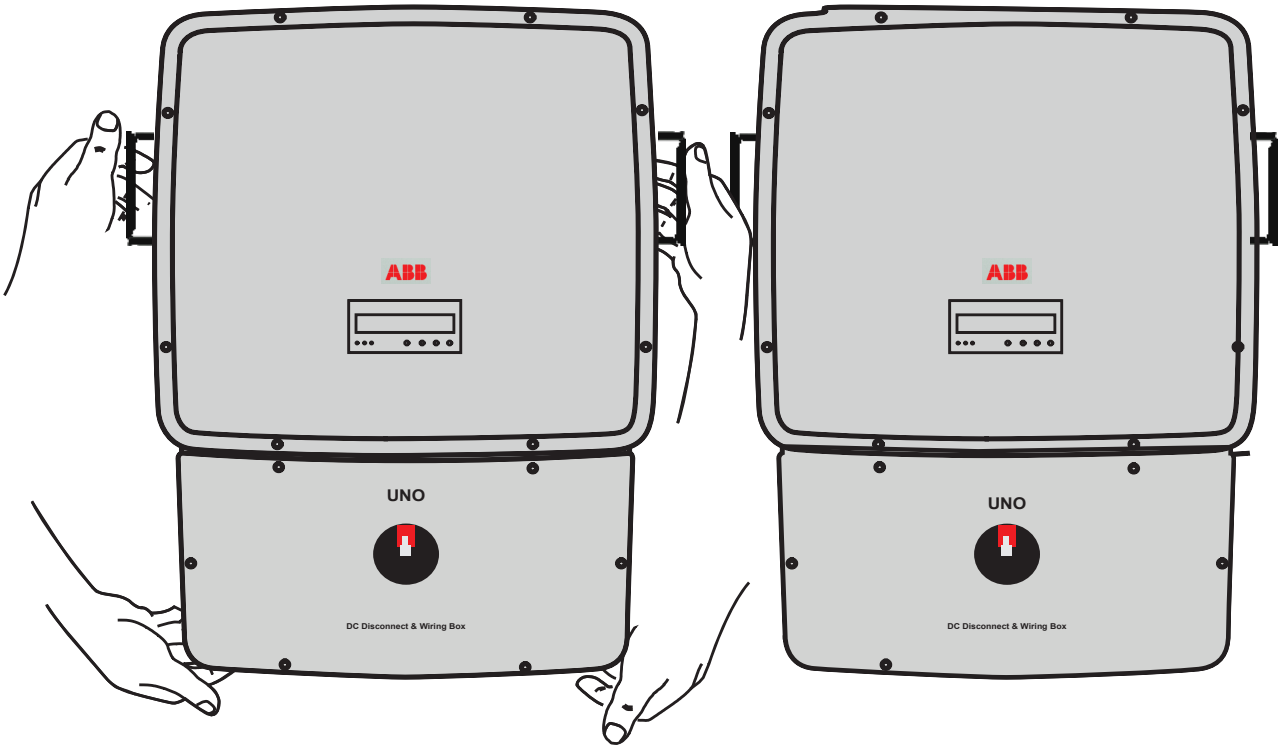
When installing multiple inverters side-by-side, mounting handles must be considered in measurements.



Recommended clearance of 2” between inverters is not required, but a reasonable clearance must be maintained to allow easy access to handles for mounting/dismounting, and for product and warning labels to be visible.



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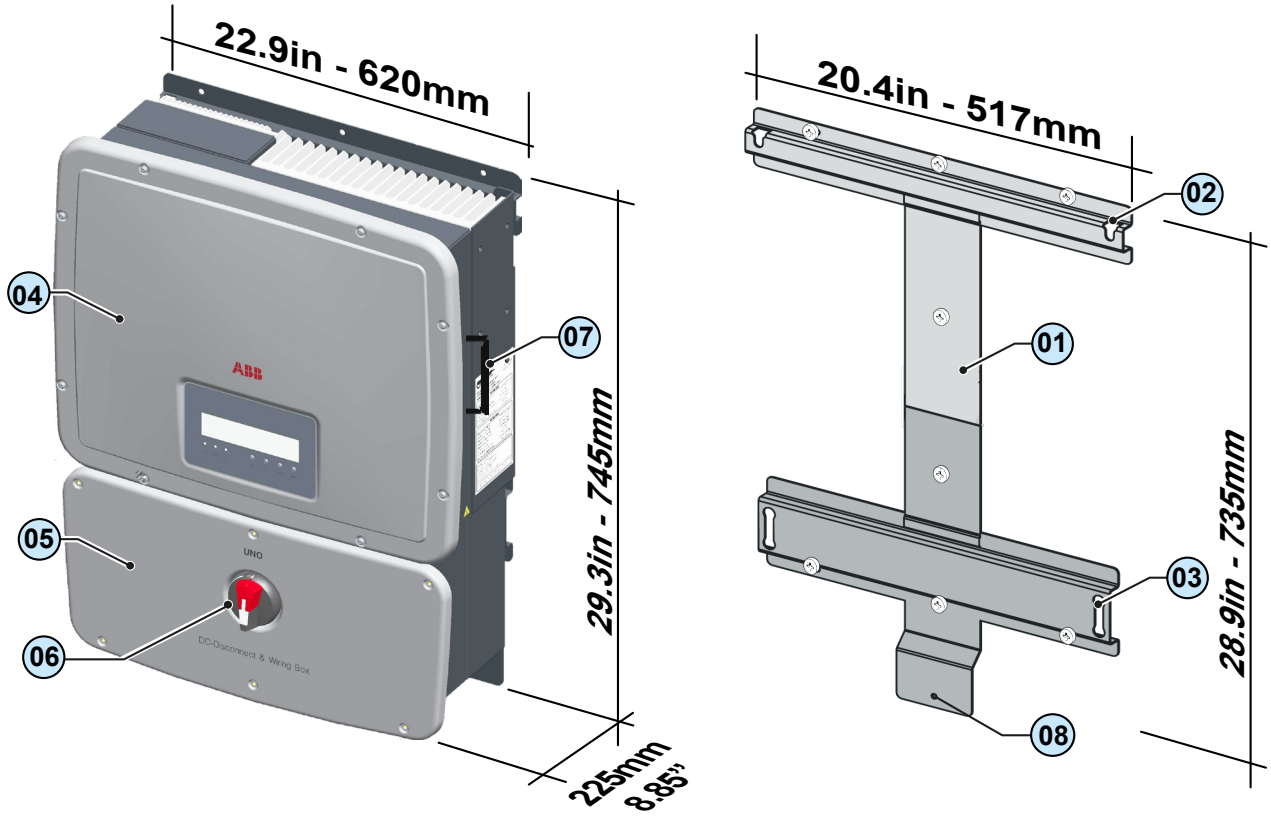
Mounting and wiring

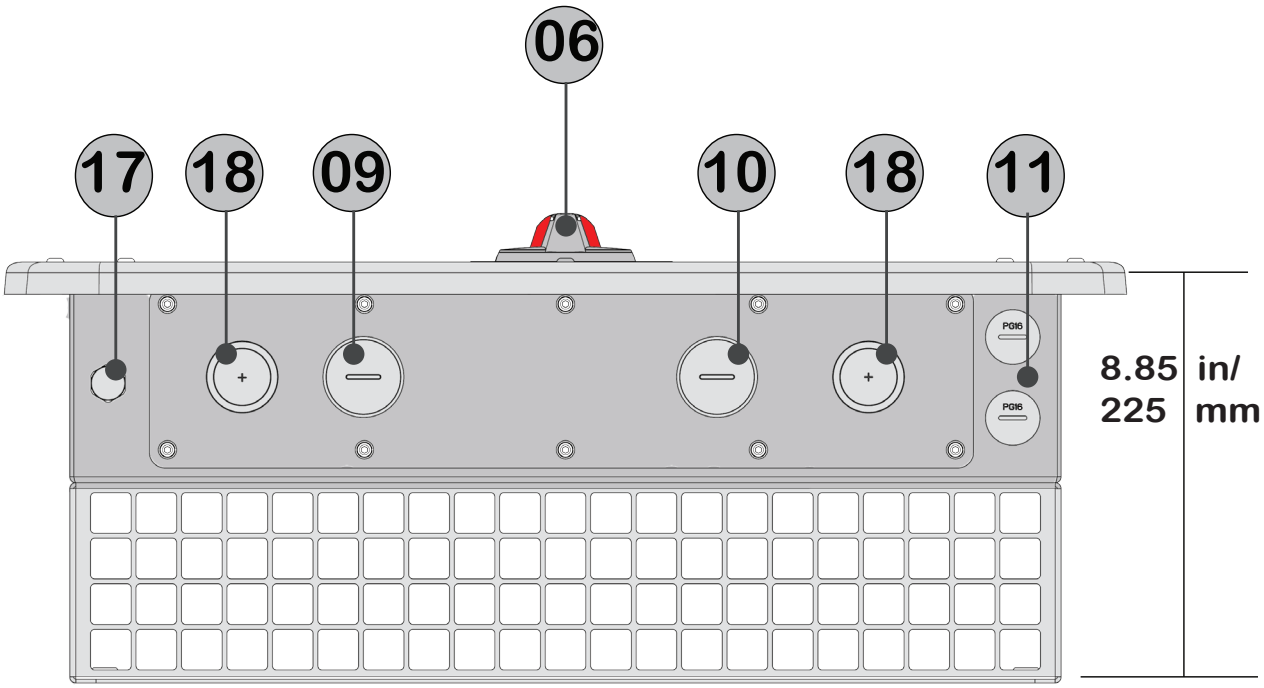
3

Labeled illustration of UNO inverter



Label	Description	Label	Description
01	Mounting bracket	05	Wiring box cover
02	Upper mounting slots	06	DC disconnect switch
03	Lower mounting slots	07	Lifting handle (1 each side)
04	Inverter cover	08	Bottom locking point for securing wiring box to mounting bracket.

Conduit entries are illustrated below. The appropriate conduit connector must be used in order to maintain required spacing between wiring groups and preserve the integrity of the NEMA 4X environmental rating.



Label	Description	Label	Description
06	DC disconnect switch	11	Signal cable openings with plastic threaded plug, 1/2“
09	DC cable opening with plastic threaded plug , 1”*	17	Gore vent pressure equalizer
10	AC cable opening with plastic threaded plug, 1“ *	18	3/4 “, 1” Concentric EKOs, 2 located on bottom of wiring box, 1 on each side of wiring box, can be punched to accommodate these sizes using a knockout hole punch
*In addition to location 18 shown on the bottom of the switchbox, two additional concentric EKOs measuring 3/4“ and 1” are available; one on the left side and one on the right side			

The DC switch (06) disconnects the photovoltaic array current from the inverter when the switch is in the OFF position. It DOES NOT disconnect the AC from the grid. The AC grid can only be disconnected from an external OCPD.

In the ON position, the DC disconnect switch handle must be pushed in and turned clockwise to 90 degrees. In this position the locking function prevents the user from removing the wiring box cover. In the OFF position (open and locked), the white center tab can be pulled out and locked using the three padlock holes.

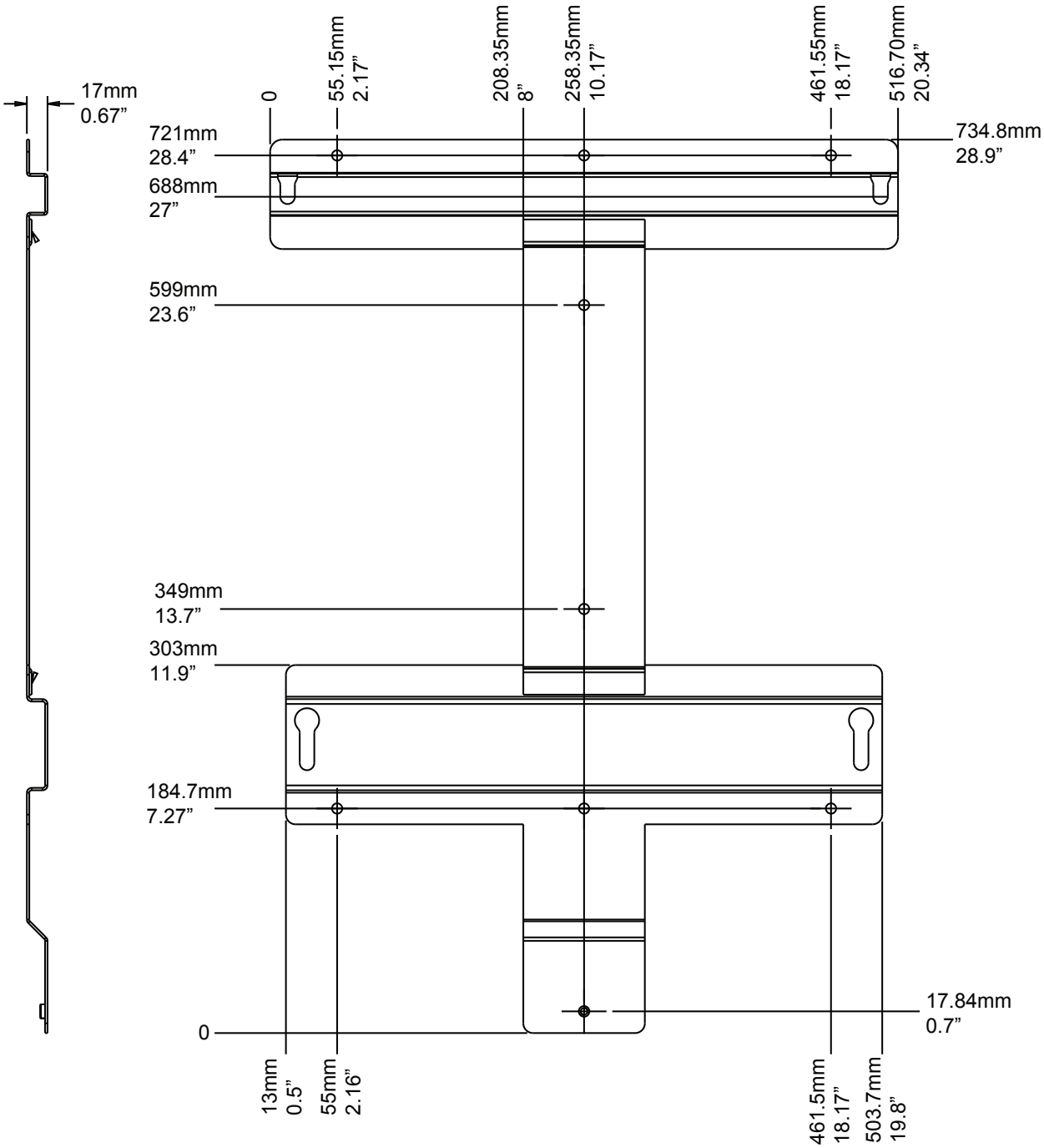
DC disconnect switch
ON position

DC disconnect switch
OFF position

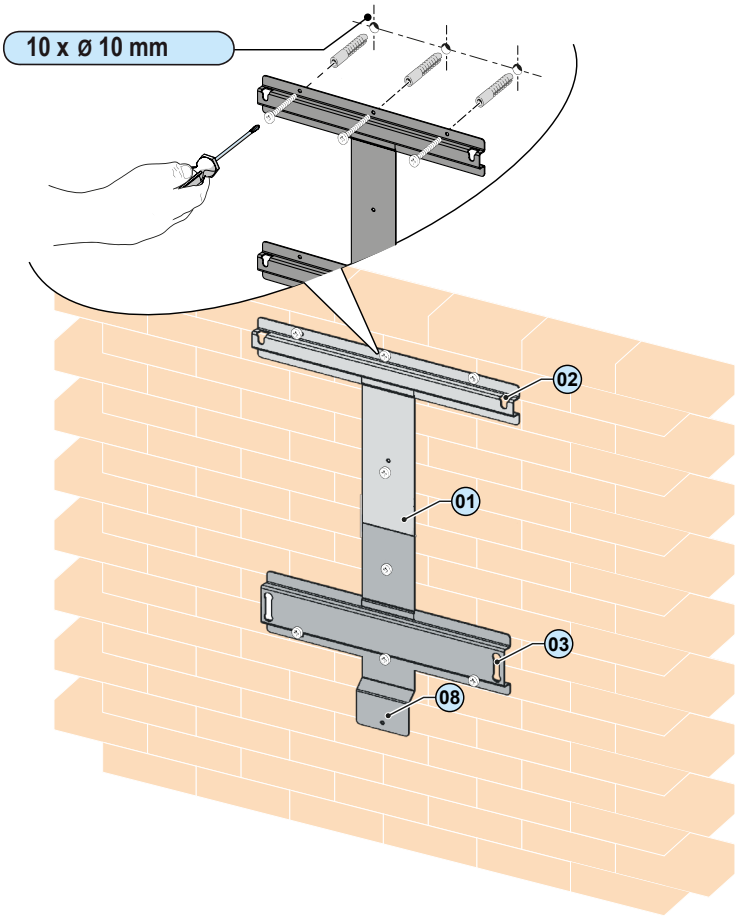
White center tab opened in OFF position with 3 padlock holes

Wall mounting

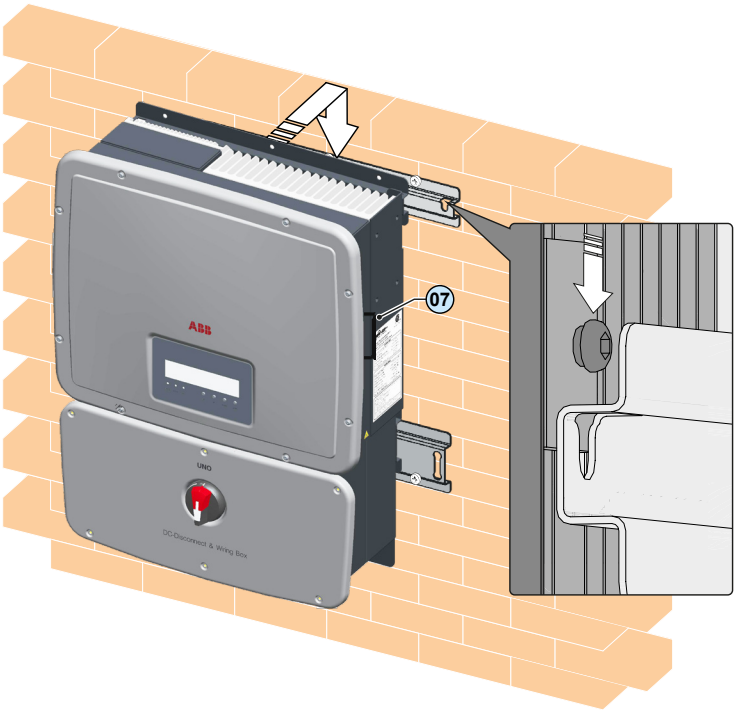
The overall dimensions of the mounting bracket are expressed in millimeters and inches.



- Using a level, position the mounting bracket **01** on the wall and use it as a drilling template.
- Drill the required holes using a 10mm/0.39” bit; holes must be about 70mm/2.75” deep.
- Attach the bracket to the wall with the screws and wall anchors supplied in the mounting kit.
- Locate the 4 bolts protruding from the rear of the inverter.
- Bolts are used as mounting studs and are inserted into the four slots, (two upper **02** and two lower **03**) on the mounting bracket **01**.
- Lift the inverter by the handles **07** using two people and orient it to the bracket so the studs are just above the associated slots.



- Once aligned, lower the inverter unit into position ensuring the four studs are seated in the respective slots.
- To complete the installation, secure the wiring box to the mounting bracket by tightening the machine screw through the bottom tab on the wiring box into the locking point **08** of the mounting bracket.



Wiring details

Always respect the nominal ratings of voltage, current, and power defined in the Appendix, part 7, when designing your system. Observe the following considerations in design:

To reduce the risk of fire, connect only to a circuit provided with 40A/50A maximum branch circuit overcurrent protection in accordance with NEC (ANSI/NFPA 70). See Maximum AC OCPD requirement in technical data table, part 7.

This UNO inverter is designed without an isolation transformer and is intended to be installed per NFPA 70, 690.35 with an ungrounded PV array.

An automatic overcurrent device (e.g. circuit breaker) must be installed between the UNO inverter and the AC utility grid. It is the responsibility of the end user to provide protection for the AC output circuit.

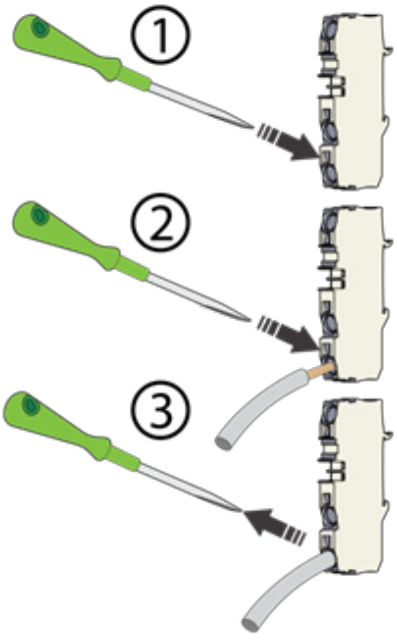
To protect the AC connection line of the inverter, it is recommended to install a device for protection against overcurrent with the following characteristics:

	UNO-7.6-TL-OUTD-S-US-A	UNO-8.6-TL-OUTD-S-US-A
Type	Typical installations use a 2-pole/600V rated bi-directional thermal-magnetic circuit breaker, UL489 or equivalent.	
Current/Voltage	40A/600V for 240V and 277V grid	50A/600V for 240V grid
	50A/600V for 208V grid	40A/600V for 277V grid

The UNO utilizes pressure type terminal blocks for connection of all conductors. Acceptable wire size ranges from 12 AWG to 6 AWG; refer to local codes for appropriate wire size. Use the procedure below to connect wiring to these blocks.

Use only Copper (Cu) wire rated for 75°C or 90°C, solid or with type B or type C stranding (19 strands maximum). For conductors with finer stranding, a suitable UL listed wire ferrule must be used. For suitable wire size (AWG), refer to NFPA NEC, Table 310.15(B)(16), (formerly Table 310.16) for US.

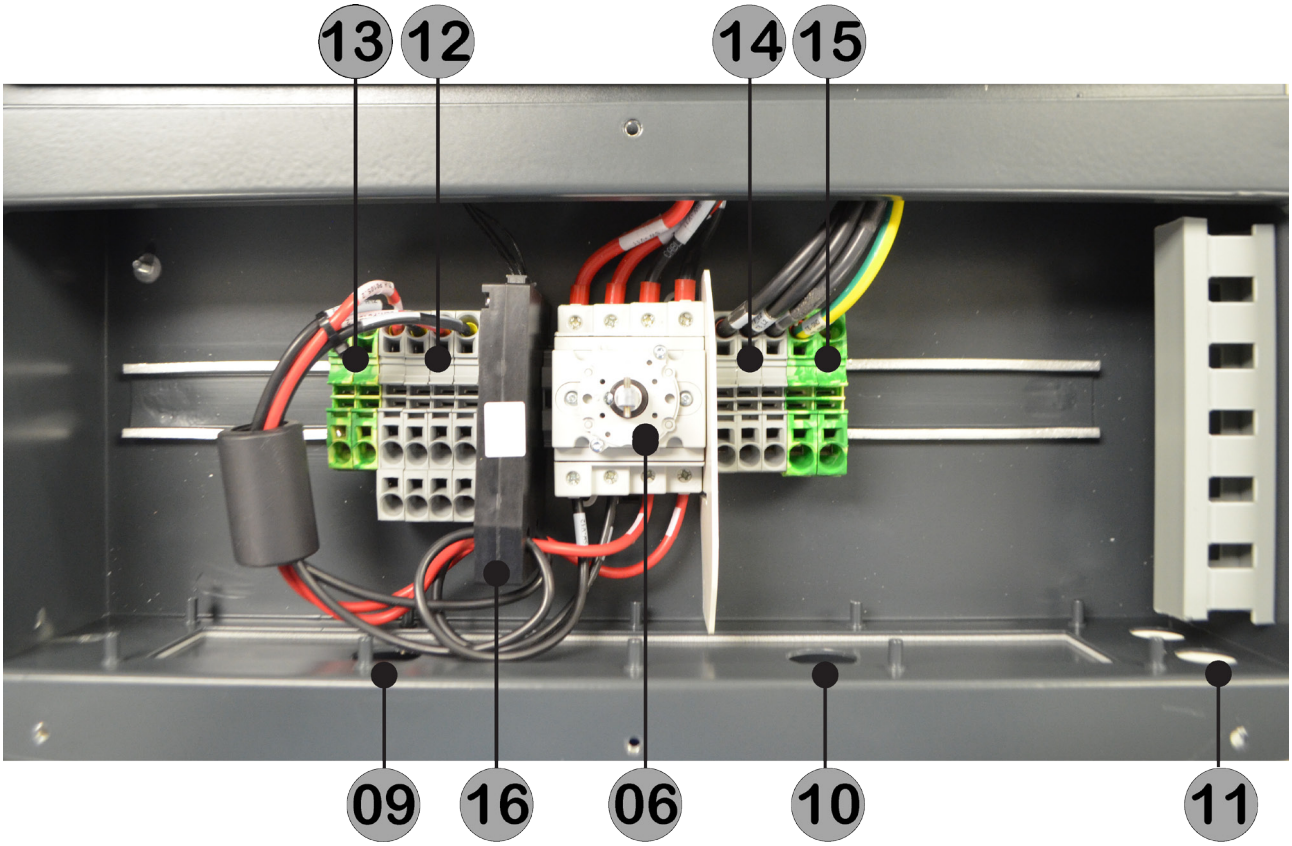
- Strip ½" of insulation from the end of the conductor to be terminated and twist strands.
- Use a small (~1/4" wide) flat blade screwdriver to open the pressure contact.
- Insert the screwdriver in the rectangular tool slot at an angle.
- Lightly press the screwdriver toward the associated wire slot until the clamp opens; hold the clamp open with the screwdriver.
- Insert the wire into the associated round wire slot until seated.
- Release the pressure on the screwdriver and remove it from the slot.
- Check security of the wire in the connector by gently tugging the wire.



Wiring box components

To access the wiring terminals in the switchbox, the cover **05** must be removed by loosening the six captive screws using the Torx screwdriver provided.

When connection operations are complete, re-install the cover **05** and tighten the cover screws with at least 2.0Nm (17.7 in-lbs) torque to maintain waterproof sealing.



Label	Description	Label	
06	DC disconnect switch	12	DC input terminal block (labeled +VIN1, -VIN1, +VIN2, -VIN2)
09	DC cable opening with plastic threaded plug , 1" *	13	DC Earth (ground) terminals
10	AC cable opening with plastic threaded plug , 1" *	14	AC output terminal block (labeled 1, 2, N, GND)
11	Signal cable openings with plastic threaded plug , 1/2"	15	AC protective earth terminals
		16	AFD board

*Four additional concentric EKOs measuring 3/4" and 1" are available, two on the bottom of the switchbox and one each on the left and right side of the switchbox

Electrical connection to the PV field - DC side

Verify that the DC voltage in the wiring box has the correct polarity and is within the operational range prior to terminating.
To prevent electrocution hazards, all the connection operations must be carried out with the DC disconnect switch (06) turned to the OFF position and locked out.

DC input connections are made after connecting a raceway to the chassis, pulling the conductors through the raceway and DC cable openings **09**, and connecting them to the DC Terminal Block **12**.

Acceptable wire size range for connector is from 12 AWG to 6 AWG, copper conductors only with 90ºC rated wire. Refer to local code for appropriate wire size.

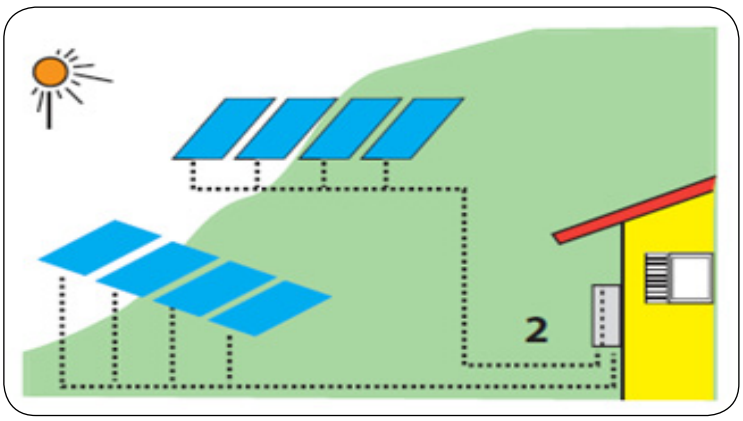
- Remove the threaded plastic plug and nut from the DC cable opening **09**.
- Insert the appropriate water-tight conduit connector and tighten to the chassis to maintain NEMA 4X compliance.
- Make appropriate conduit runs from array and pull the array conductors through the raceway to the inverter.
- Connect the conductors to the correct terminals on the DC terminal block **12**.
- Connect any equipment grounding conductors in the raceway to the EGC terminal block **13**.
-

Independent or parallel configuration of inputs

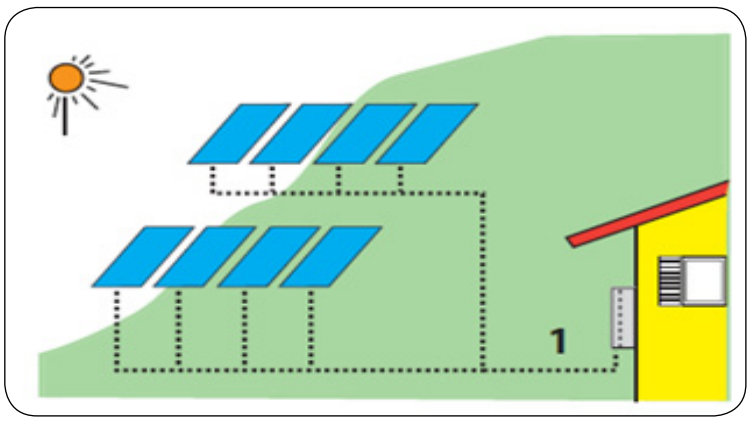
The UNO inverters have dual inputs with independent maximum power point tracking (MPPT) control. When operated in the dual input (independent) mode, the inverter can optimize two independent arrays. The UNO is shipped in the independent configuration as default.

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

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 (to provide 60% max of the total input power).



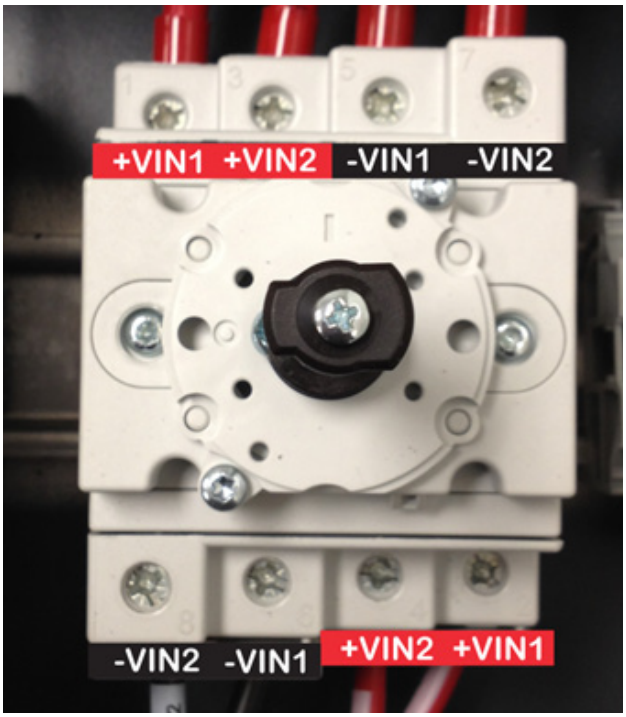
Single MPPT configuration – Parallel mode
In the parallel mode, the two channels are connected in parallel, and strings of photovoltaic modules having the same type and number of modules in series can be connected in parallel at two channels making a single MPPT. All strings must be identical and oriented to the same sun azimuth



Installing jumpers for parallel configuration

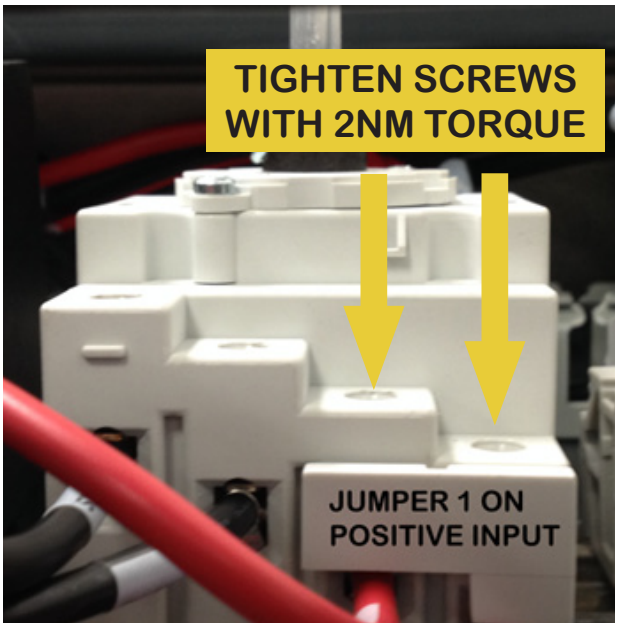
The UNO is configured in the independent mode as default.

Parallel configuration is made by using the two jumpers provided to short the positive and negative inputs on the DC disconnect switch. In addition, the parallel input mode must be selected in the UNO display menu and can be done as part of the commissioning procedure described in section 4.

Install parallel input jumpers on DC disconnect switch	
• Using a #2 Phillips screwdriver, loosen the 4 screws on the **bottom** of the DC switch. • Jumper 1 will short +VIN1 and +VIN2, jumper 2 will short –VIN1 and –VIN2.	The jumpers will be inserted on the DC switch with the positive and negative wires, together in the same slots.
	
DC disconnect switch without jumpers (default INDEPENDENT mode)	**Bottom view of DC disconnect switch 06 with no jumpers installed (independent mode)**

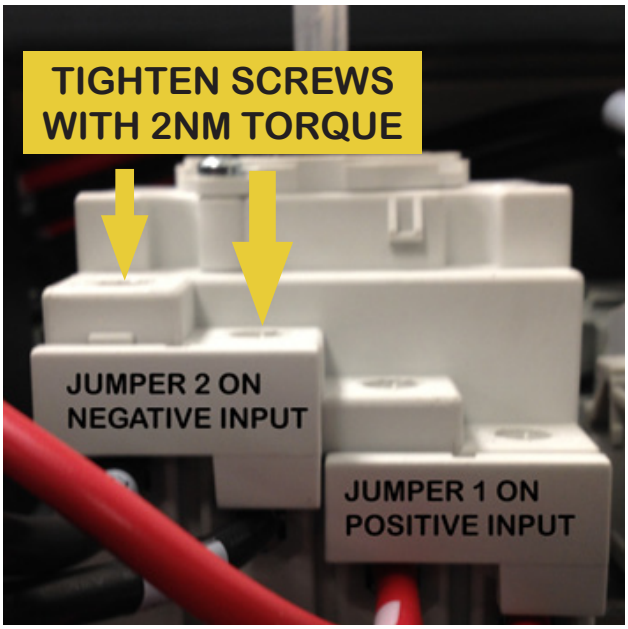
Insert jumpers on positive and negative inputs

- Gently loosen 2 screws in positive input until jumper can fit in same slot as wire.
- Insert jumper 1 in slots of +VIN1 and +VIN2, along with wires.
- Push wires firmly in slot and tighten both screws to 2nm torque.



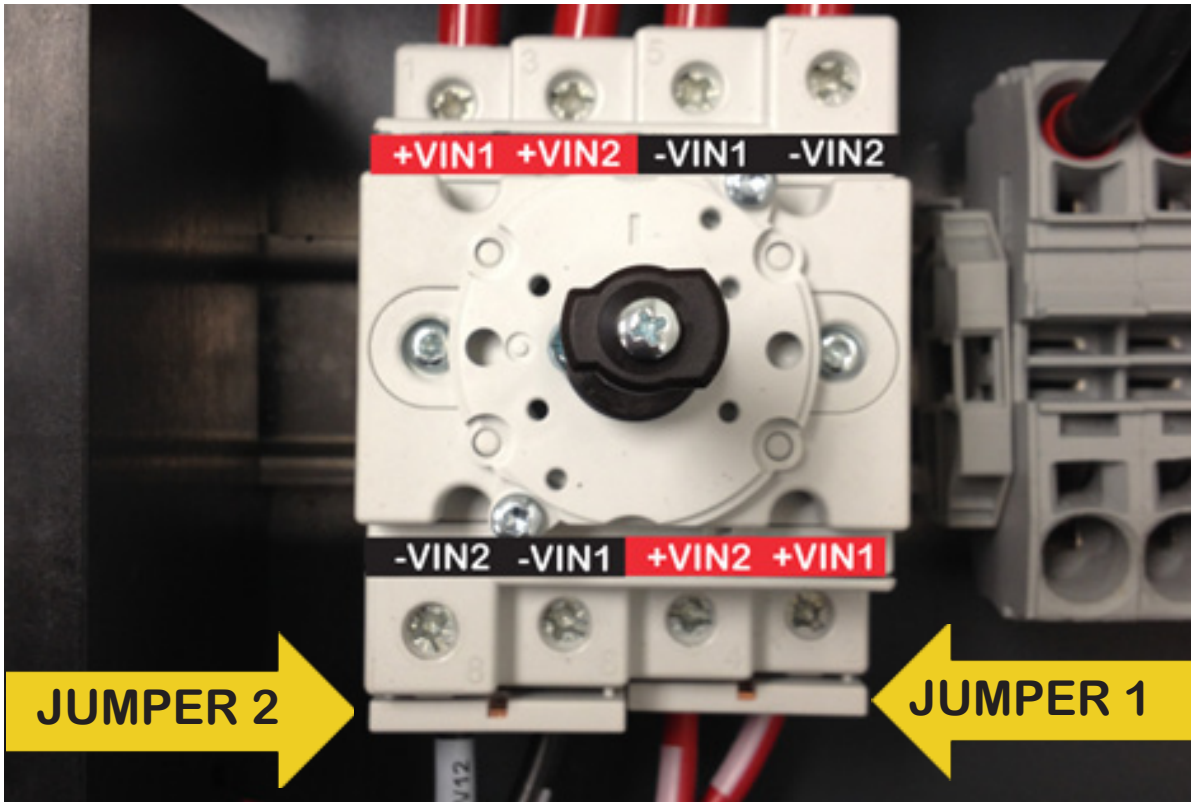
Bottom view of DC disconnect switch with jumper 1 installed

- Gently loosen 2 screws in negative input until jumper can fit in same slot as wire.
- Insert jumper 2 in slots of –VIN1 and –VIN2, along with wires.
- Push wires firmly in slot and tighten both screws to 2nm torque.



Bottom view of DC disconnect switch with jumper 1 and jumper 2 installed

DC disconnect switch with parallel input jumpers installed

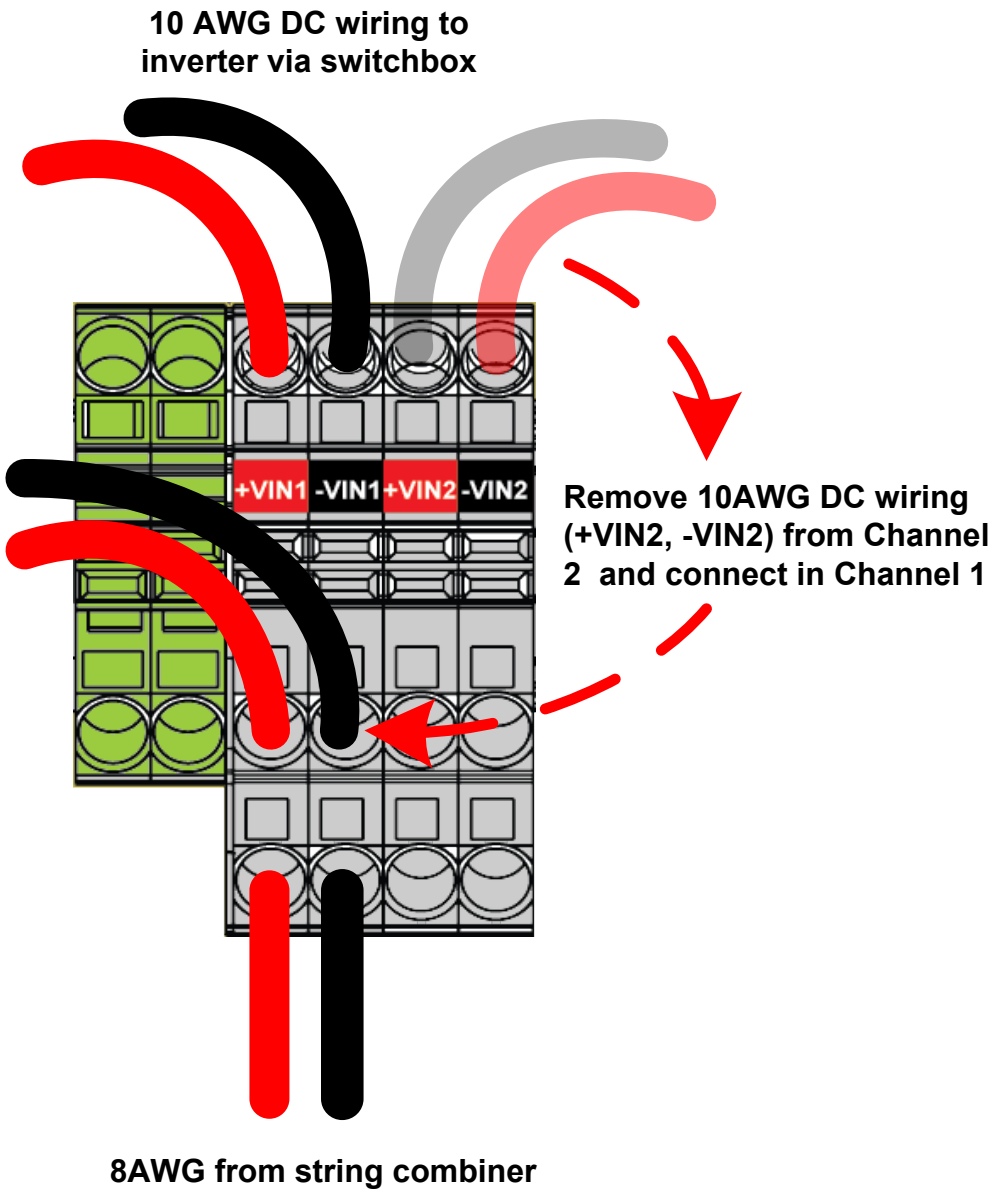


DC disconnect switch with jumpers 1 and 2 in place (parallel mode)

UNO 8.6kw - External string combiner with single MPPT input

When using an external string combiner with a single input for the UNO 8.6kW, it is not possible to use the 10AWG wire with the 48A power level in the switchbox.

In this case, the wires of channel 2 terminal block must be connected instead to the channel 1 terminal block in order to share the current, as illustrated below.

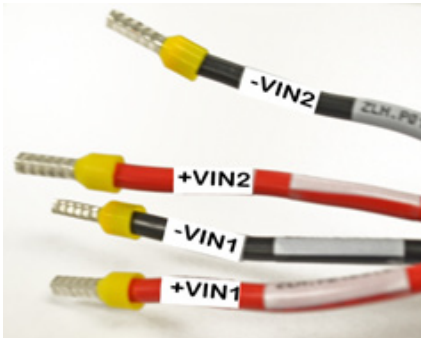
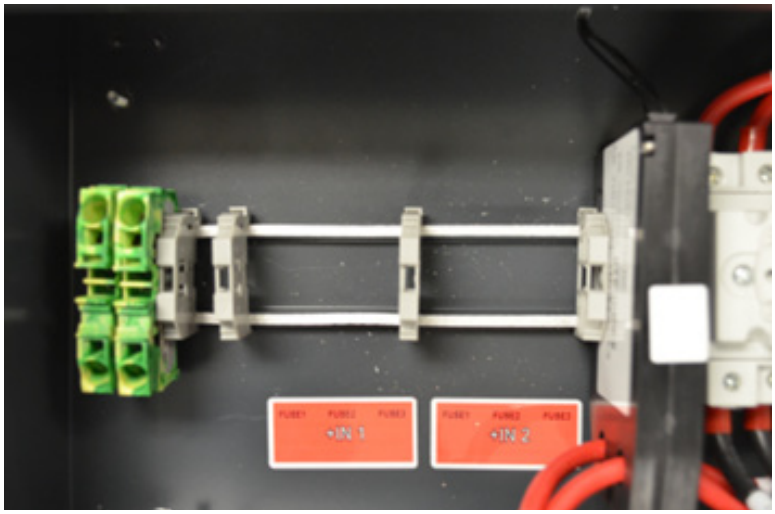


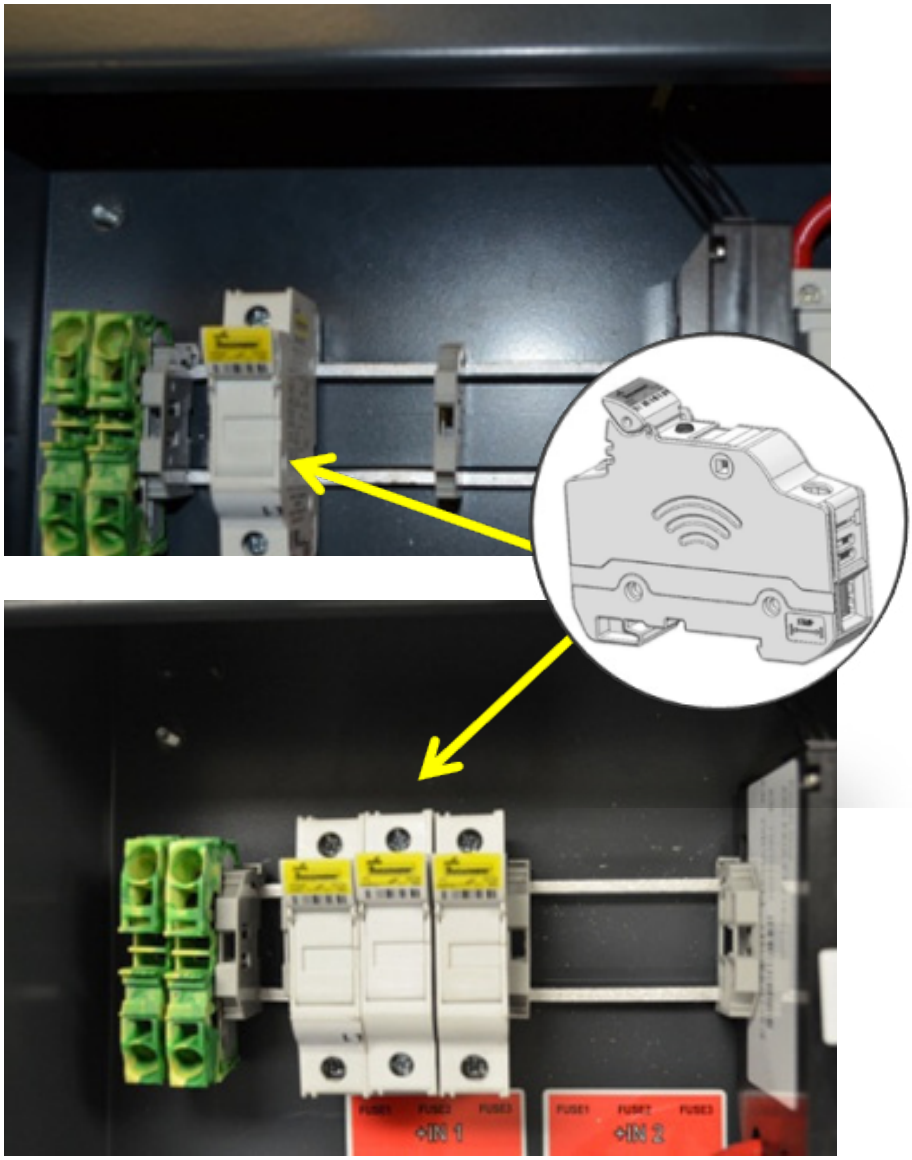
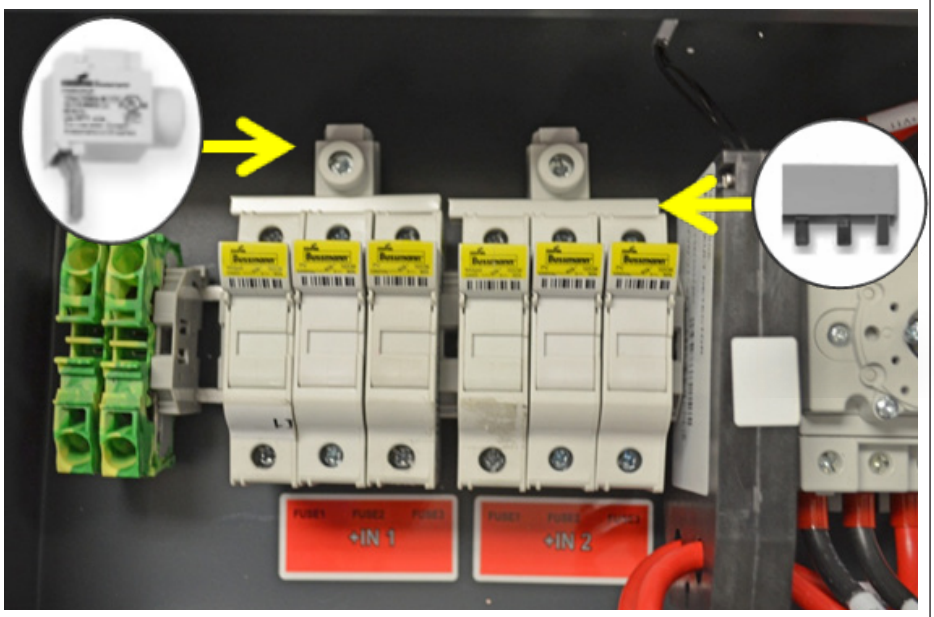
Optional DC fused inputs

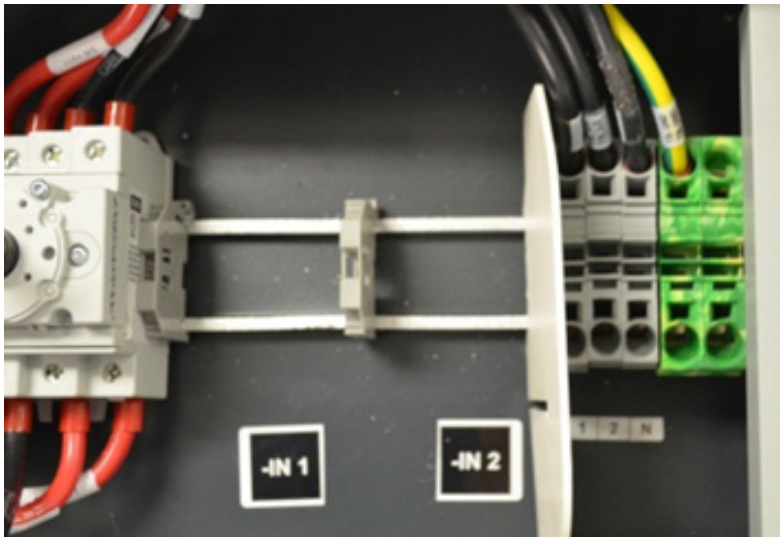
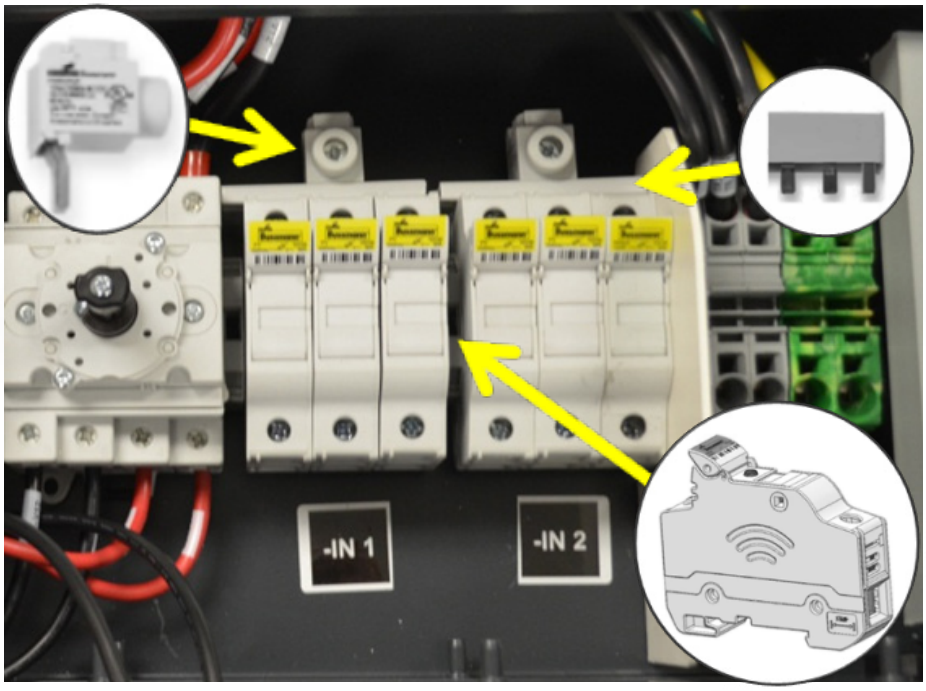
The wiring box is designed with room to accommodate three fused DC inputs per MPPT channel resulting in a total of six fused inputs (12 fuses and 12 fuse holders, considering positive and negative inputs).

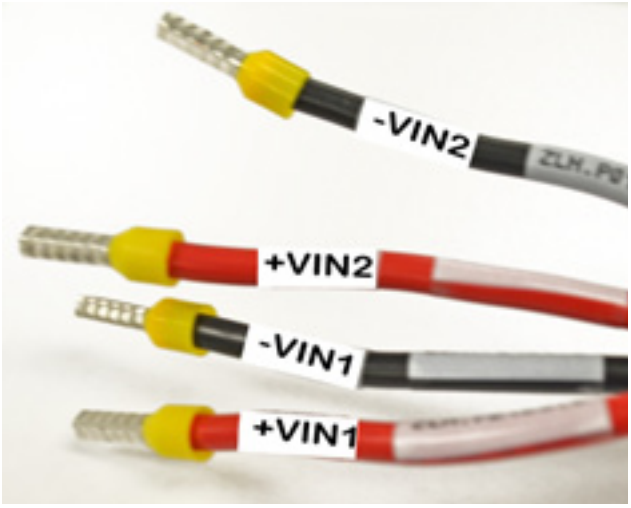
An optional kit is available for addition of the DC fused inputs; see table of components in section 1. Wiring instructions for installing the kit are shown below.

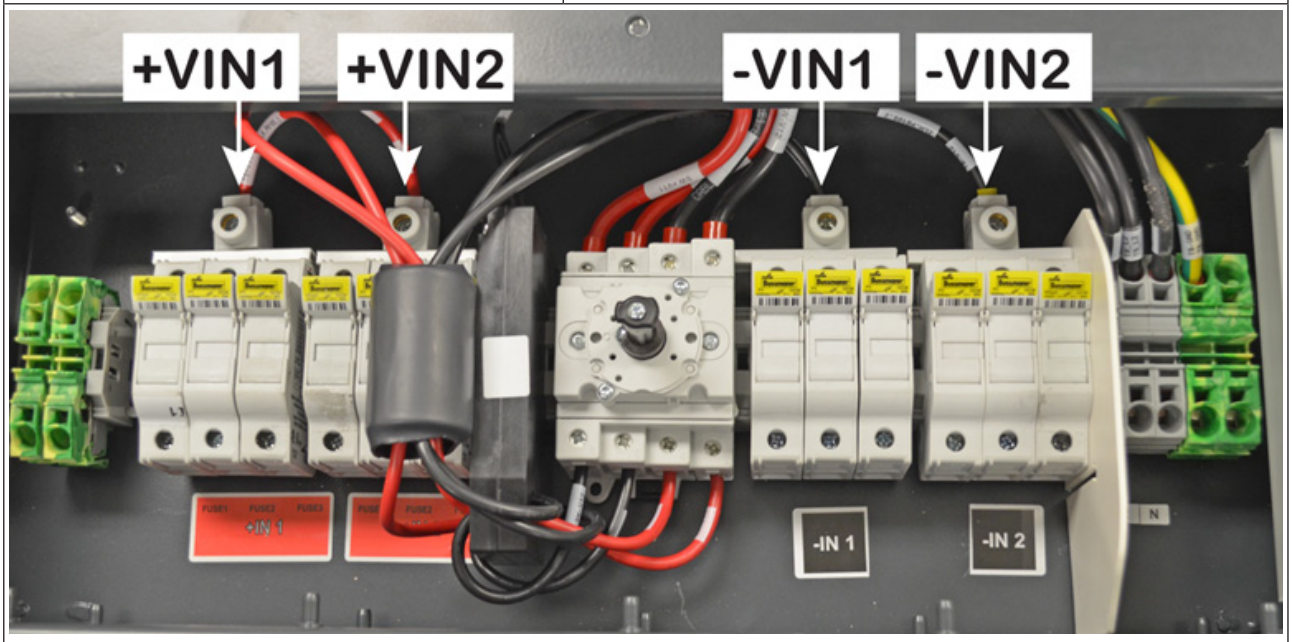
To prevent electrocution hazards, all the connection operations must be carried out with the DC disconnect switch (06) turned to the OFF position and locked out and the external AC disconnect switch downstream of the inverter (grid side) open and locked out.

DC terminal blocks	
Remove wires, +VIN1, +VIN2, -VIN1, -VIN2 from the DC terminal block.	 
Use a small, flat head screw driver to remove the DC terminal block from the din rail by pushing screw driver into space at top of terminal block and lifting up and off of din rail.	
Use the same process with a small, flat head screw driver to lift and move the DC ground terminal to edge of din rail. Move end blocks using the same process to make space for fuse holders.	

DC terminal blocks	
Place 6 fuse holders on DC side, in two groups of 3 each. Attach by hooking fuse holder at top of din rail and snapping onto bottom of din rail.	
Fit 1 terminal feeder atop each group. Insert one 3 pin bus bar feeder on each terminal block grouping. Tighten 3 screws in each grouping	

AC terminal blocks	
Use a small, flat head screw driver to loosen and move end blocks, AC terminal block, and AC ground terminal on the din rail by pushing screw driver into space at top of block and lifting up and off of din rail.	
Move AC terminal block and AC ground terminal to end of din rail, leaving separator next to AC terminal block. Slide end blocks to make space for fuse holders	
Place 6 fuse holders on AC side, in two groups of 3 each. Insert 1 terminal feeder atop each group. Insert one 3 pin bus bar feeder on each terminal block grouping. Tighten 3 screws in each grouping	

Reconnect DC wiring	
Wires removed from DC terminal block in step 1 are labeled, +VIN1, +VIN2, -VIN1, -VIN2. Connect wires in terminal feeders of respective fuse holder groupings as illustrated below. Insert the 12 fuses provided in fuse holders.	



Grid output connection (AC side)

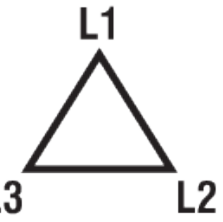
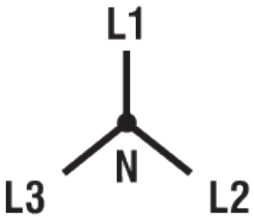
Wire must be sized based on ampacity requirements of the NEC or other applicable prevailing code, but no smaller than #8Cu.
To prevent electrocution hazards, all the connection operations must be carried out with the external AC disconnect switch downstream of the inverter (grid side) open and locked out.

The cross-section of the AC line conductor must be sized correctly in order to prevent unwanted disconnection of the inverter from the grid due to high impedance of the line that connects the inverter to the power supply point. If the impedance is too high, it will result in an increase in the AC voltage at the inverter output which is higher than the allowable limit, causing the inverter to turn itself OFF.

Connection to AC terminal block

AC grid wiring is based on the grid standard shown in the utility configuration table below.

- Run an approved raceway between inverter and external AC OCPD.
- Remove the threaded plastic plug and nut from the AC cable opening **10**.
- Insert the appropriate water-tight conduit connector and tighten to the chassis to maintain NEMA 4X compliance.
- Make appropriate conduit runs from grid and pull the AC conductors through the raceway to the inverter.
- Connect the conductors to the correct terminals on the AC terminal block **14** based on the AC grid standard used in the table below.
- Connect the main AC ground cable in the raceway to protective earth terminal block **15**.

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	-

AWG# 4-8 / 75 °C | AWG# 4-10 / 90 °C

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 setting of the country

In addition to the selection of grid voltages based on the installation site, grid parameters may be dictated by the utility company or authority having jurisdiction according to the country in which the inverter is installed.

The UNO is shipped in the grid standard 240V/Split Single Phase as default. The standard can be changed using the INFO menu on the UNO display and is done as part of the commissioning procedure described in section 4. Available grid parameters are below.

Canada, USA	240VAC 3W
Canada, USA	208VAC 2W
Canada, USA	277VAC 2W

Communication card connections

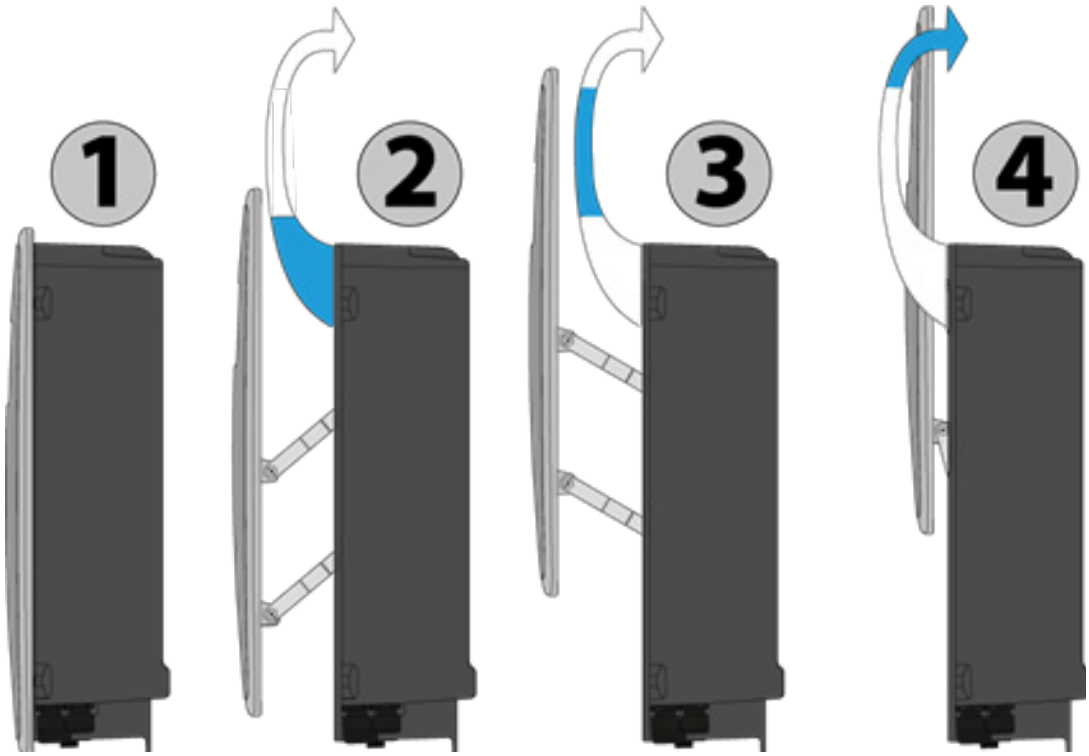
Wiring for the RS-485 communication system and hardwired control options must be routed through the switchbox and into the main inverter chassis for termination. Communication and signal wiring connections are described on the following pages.

It is necessary to open the inverter cover **04** to access the communication card which is located in the bottom right corner of the inverter box.

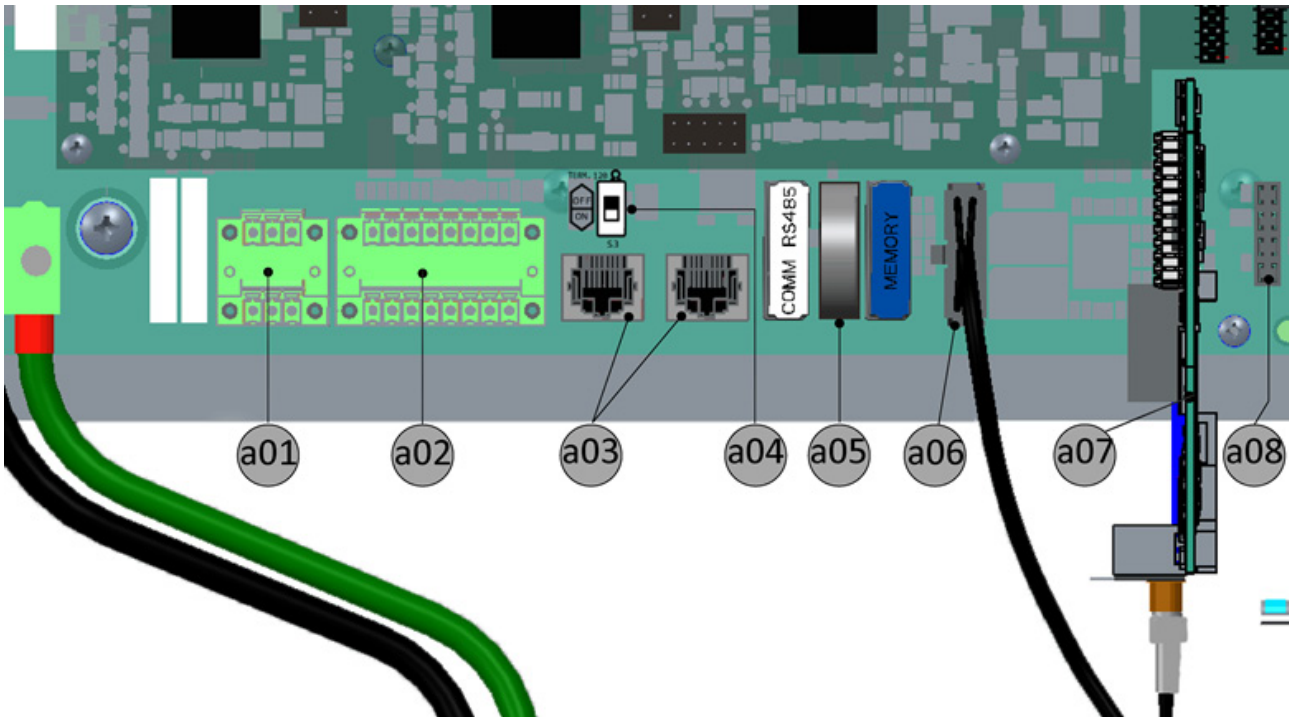
Opening the hinged inverter cover

- Loosen the eight captive screws on the inverter cover **04**.
- The cover is equipped with fixed hinges and is not intended to be removed from the chassis.
- Using light pressure pull out and up on the cover so it rotates in an upward arc to its rest position.
- The inverter cover lifts only high enough to access the communication card.
- Lock the cover in place by pushing it forward, as show below in steps 3 and 4.

When connections to the communication card are complete, close the front cover and tighten the cover screws with at least 2.0Nm (17.7 in-lbs) torque to maintain waterproof sealing.



Communication and signal wiring connections are located on the main inverter board and illustrated below.



Label	Description
a01	Multi-function relay
a02	Remote control, RS-485, Ethernet
a03	Connection of RS-485 line on RJ45 connector
a04	Switch S3 for termination resistance
a05	CR2032 battery housing (3V-81566200029-G)
a06	Arc fault detection (AFD) connection on main board
a07	Radiomodule slot board (Zigbee)*
a08	WiFi board*
*optional add on boards	

Serial communication connection (RS-485)

The RS-485 communication line connects the inverter to the monitoring devices and may be “daisy-chained” (in-out) among multiple inverters. The RS-485 connecting cables can use both the terminal connections **a02**, as well as the RJ45 connectors **a03**, to connect to the dedicated port.

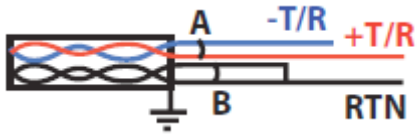
To connect the RS-485 cables to the communication card, remove the threaded plastic plugs from the signal cable openings **11** and replace with the appropriate water-tight conduit connector. Whether these cables need to be protected by conduit depends on the applicable wiring code.

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 ½" signal openings **11**.

If the terminal blocks are used, the signals RTN, +T/R and –T/R (shown below) have to be cabled. If the RJ45 plugs are used, the pin-out is shown at the bottom of the page.

Use a cable designed for use with RS-485 communications, which has a twisted pair for the +/-T/R signals and a third conductor used as a return (RTN). The figure below shows a cable with two twisted pairs where one pair is shorted together to create a RTN line. Another choice such as Belden 3106A, is a data cable wire with one twisted pair, one ground conductor, and a shield with drain wire (equivalent).

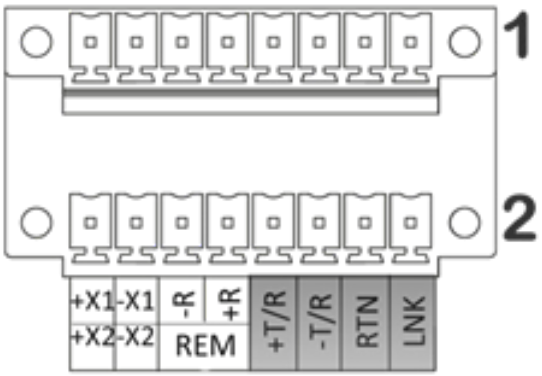


Signal	Symbol	Pair	Cable
Positive data	+T/R	A	1
Negative data	-T/R	A	2
Reference	RTN	B	1+2

Continuity of the shield in the RS-485 cable is important for low noise on the line, particularly 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.

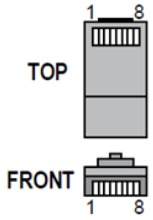
The shield wiring must be continuous as it passes from one inverter to the next on a daisy chain, but must not be tied to ground at these junctions.

- If using standard multi-conductor RS-485 cable, locate the mating connectors (provided) for the terminal block **a02**.
- Connect the three RS-485 leads (-RTN, +T/R, -T/R) to the mating connector corresponding points.
- Attach the mating connector to **a02** terminal block at corresponding points.



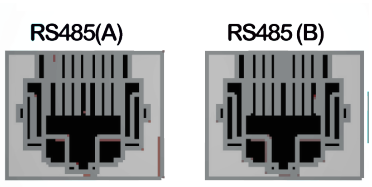
For systems with multiple inverters, two parallel terminal rows are on the terminal block and two mating connectors are included for this purpose.

Pin-out of RJ45 connector plugs



Pin #	Function
1,2,6,8	Not Used
3	+ Data Line (+TR)
4	Remote OFF (+R)
5	- Data Line (-TR)
7	Signal Return (RTN)

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.



Daisy chain units for connection to a monitoring system

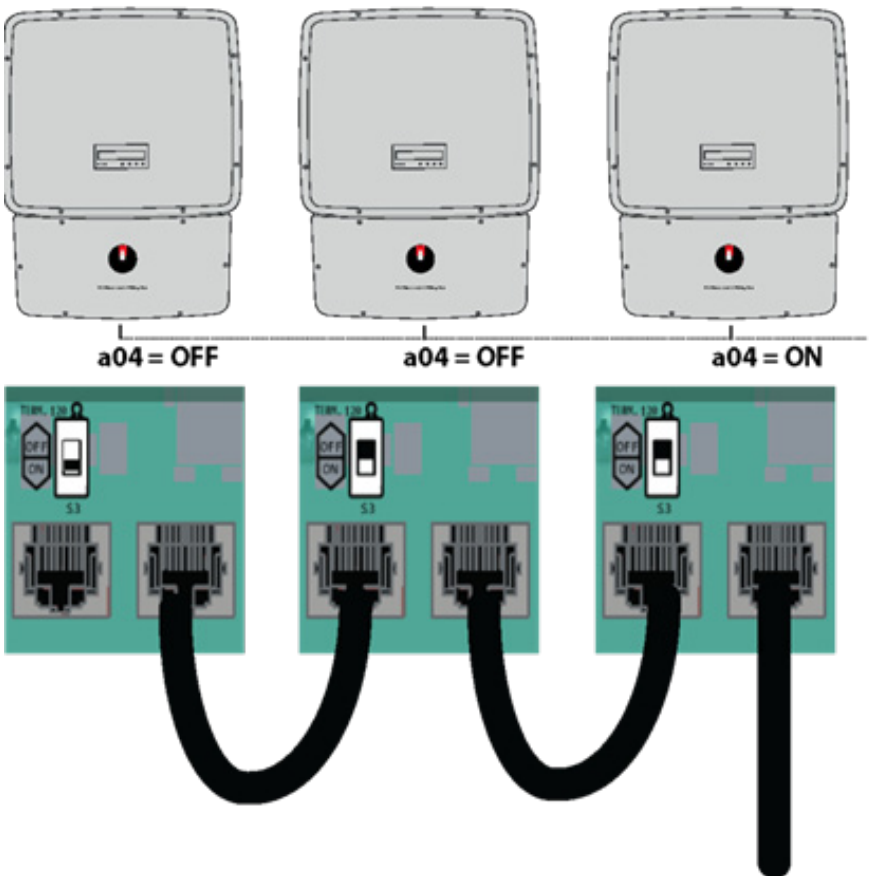
The RS-485 terminal block connectors **a02** or RJ45 connectors **a03** can be used to connect a single inverter or implement a multi-unit wiring configuration (daisy chain). The recommended length of total communication cable line for all inverters in the system is 1,000 meters (1094 yards) or less.

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 S3 switch **a04** down into the ON position.

All other inverters in the daisy chain will have the S3 switch **a04** 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 (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 S3 (**a04**) in the OFF position.

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.

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.

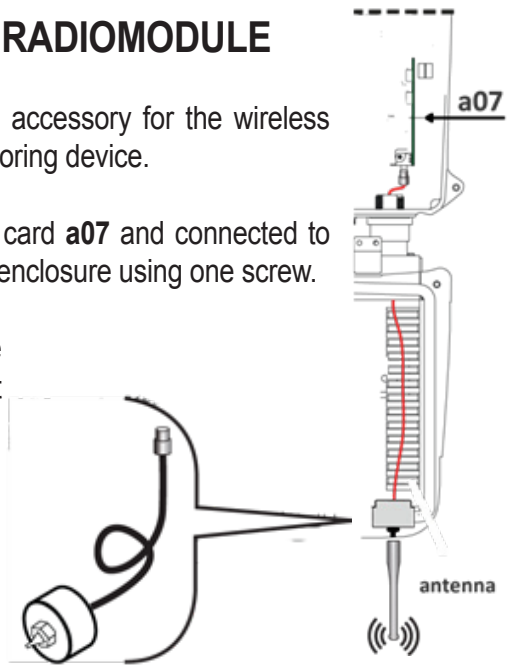
Equivalent RS-485 to RS-232 adapters found on the market can also be used for the same purpose; however, they have not been specifically tested in order to guarantee correct operation of the connection. These devices may also require external termination impedance, whereas this is not necessary with the PVI-USB-RS485_232.

Optional monitoring system via RADIOMODULE

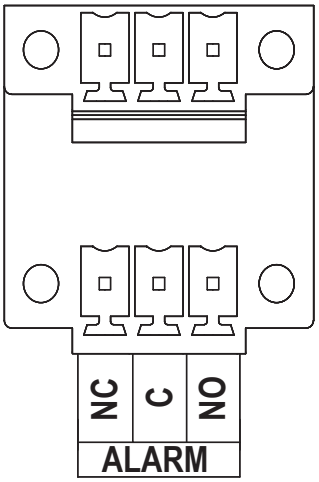
The PVI-RADIOMODULE Zigbee board is an accessory for the wireless transmission of data via radio waves to a monitoring device.

It is mounted vertically on the communication card **a07** and connected to the inverter via one connector anchored to the enclosure using one screw.

It is necessary to install the antenna outside the inverter using the signal connector conduit openings **11** as illustrated.



Configurable relay connection (Alarm)



The inverter has a multi-function relay accessible at terminal block **a01** and it is provisioned with a removable screw-terminal mating connector 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. See 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:

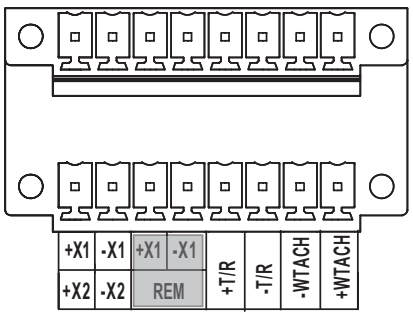
Alternating current	Max Voltage: 240 Vac	Max Current: 1 A
Direct current	Max Voltage: 30 Vdc	Max Current: 0.8 A

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 (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 connector **a02**. (+X1/-X1 terminals can be used as an additional remote input.)



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).

Operations

4

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.

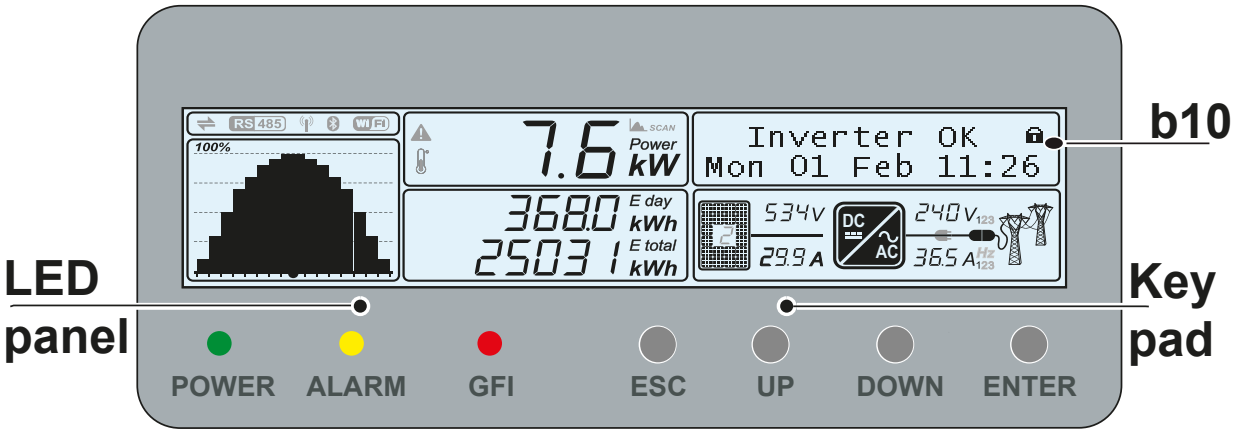
Internally stored data
The inverter internally stores a set of data that is necessary for processing statistical data which includes an error log with time stamps.

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 on the cyclical display area **b10** and access the data logged internally on the UNO, 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 **b10**..
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 **b10**.

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. Pressing the ESC key gives access to the three main menus: Statistics, Settings, and Information. To return to the preceding menu, press the ESC key.

The three menus can be accessed with just the array connected. Some parameters (e.g., current, voltage, power, partial energy, lifetime energy etc.) are available only after grid connection.

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. A padlock symbol will appear.

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

Descriptions of symbols and display fields

b1 -Indicates the transmission and reception of data through the RS-485 line

b2 - Indicates the presence of the RS-485 communication line

b3- Reports the presence of a line of radio communication (Radiomodule card installed)

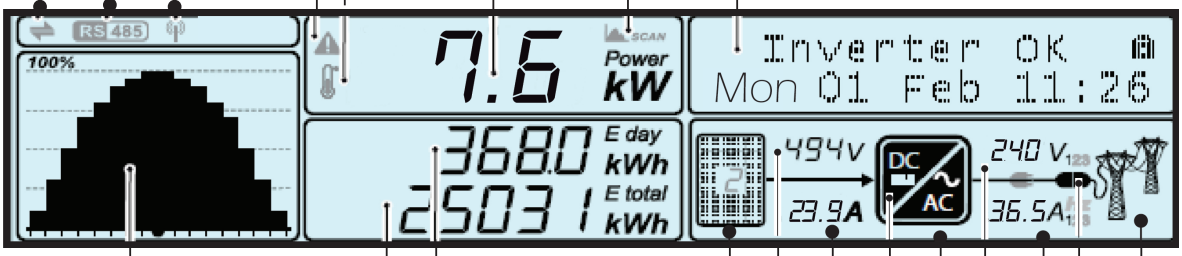
b6- Warning symbol indicates presence of power limiting, input voltage out-of-range or power limitation imposed by the grid

b7- Reports power limiting due to high internal temperature

b8- Instantaneous power generated for the grid

b9- MPPT SCAN function activated

b10- Lines of text for the cyclical display of parameters, error codes, and menus



b22- Status of AC grid

b21- Connection to the grid

b20- Output AC current

b19- Output AC voltage

b18- Indicates the circuit for conversion from DC to AC

b17- Indicates DC/DC input currrent

b16- DC current value

b15- DC voltage value

b14- Indicates the PV array voltage is higher than the Vstart of the inverter and array 1/2

b13- Displays the energy produced over a day

b12- Displays the total energy produced since installation of the inverter

b11-Graph of the power fed into the grid (from 0 to 100%). The time scale is settable to 8, 16, or 24 hours.

Cyclical display of general information

The graphic display area **b10** consists of 2 lines with 16 characters per line. When moving through the menu using the buttons of the keypad, area **b10** 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.

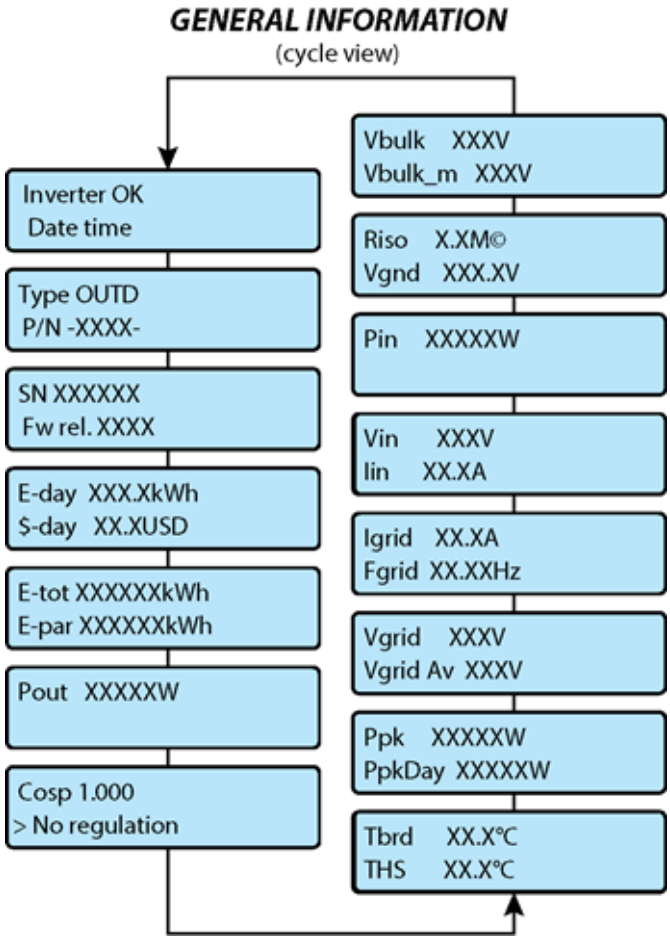
During regular operation the display will cycle through general information shown at right.

Cycling is indicated by two arrows in the top right corner of display area **b10**.

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

When locked, the current information displayed will remain on screen

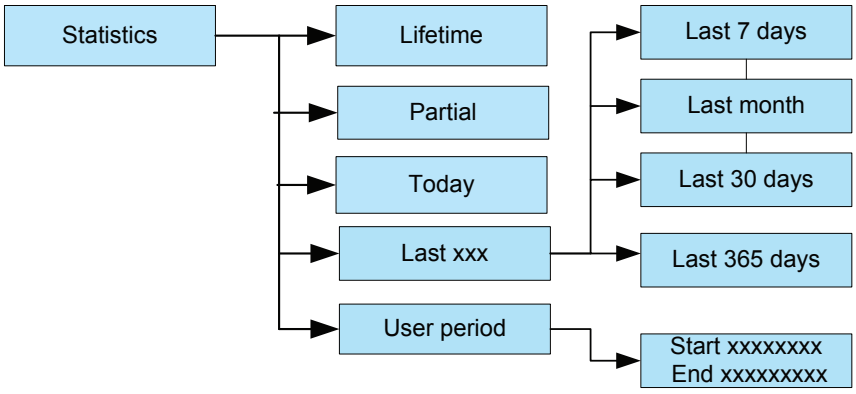
Press and hold the ENTER button until the arrows are displayed to unlock and cycle through the display.



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'

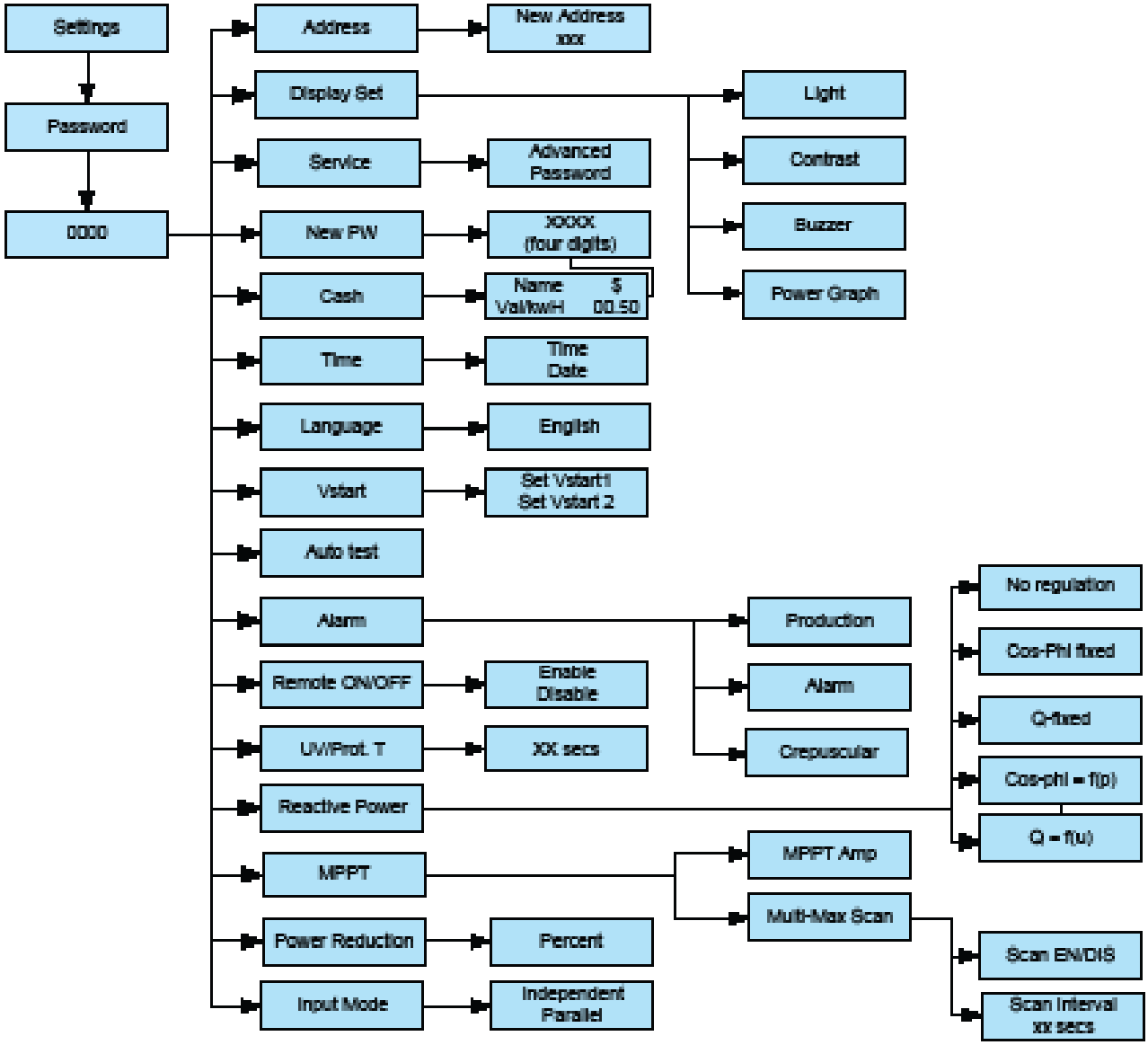
Once the start and end dates for the user periods have been selected, the following data is available:

- E-use: Energy produced during the selected period
- Val. : Value of production for the selected period calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
- CO2 : Amount of CO2 saved during the selected period

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

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 IEEE 1547 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.

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. [115% of Nominal line to neutral Voltage]	319 V	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]	139 V	Fixed
SET F>>	Indicates the value of the absolute over frequency set point beyond which the inverter disconnects from the grid	63 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]	305 V	305 V to 319 V
SET U>(10 min)	Inverter disconnects from the grid after 10 minutes in case the average grid voltage overcomes the threshold value(305V)	305 V	305 V to 319 V
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]	244 V	139 V to 244 V
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.	305 V	305 V to 319 V
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.	244 V	139 V to 244 V
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
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

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 [115% of Nominal line to neutral Voltage]	115% 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	63 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 grid [110% of Nominal line to neutral Voltage]	110% of Nominal line to neutral Voltage	(110% x VLN) to (115% x VLN)
SET U> (10 min)	Inverter disconnects from grid after 10 minutes in case the average grid voltage overcomes threshold value (110% x VLN)	110% of Nominal line to neutral Voltage	(110% x VLN) to (115% x VLN)
SET U<	Indicates the value of the intermediate under voltage set point below which the inverter disconnects from grid [88% of Nominal line to neutral Voltage]	88% of Nominal line to neutral Voltage	(50% x VLN) to (88% x VLN)
SET F>	Indicates the value of the intermediate over frequency set point beyond which the inverter disconnects from 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 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 VLN) to (115% x VLN)
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 VLN) to (88% x VLN)
SET F Conn>	Indicates the value of the intermediate over frequency set point to allow the inverter to connect to grid first time	60.5 Hz	60.2 Hz to 63.0 Hz
SET F Conn<	Indicates the value of the intermediate under frequency set point to allow inverter to connect to the grid 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	160 msec to 300 sec

Parameter	Definition	Default Value	Adjustable Ranges
SET TIME U<<	Indicates the value of the countdown timer associated with the absolute under voltage setpoint U<<	0.16 sec	160 msec to 300 sec
SET TIME F>>	Indicates the value of the countdown timer associated with the absolute over frequency setpoint F>>	0.16 sec	160 msec to 300 sec
SET TIME F<<	Indicates the value of the countdown timer associated with the absolute under frequency setpoint F<<	0.16 sec	160 msec to 300 sec
SET TIME U>	Indicates the value of the countdown timer associated with the intermediate over voltage setpoint U>	1 sec	160 msec to 5 sec
SET TIME U<	Indicates the value of the countdown timer associated with the intermediate under voltage setpoint U<	2 sec	160 msec to 5 sec
SET TIME F>	Indicates the value of the countdown timer associated with the intermediate over frequency setpoint F>	0.16 sec	160 msec to 300 sec
SET TIME F<	Indicates the value of the countdown timer associated with the intermediate under frequency setpoint F<	0.16 sec	160 msec 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	2 sec to 300 sec
SET TIME Conn 2	Indicates the time the inverter takes to connect to the grid after a grid fault.	300 sec	2 sec to 300 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
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

Parameter	Definition	Default Value	Adjustable Ranges
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	Enable/disable the gradual feeding of power after the grid connection	Enable	Disable or Enable
OF Derating	Enable/disable the power derating mode in the event of grid over-frequency	Enable	Disable or Enable
OF Der. Rest. T	Set time of restart for power derating in the event of grid over frequency	Enable	Disable or Enable
Reset country S	Resetting the “grid standard” selection time.	Enable	Disable or Enable

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 webpage.

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 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

When set to OFF, the display will cycle through two screens:

Remote OFF	Waiting Rem.ON… to restart

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).

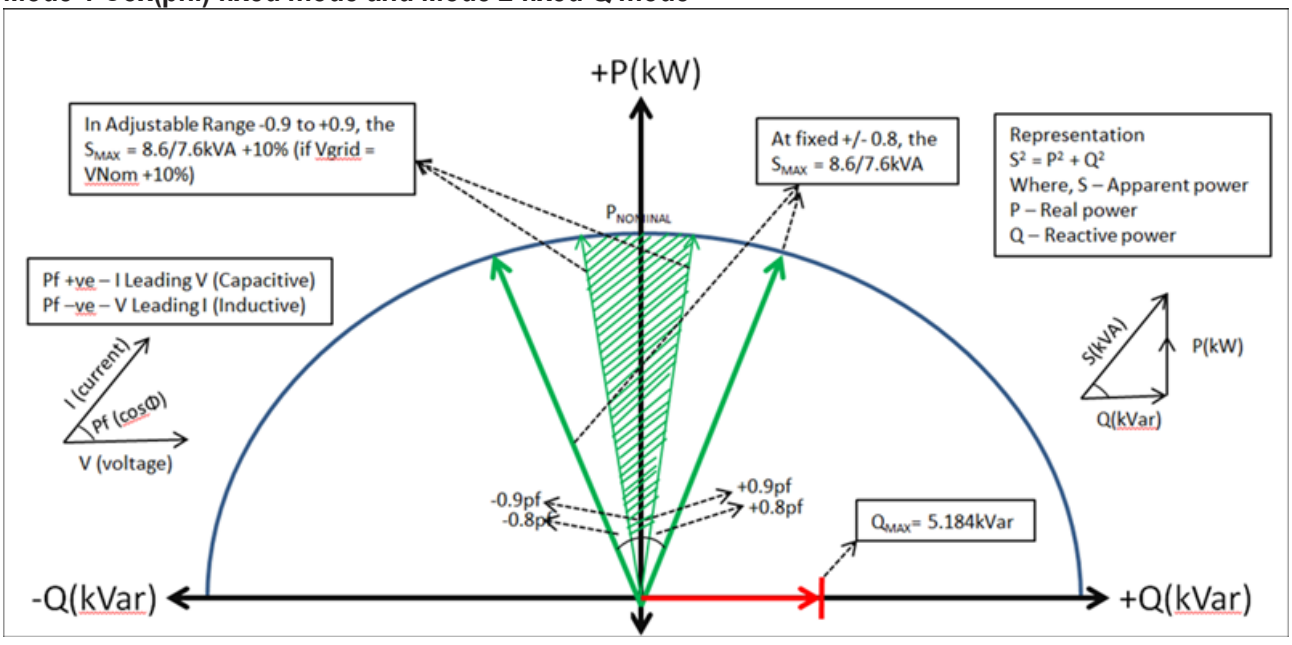
The default time is set at 60 sec. The user can set it from 1 to 3600 sec. Example: with the UV Prot.time set at 60 seconds, if the VIN drops below 70% of Vstart at 9:00, the inverter stays connected to the grid (taking power from it) until 9:01.

Reactive Power – This section of the menu can be used to manage the input of reactive power to the grid. From the Settings menu choose Reactive Power and scroll DOWN to select one of 5 possible types of management (Mode 0 is enabled by default).

- *Mode 0 (default) No regulation or Unity Power factor mode*: enabled by default.
- *Mode 1 - Fixed cos-phi:* - sets power factor to a fixed value. Refer to Power Chart figure below. To enable this mode, select Enable and then OK (using the UP / DOWN arrows). When enabled, Set percentage will appear on the display allowing you to set the value of Cos-Phi as a percentage from 0.1 to 100.

- *Mode 2 - Fixed Q:* sets power factor to a percentage, input in % required. Refer to Power Chart figure below.
  To enable this mode, select Enable and then OK (using the UP / DOWN arrows).
  When enabled, *Set value* will appear on the display allowing you to set the value of Cos-Phi (either Over or Under excited from 1.000 to 0.800).

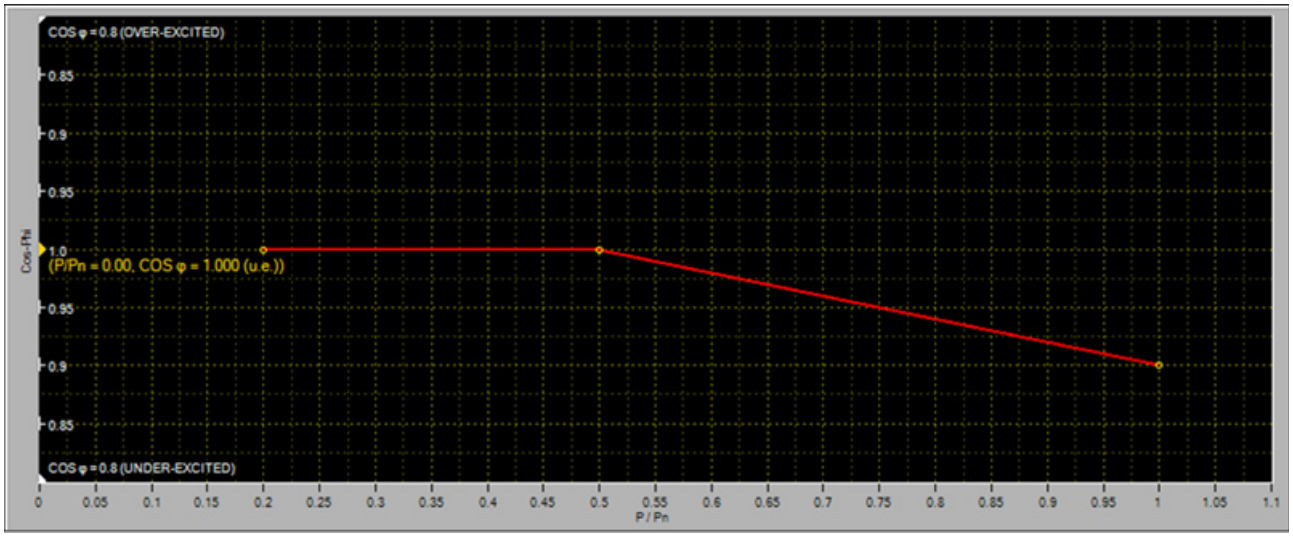
Mode 1 Cox(phi) fixed mode and Mode 2 fixed Q mode



- *Mode 3 - Cos-phi = f(P)*: Power factor as a function of active power generated by the inverter. To enable this mode, select Enable and then OK (using the arrows). When enabled, *Use def curve* will appear on the display, allowing you to set the control curve.

The standard curve and settings loaded into the inverter are shown below. Other curve functions can be loaded using the Aurora Manager Lite >> Reactive Power Regulation >> Cos-phi = f(P) curve setup & Q(U) curve setup. Download the free Aurora Manager Lite software from the website.

Standard curve for Mode 3, cos(phi) in f(P)



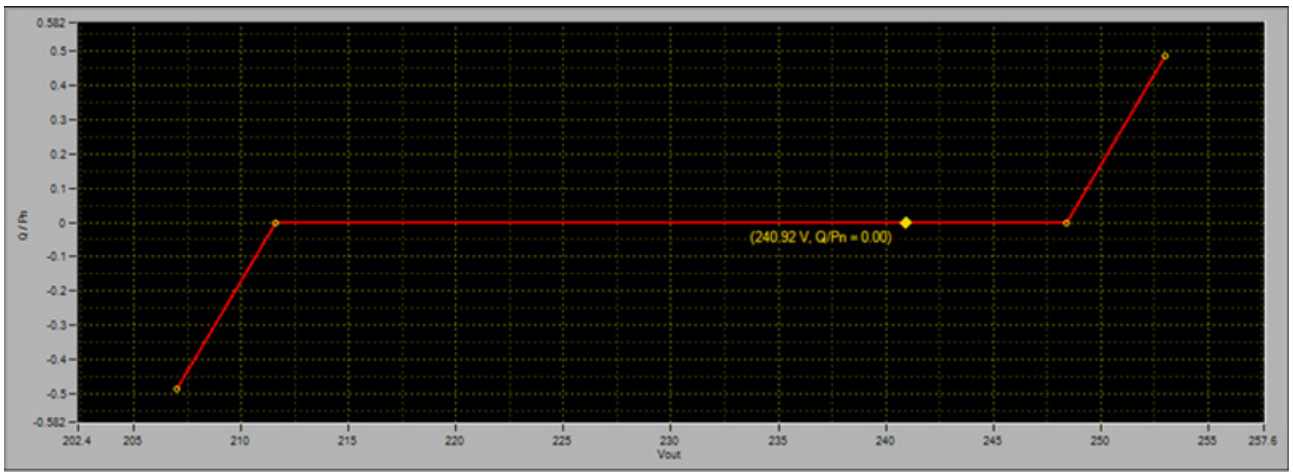
- *Mode 4 - Q = f(U)*: Reactive power as a function of the grid voltage measured by the inverter. To enable this mode, select Enable and then OK (using the UP / DOWN arrows). When enabled, *Use def curve* will appear on the display, allowing you to set the control curve.

The standard curve and settings loaded into the inverter are shown below. Other curve functions can be loaded using the Aurora Manager Lite >> Reactive Power Regulation >> Cos-phi = f(P) curve setup & Q(U) curve setup. Download the free Aurora Manager Lite software from the website.

Standard settings for Mode 4, Q in f(U)

Index	P/Pn %	Cox-Phi	Under/Over excited
0	20.00	1.000	UNDER excited ▼
1	20.000	1.000	UNDER excited ▼
2	50.000	1.000	UNDER excited ▼
3	100.000	0.9000	UNDER excited ▼

Standard curve for Mode 4, Q in f(U)



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.

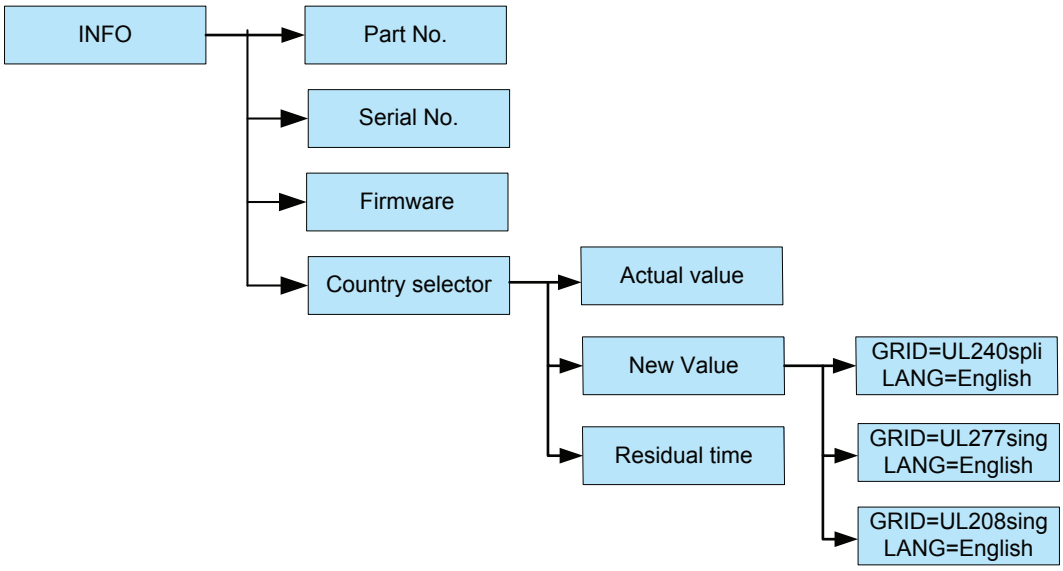
Power Reduction – This section of the menu may be used to adjust the limits on active power which the inverter can input to the grid by setting the percentage of rated power at which the limit should be tripped. It can be set from 0% to 100% in 1% steps.

Input Mode - Allows selection of parallel or independent input mode. Default setting is independent;

- From Input Mode press ENTER to display Independent mode.
- Scroll DOWN to Parallel and press ENTER to change mode.
- A second display screen will open; press ENTER to confirm selection or ESC to cancel.
- Inverter will automatically shut down and restart to apply new setting.

Information Menu

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



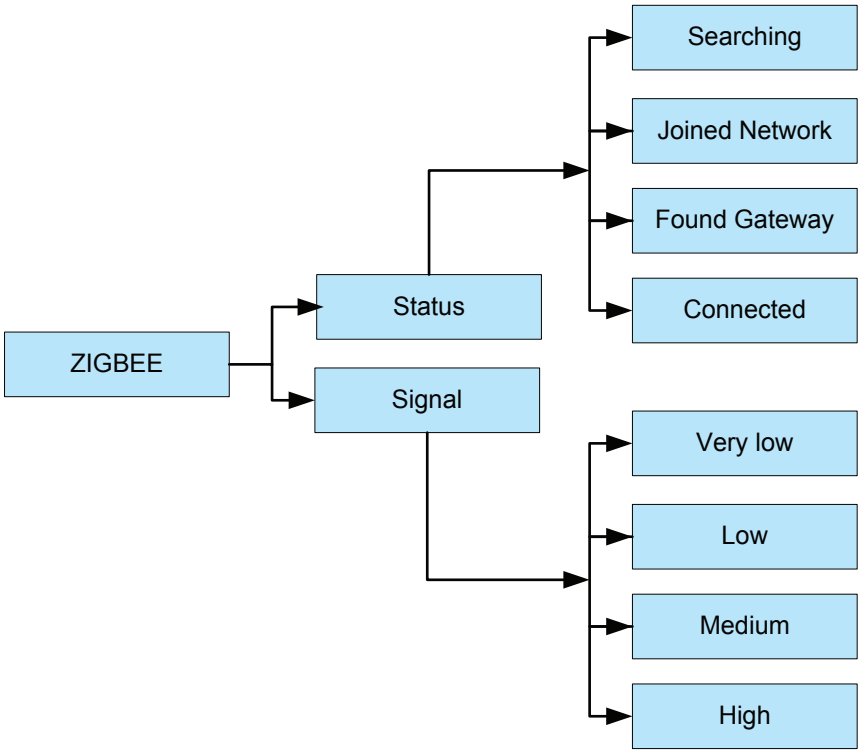
Part No. - Displays the UNO part number.
Serial No. - Displays the UNO serial number and the week (from 1 to 52) and year of manufacture.
Firmware - Displays the revision of the firmware installed in the equipment.
Country selector - Display and configuration menu for grid standard. Can be set at 240V/ Split Phase, 277V/Single Phase, or 208V/Single phase.
Default grid standard is 240V/Split phase.

- *Actual value:* Displays the set grid standard.
- *New value:* Modify the grid standard:
  From *New value* screen press ENTER to display grid standard
  Press DOWN to scroll to new grid standard
  Press ENTER to select, *Confirm NO* screen opens
  Press DOWN to *Confirm YES* and press ENTER to confirm.
  Inverter will automatically shut down and restart to apply new setting.
- *Residual time*: Displays the time remaining in which it is still possible to set a new grid standard. When the time expires, *Locked* will be displayed, which indicates it is not possible to change the grid standard again. Call customer service if it is necessary to change the grid standard after the 24 hour period.

Zigbee Menu

The ZIGBEE view-only menu provides status of the radiomodule connection and signal strength.

The Zigbee menu is visible only when the optional radiomodule board is installed (see section 3).



Commissioning

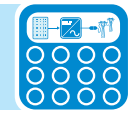
Do not place any items on the inverter during operation.

Do not touch the heat sink when the inverter is operating, as some parts may be hot and cause burns.

Configure inverter settings

The following settings can be configured before or after commissioning the inverter using the display menu. If the settings are configured prior to grid connection the inverter display only needs DC power to use the menus. DO NOT connect the AC power (grid side) at this time!

With only the array connected, turn the DC disconnect switch to the ON position. The GREEN POWER LED will flash and the YELLOW ALARM LED will be steady. The LCD will display *Missing Grid*.



Press the ESC button to open the three main menus. Use the DOWN button to scroll to *Settings* and press ENTER. A password screen will open; the default password is 0000. Pressing ENTER four times loads four zeros on the display and opens the Settings submenu.

Address (RS-485) - Default address is set at 2 for a single inverter. The RS-485 address may need to be changed or assigned. Address values are assigned manually using any value in the range 2 to 64.

- From the *Settings* menu, scroll to *Address* and press ENTER.
- *New Address* screen opens; press DOWN to select number field and press ENTER.
- Press UP or DOWN key to scroll through numbers; press ENTER to select new number.
- Press ESC to return to main menus.

Input mode - Default setting is independent mode. To select parallel mode:

- From the *Settings* menu, scroll to *Input mode* and press ENTER.
- *Independent* screen opens; press Enter to view options.
- Press DOWN to scroll to *Parallel* and press ENTER to select.

DC power will automatically recycle when Input mode has been modified.

Modifications to the grid/country standard are made using the Information menu.

Country Standard - Default grid standard is 240V/Split Phase.

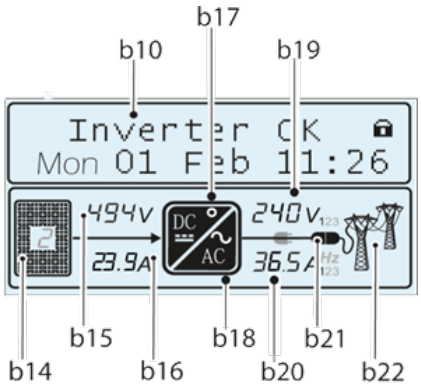
- Press the ESC button to open the three main menus.
- Use the DOWN button to scroll to *Info* and press ENTER to open the submenu.
- *Part number* screen opens; press DOWN to scroll to *Country selector* and press ENTER.
- *Actual value* screen opens; press DOWN to scroll to *New value* and press ENTER.
- From *New value* screen press ENTER to display grid standard.
- Press DOWN to scroll to desired grid standard.
- Press ENTER to select, *Confirm NO* screen opens.
- Press DOWN to *Confirm YES* and press ENTER to confirm.

DC power will automatically recycle when Country Standard has been modified.

Power ON the inverter

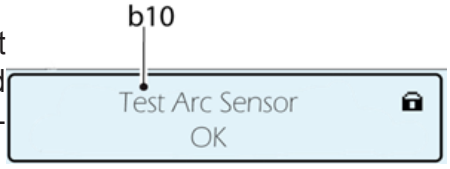
1. Turn the DC disconnect switch in the ON position. If there are two separate external disconnect switches (one for DC and the other for AC), first close the AC disconnect switch and then the DC disconnect switch.

2. Once the inverter is powered, icon **b14** comes on to indicate that the voltage from the photovoltaic array has reached the Vstart threshold (voltage necessary for connecting the inverter to the grid).



For input voltages lower than Vstart, the icon **b14** remains off, the "Waiting Sun" message is shown on the display and the voltage and current values are present (icons b15 and b16).

3. As soon as "Waiting Sun" conditions are met successfully, the inverter display shows the AFD board self-test running. The results are displayed in the two-line graphic display **b10**.



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.

4. If there are no irregularities after checking the grid voltage and frequency parameters, the grid connection sequence starts. Once all the checks are finished, and all grid parameters are observed, icon **b22** comes on.

During these checks, icon **b22** is flashing. This check can take several minutes depending on grid conditions and grid standard settings.

5. At this point icon **b17** flashes to indicate the start-up phase. This icon will remain permanently switched ON when the DC-DC is operating at steady state.

At the same time as icon **b17** comes on (steady), icon **b18** will come on to indicate that the inverter circuit has begun working (DC- AC).

6. The grid connection will start immediately. During this phase the icon **b21** will be displayed in steps until the connection of the inverter is complete. After the inverter is connected, the icon **b21** will stay plugged in as shown below.

Icon **b21** – inverter connected to network (plugged in)

Icon **b21** - inverter not connected to network (unplugged)

Once the connection sequence is complete, the inverter starts to operate and indicates correct operation by the green LED lighting steady on the LED panel. This means there is sufficient sunlight to feed power into the grid.

If there is not sufficient sunlight, the unit will repeat the procedure until all the parameters controlling connection to the grid (grid voltage and frequency, confirmation of no ground fault) are within the range. During this procedure, the green LED flashes ON and OFF.

Dynamic behavior of the display during operation

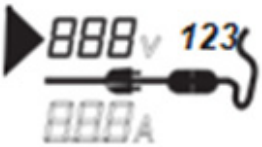
If the MPPT scan function is enabled, icon **b9** will be shown on the display and flash during scanning.

During operation, the following values are displayed in rotation:

Voltage **b15** and current **b16** from the PV field.

Depending on the configuration or model of the inverter, the voltages and currents of one or both channels (or of the single strings) will be displayed. The input channel measured is indicated by the value displayed in **b14**.

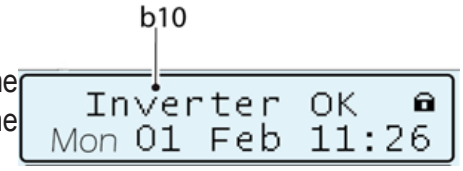
Voltage **b19** and current **b20** of the AC grid.



Depending on the model of inverter, the voltages and currents the AC grid will be displayed.

At the end of the display cycle described above, the grid frequency will be indicated in **b20** and the line voltage will be indicated in **b19**.

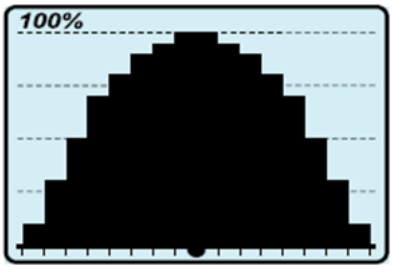
At the same time, the main readings made by the inverter will be displayed in rotation on the two-line graphic display **b10**.



Power graph **b11** is a histogram that includes 16 horizontal units and 20 vertical units. The period of time is represented by the horizontal axis of the graph and can be set by the user to 8, 16 or 24 hours; each horizontal unit can represent 30, 60 or 120 minutes.

The vertical axis represents the maximum power reduction (7.6kW for the UNO-7.6--TL and 8.6kW for the UNO-8.6-TL). 100% corresponds to the outgoing exported power value.

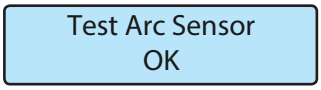
The power value expressed by each column of the graph represents the average value of the power during the period relating to the time unit.



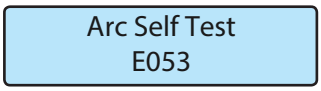
Arc fault detection self-test errors

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:

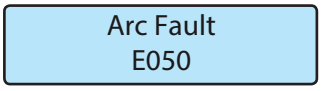
If the self-test results are OK, the inverter will continue to AC grid connection.



If a potential problem on the AFD board is detected, the self-test will result in an error. Refer to table 5 in this section for possible solutions to the error.



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.



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.

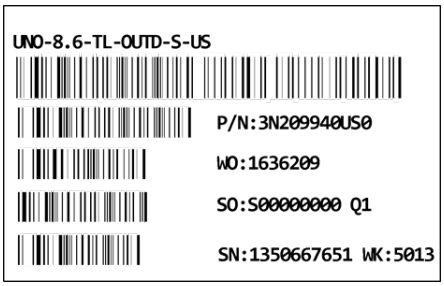
Obtaining the service level password

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.

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 Vdcmin 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.

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 boost 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	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: - 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.	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. (Damp increases leakage and can therefore be the cause of a reduction in insulation resistance).
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 must be carried out by specialized staff assigned to perform this work. DO NOT allow the equipment to be used if problems of any kind are found.

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

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 Part 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.

Power-down procedure

Once the inverter is wired and connected to the grid use the following procedures to disconnect for maintenance.

THE FOLLOWING OPERATIONS MUST ALWAYS BE PERFORMED before accessing the power input of the switchbox in order to avoid injury to personnel and/or damage to equipment. 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.

Disconnect from the AC Grid by one of the following methods:

- Turn-OFF the external AC switch
- Turn-OFF the Over Current Protection Device (circuit breaker)

Disconnect the inverter from the PV array by turning OFF the external DC disconnect switch.

NOTE: When possible, turn off the AC switch first; however, there is no specific order for turning off the two switches.

Routine maintenance

Checking and maintenance operations must be carried out by specialized staff assigned to carry out this work. DO NOT allow the equipment to be used if problems of any kind are found, and restore the normal conditions correctly or make sure this is done.

	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.
	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.
	Once a year or in the event of malfunction, check that the environmental conditions have not changed drastically (exposure to weather conditions); also check that the inverter or PV panels have not been shaded or isolated by foreign bodies.
	Once a year or in the event of malfunction, check the tightness of the cable openings, the fitting of the connectors, and front covers. Loose fittings can allow water seepage into the cabinet which may result in short circuits due to high humidity.

Other maintenance

INTERVAL	INVERTER MAINTENANCE ITEM
6 months	Check the cooling air path and heatsink for blockages
Annually	Check internal cooling fan operation (monitor start-up for warning)
Annually	Check DC pressure connectors*
Annually	Check AC pressure connectors*
Annually	Re torque chassis access covers to insure NEMA4X compatibility*
Annually	Check all connections terminals for discoloration or signs of high temp/current*
3 years	Remove and replace the memory back-up battery, see instructions below

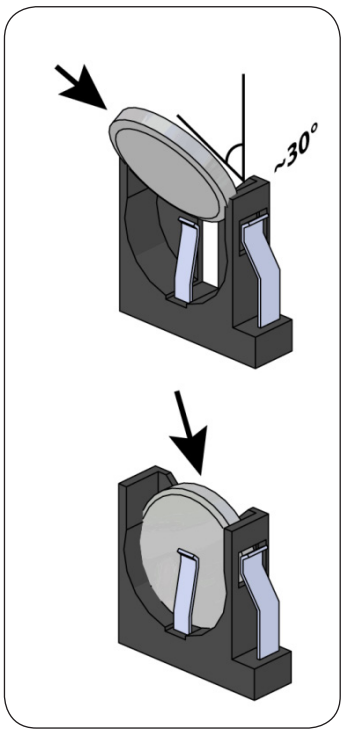
* Check initially after first six months of operation, then annually. In case of malfunctions between maintenance points, recheck all items after repairs are completed.

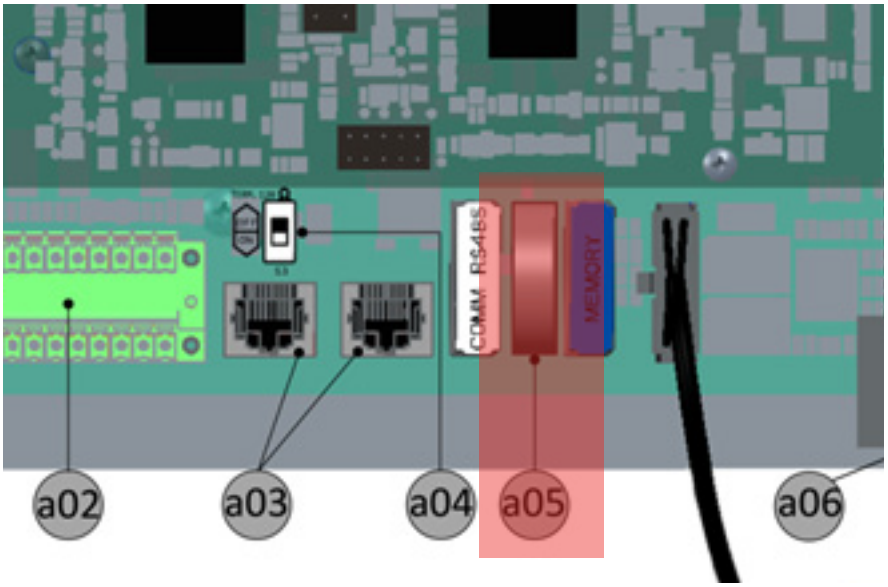
CR2032 battery replacement

The replacement of the battery should be performed only by trained personnel.

The CR2032 battery housing **a05** is located on the inverter connection board and is visible after opening the inverter cover. When this battery is at end-of-life, a message is displayed informing that the battery needs to be replaced.

- Insert the new battery into its holder, sliding in at a 30° angle.
- The battery should seat into the correct position within the holder.
- Close the front cover and tighten the cover screws with at least 2.0Nm (17.7 in-lbs) torque to maintain Nema 4X compliance when complete.





Installing a replacement inverter chassis

The inverter chassis is designed as a removable unit that can be detached from the switchbox for replacement without dismounting the installed switchbox.

This section assumes the unit has been physically mounted in its final location, and the inverter has been previously wired and connected to the PV array and the AC grid.

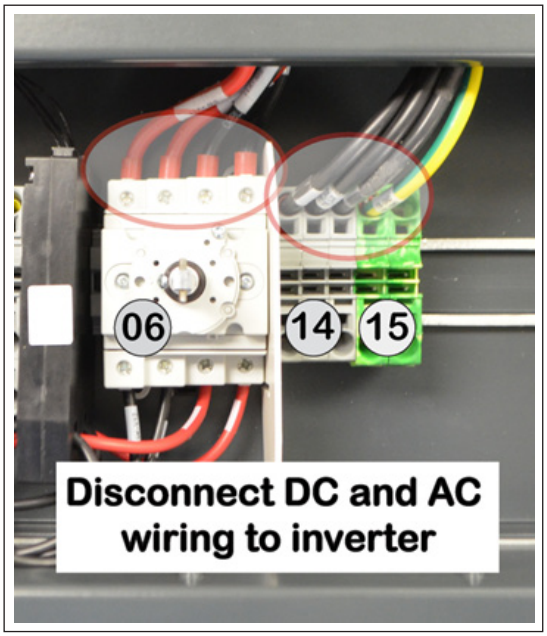
To prevent electrocution hazards, this operation must be carried out with the DC disconnect switch (06) turned to the OFF position and locked out and the external AC disconnect switch downstream of the inverter (grid side) open and locked out.

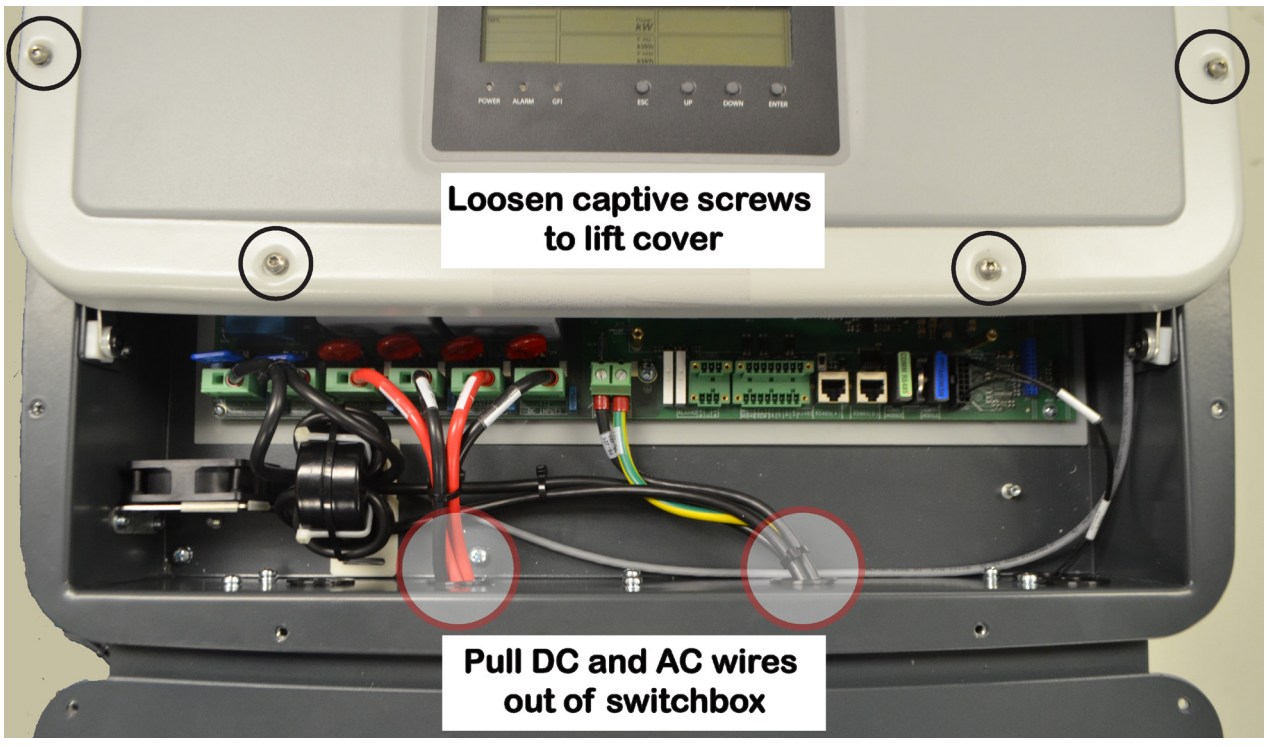
- Disconnect from the AC grid by one of the following methods:
  a. Turn-OFF the external AC switch (if any)
  b. Turn-OFF the Over Current Protection Device (circuit breaker)
- Disconnect the inverter from the PV array by turning OFF the external DC disconnect switch.

To avoid the risk of electric shock from energy stored in capacitors, wait at least ten minutes after disconnecting both AC and DC sides before opening the front panels.

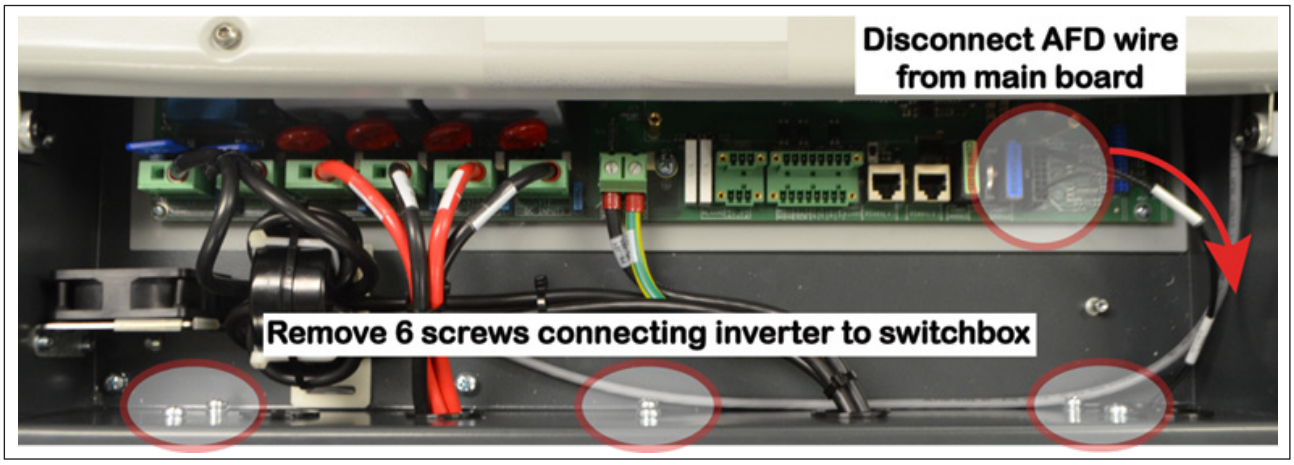
Removing the old inverter chassis from the switchbox

1. Remove the switchbox cover by loosening the six captive screws using the Torx screwdriver provided.
2. Using a Phillips head screwdriver, remove the four wires at the top of the DC disconnect switch **06**.
3. Remove all AC wiring and ground wiring connected at the top of AC terminal block **14** and AC protective earth terminal **15** using the following steps:
   - Use a small (~1/4" wide) flat blade screwdriver to open the pressure contact.
   - Lightly press the screwdriver toward the associated wire slot until the clamp opens;hold the clamp open with the screwdriver.
   - Gently pull the wire out of the slot, release the pressure on the screwdriver and remove it from the slot.
4. Loosen the 8 captive screws on the hinged inverter cover and gently lift cover up to open. The cover is equipped with fixed hinges and is not intended to be removed from the chassis.
5. Pull DC wires (removed in step 2) and AC wires (removed in step 3), out of the switchbox through the cut-out holes.





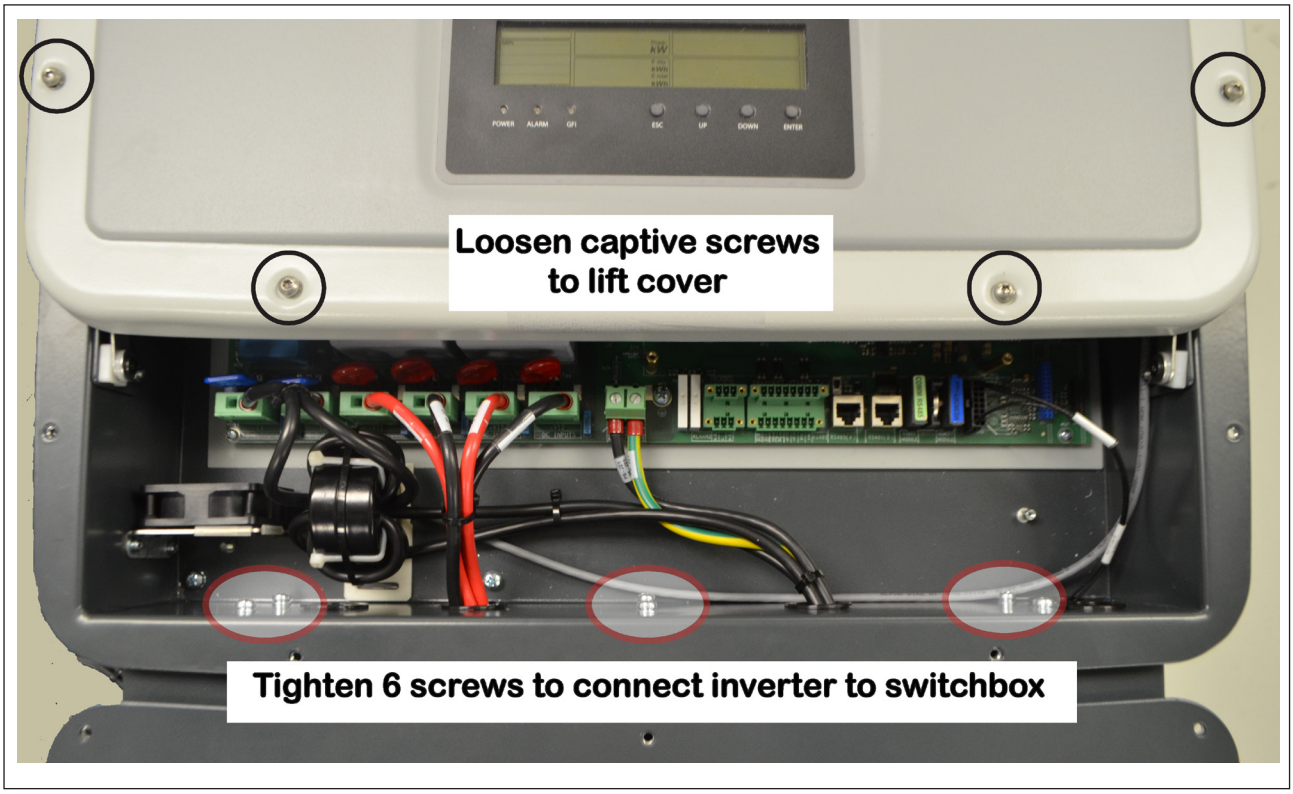
6. Disconnect the AFD wire at main board and pass through cut-out hole to switchbox.
7. Disconnect any other serial communication and signal wiring present on the main board and pass through the cut-out hole to the switchbox.
8. Remove 6 screws on the bottom of inverter chassis, (3 in front, 3 in back), using a ratchet and standard Phillips head bit.



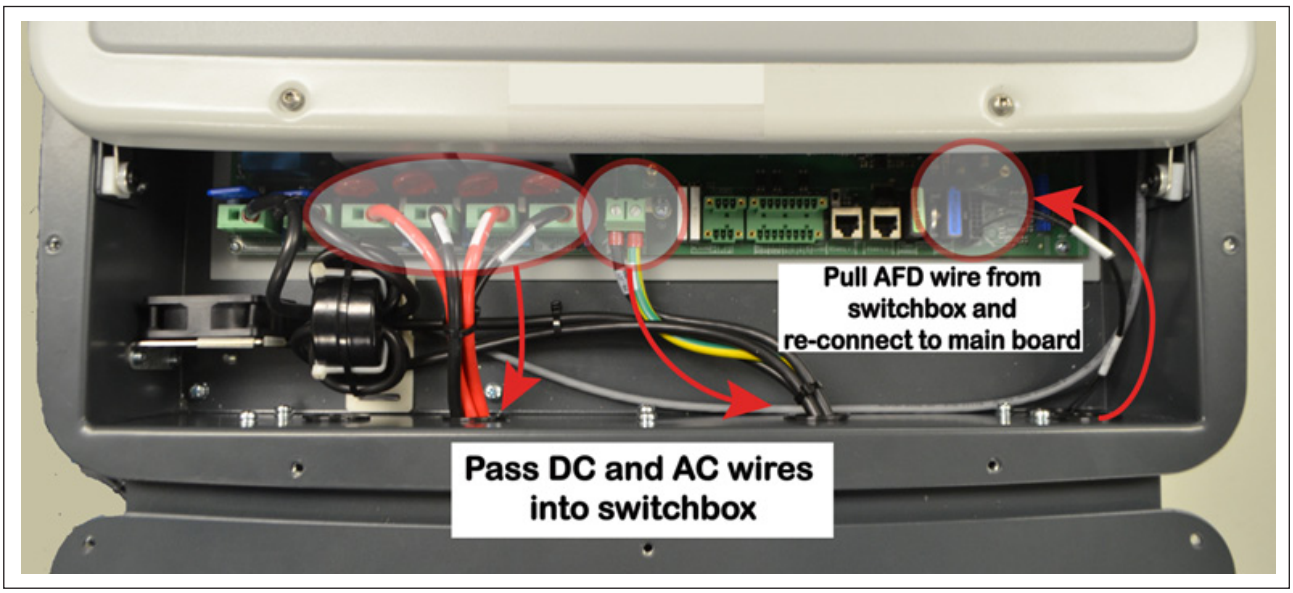
9. Close the inverter cover and tighten the 8 captive screws.
10. Using two people, lift the inverter up by the handles and pull out to remove from the upper slots on the mounting bracket.

Installing the replacement inverter chassis

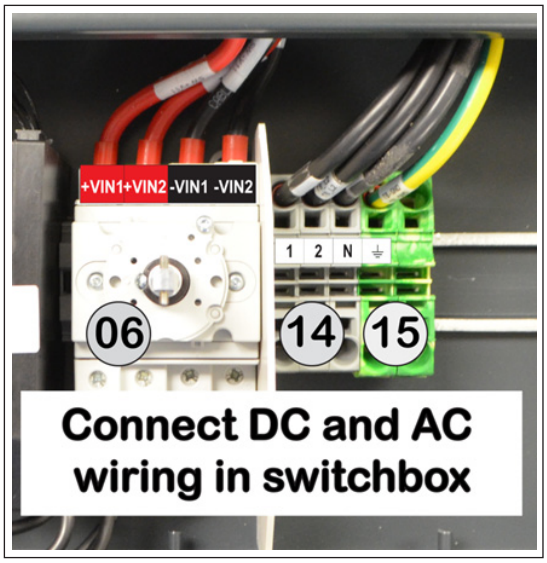
1. Unpack the new inverter chassis and use two people to remove it from the packaging.
2. Using two people, lift the inverter by the handles and orient it to the bracket so the studs are just above the associated slots.
3. Once aligned, lower the inverter unit into position ensuring the two studs are seated in the upper slots.
4. Loosen the 8 captive screws on the hinged inverter cover and gently lift cover up to open. This cover is equipped with fixed hinges and is not intended to be removed from the chassis.
5. Fasten the 6 screws on the bottom of inverter chassis, (3 in front, 3 in back), to the switchbox, using a ratchet and standard Phillips head bit. Tighten the screws with at least 2.0Nm (17.7 in-lbs) torque to maintain waterproof sealing.



6. Pass DC wires and AC wires from inverter main board through the cut-out holes into the switchbox.
7. Pull the AFD wire from the switchbox through cut-out hole to the inverter and connect at main board, as shown below.
8. Connect any other serial communication and signal wiring previously connected on the main board by routing from the switchbox through the cut-out hole to the inverter. See communication card connections, section 3, for instructions.



9. Using a Phillips head screwdriver, connect the four DC wires, +VIN1, +VIN2, -VIN1, -VIN2, at the top of the DC disconnect switch **06** to the correct positions illustrated at right.
10. Connect all AC wiring and ground wiring at the top of AC terminal block **14** and AC protective earth terminal **15**, to the correct positions illustrated at right using the following steps:



- Use a small (~1/4" wide) flat blade screwdriver to open the pressure contact.
- Lightly press the screwdriver toward the associated wire slot until the clamp opens; hold the clamp open with the screwdriver.
- Insert the wire into the associated round wire slot until seated.
- Release the pressure on the screwdriver and remove it from the slot.
- Check the security of connection in the AC connector by tugging on the wire.

11. When connection operations are complete, re-install both covers and tighten the cover screws with at least 2.0Nm (17.7 in-lbs) torque to maintain waterproof sealing.

To commission the replacement inverter, refer to Commissioning in section 4.

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.

Appendix 7

System description

UNO 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.

Connection of several inverters together

If the photovoltaic system exceeds the capacity of a single inverter, it is possible to make a multiple connection of inverters to the system, with each one connected to a suitable section of the photovoltaic field, on the DC side, and connected to the grid on the AC side.

Each inverter with multiple strings will work independently of the others and will supply the grid with the maximum power available from its section of photovoltaic panels.

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

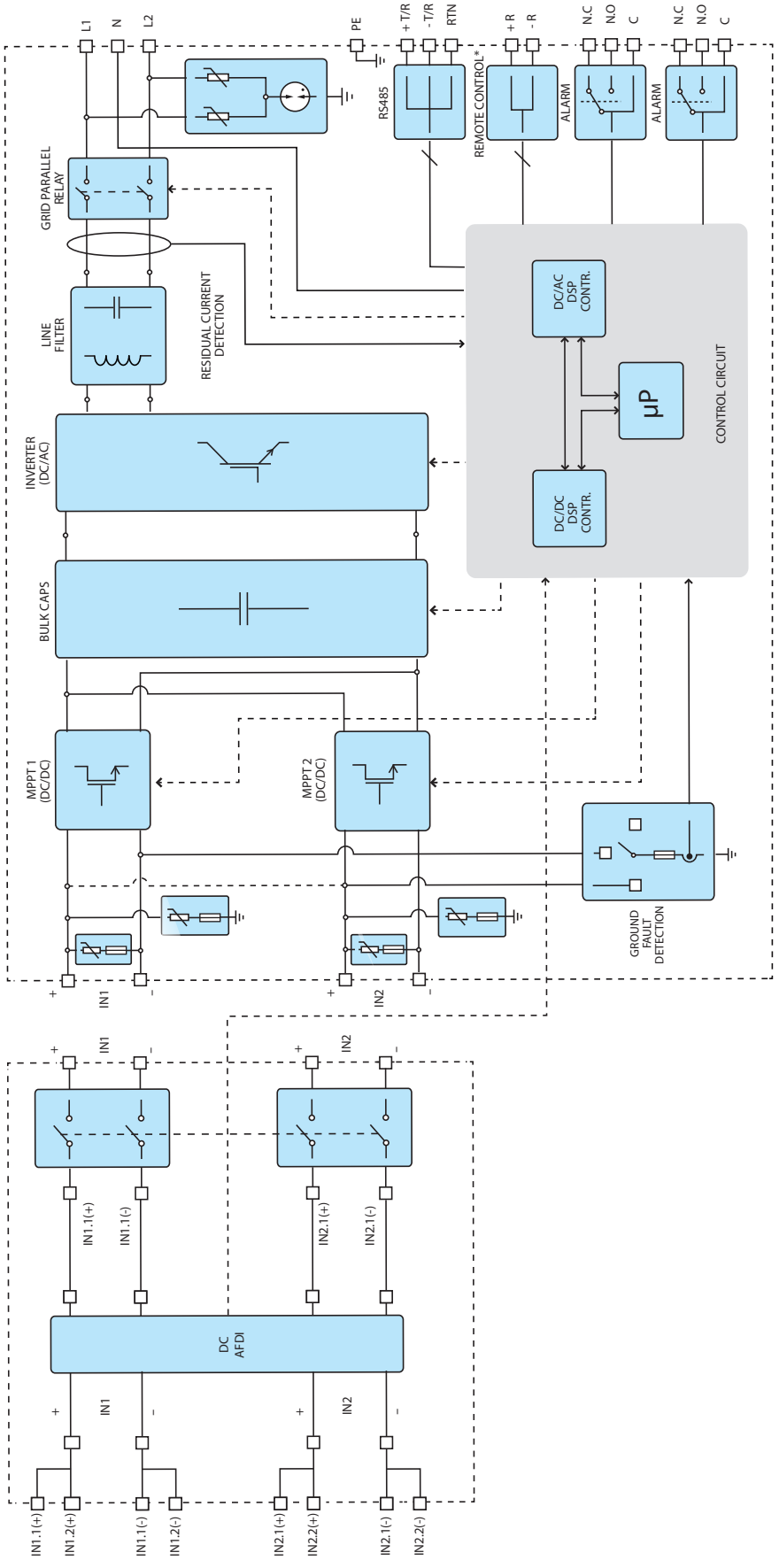
Anti-Islanding
In accordance with required national standards and laws, in the event of a local grid outage by the utility, or when the grid equipment is switched OFF for maintenance operations, the inverter must be physically and safely disconnected, to ensure protection of personnel working on the grid. To prevent possible islanding, the inverter has an automatic protective disconnection system called “Anti-Islanding”.

Ground fault in the photovoltaic panels
An advanced ground fault protection circuit continuously monitors the ground connection and disconnects the inverter when a ground fault occurs, indicating this condition by means of the red GFI on the LED panel.

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 unlock the unit pressing ‘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.

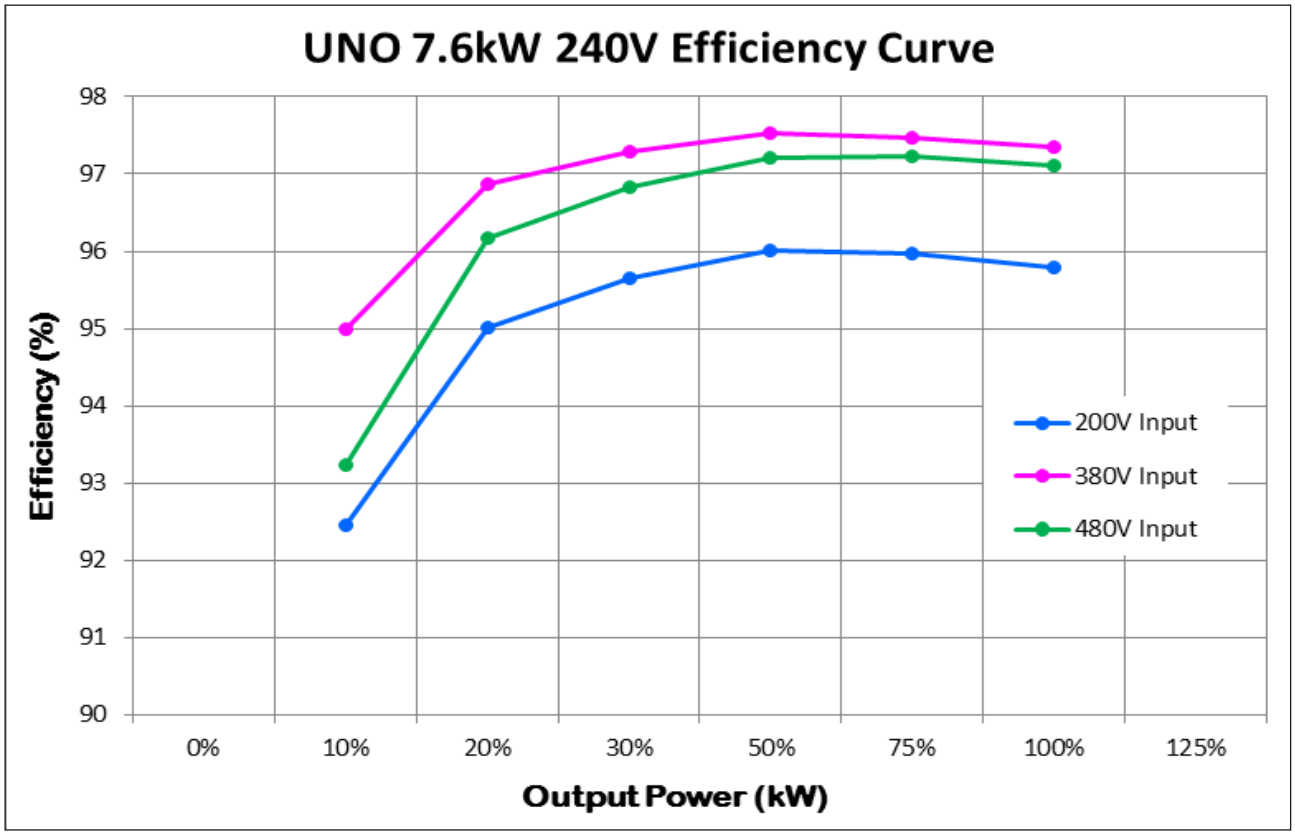
Further protective devices
The inverter is equipped with additional protective devices to guarantee safe operation in any circumstance. These protective devices include:
- Continuous monitoring of the grid voltage to ensure the voltage and frequency values stay within operating limits.
- Control of internal temperatures to automatically limit the power if necessary to ensure the unit does not overheat (derating).

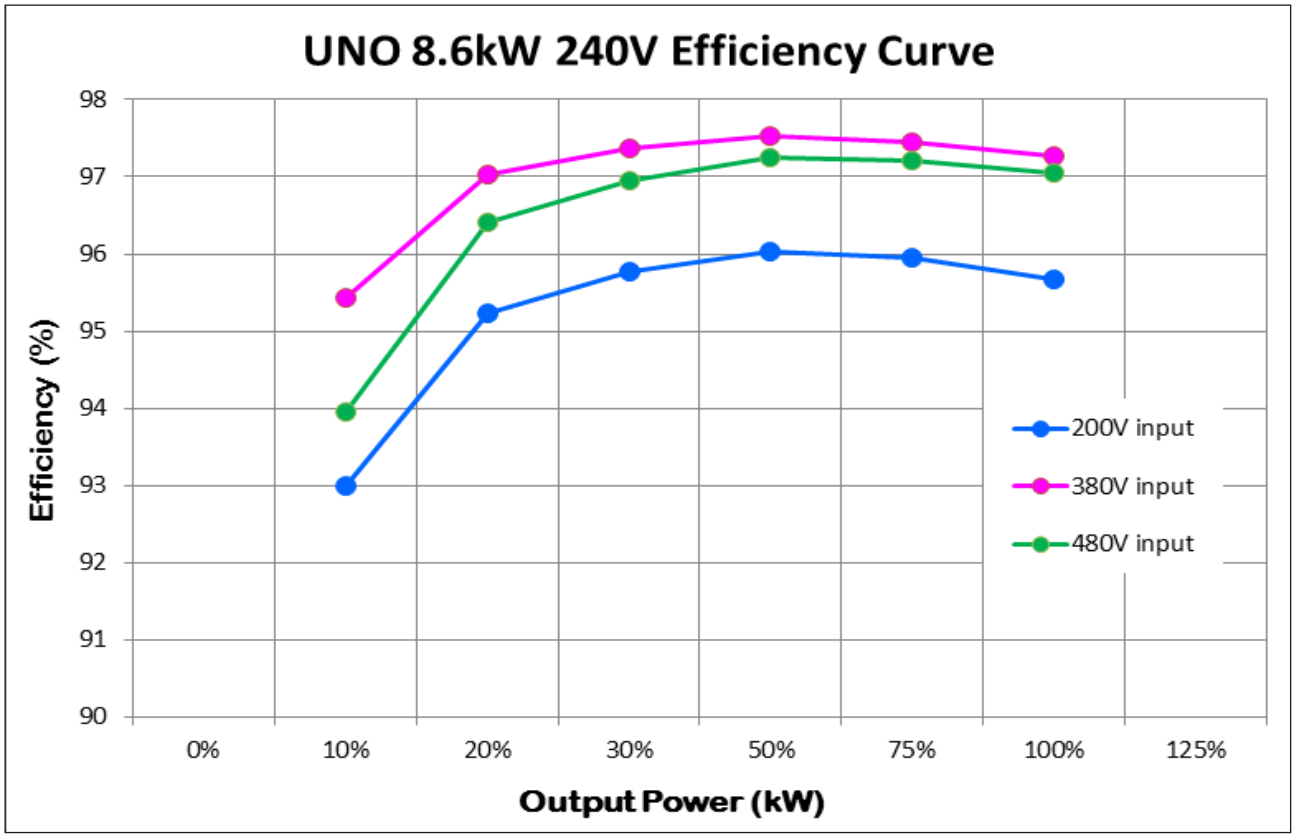
Topographic diagram of the equipment



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.





Voltage and temperature derating due to altitude

Certain conditions should be considered when choosing an installation location at high altitudes.

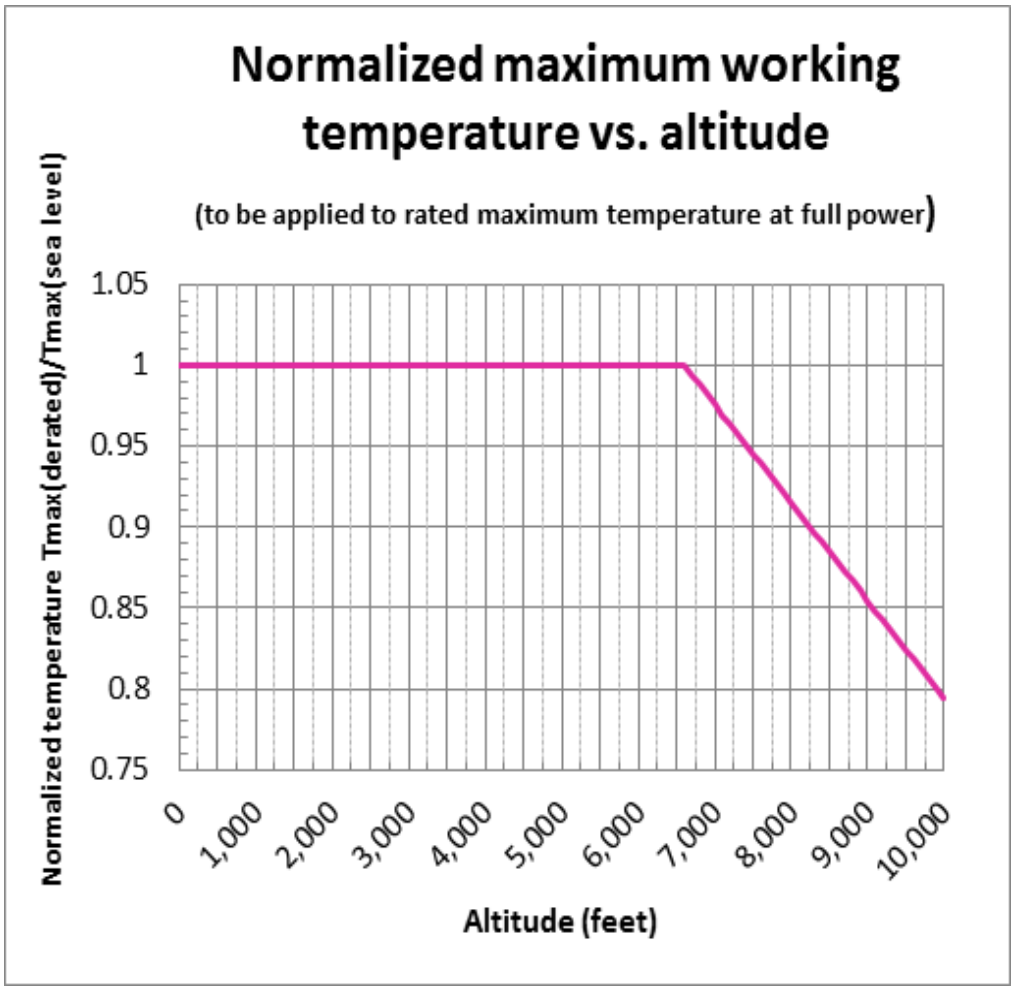
Air pressure decreases as altitude above sea level increases. The reduced air density results in less effective heat dispersal, hence the need to reduce rated operating temperatures. The dielectric strength of air also drops as the air pressure drops, necessitating a reduction in rated operating voltages so to avoid electric arcs in high voltage circuits.

Standard design guidelines cover normal operation up to 6600 feet (2000 meters) elevation. Guidelines given below will aid the designer in planning installations above 6600 feet. These are not hard and fast rules, but guidelines to aid the designer.

Temperature derating

The Y-axis of the graph in Figure 7 3 is the normalized temperature derating. The inverter's rated maximum ambient temperature applies up to altitudes of 6600 feet (2000m). Between 6600 and 10,000 feet, the ambient temperature for the inverter must be decreased by the corresponding fraction shown on the Y-axis of the graph.

These derating guidelines are applicable to both indoor and outdoor applications. The installation designer should consider the site layout, wind, typical maximum temperatures, and other environmental parameters in determining if less derating is acceptable.

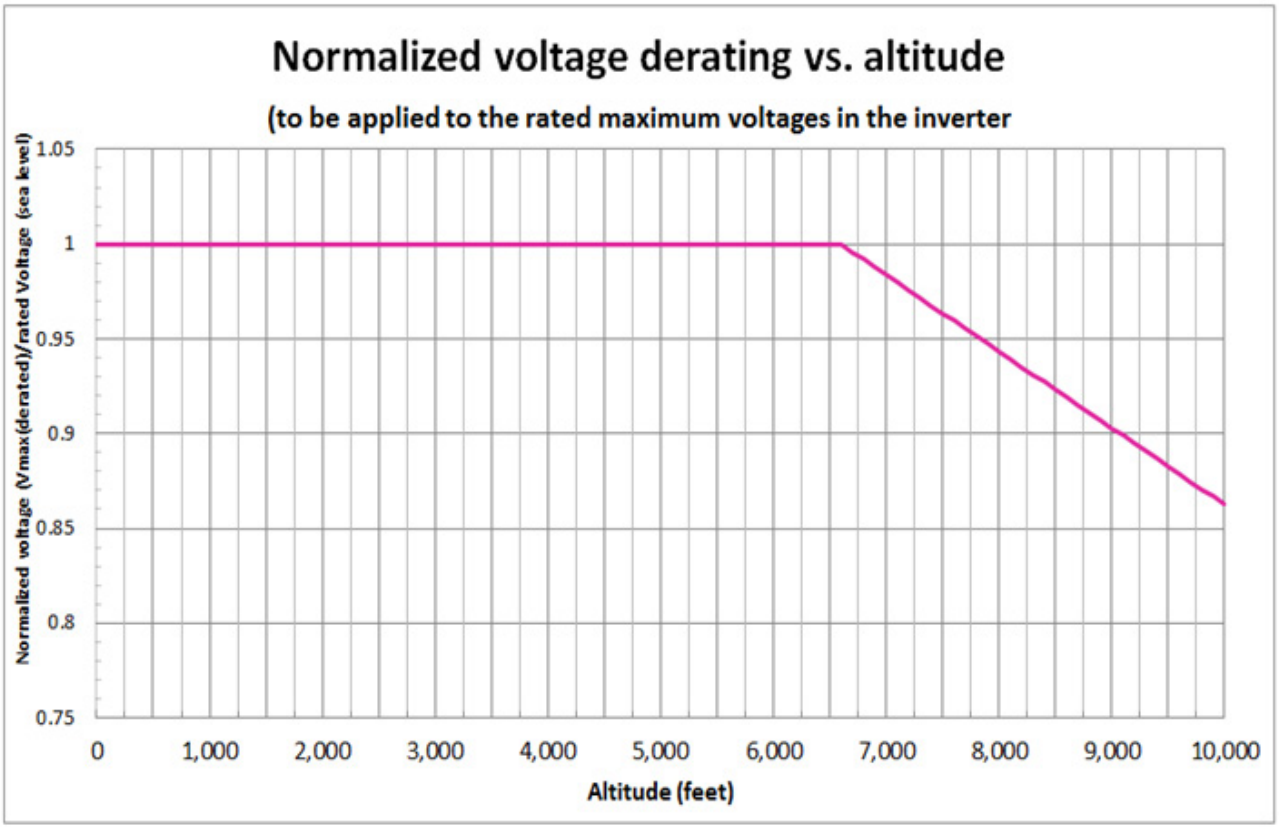


EXAMPLE – TEMPERATURE DERATING CALCULATION for an UNO-7.6/8.6-TL-US installed at 7500 feet:

- The maximum rated temperature, for full power operation at sea level, from the UNO-7.6/8.6-TL-US series datasheet, is 122oF (50oC).
- The normalized temperature derating factor, from the graph in Figure 7 3, at an altitude of 7500 feet is .945.
- The maximum full-power temperature for operation at 7500 feet would be 122oF * .945 = 115oF --OR-- 50oC * .945 = 47oC.

Voltage derating

The dielectric strength of air decreases with altitude, so the maximum DC input inverter voltage must be decreased at high altitudes to avoid unwanted electrical arcs. Figure 7 4 shows normalized voltage derating factor with increased altitude.

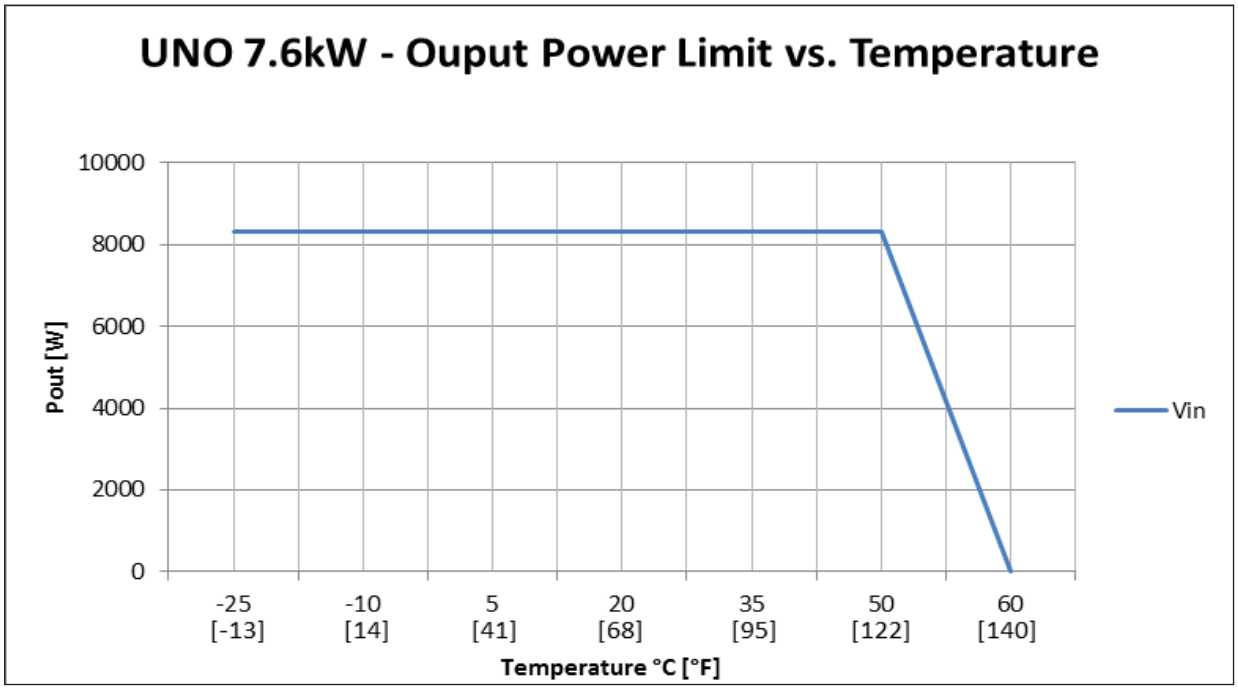


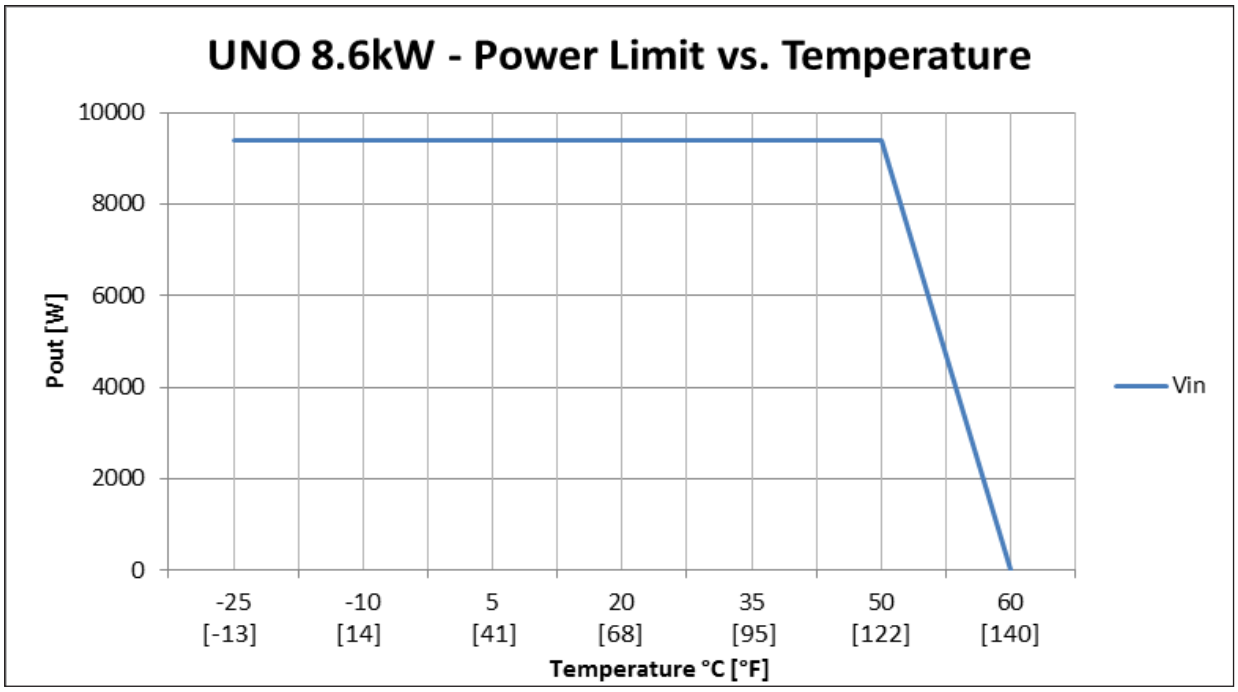
Automatic power reduction

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

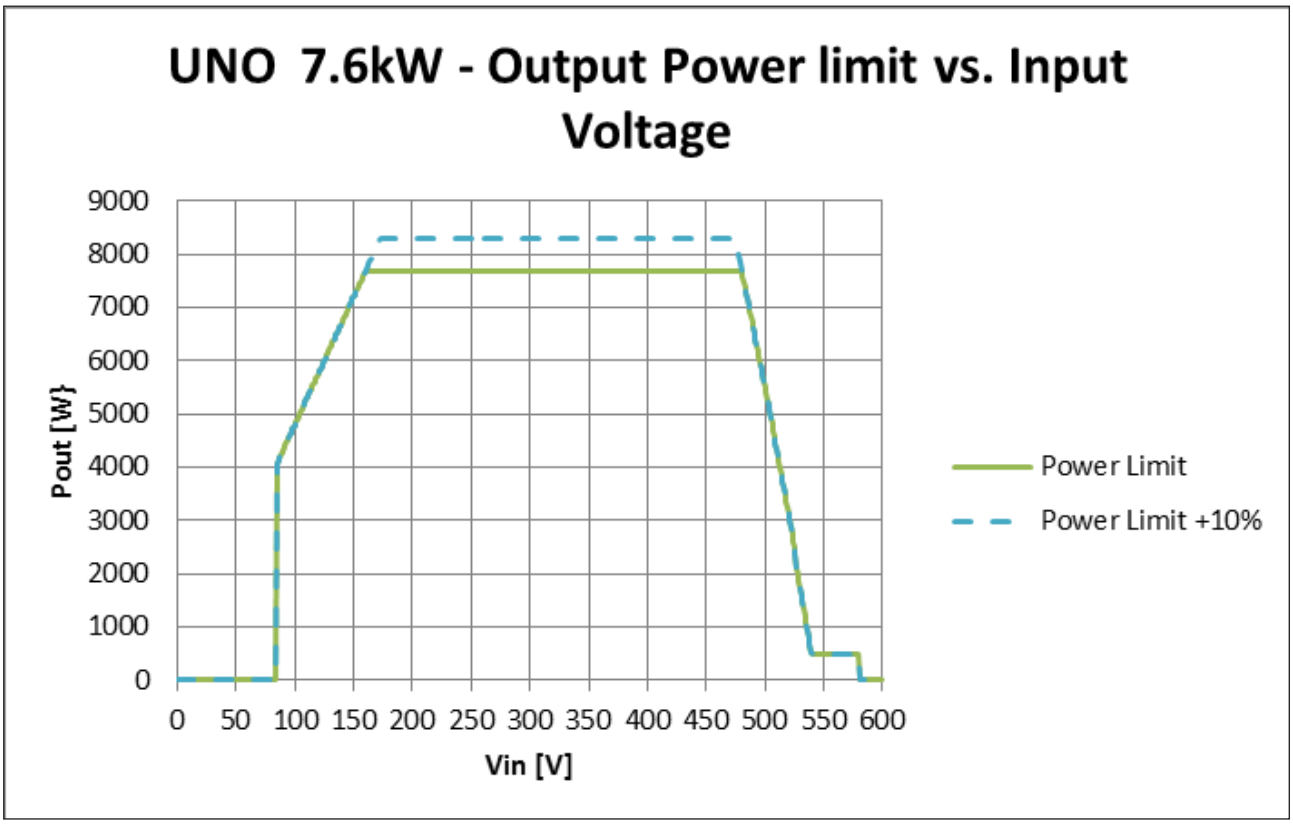
Power reduction due to ambient or inverter temperature depends on many operating parameters, such as input voltage, grid voltage and power available from the photovoltaic arrays. The inverter may reduce its output power during the day according to the value of these parameters. The following graphs show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

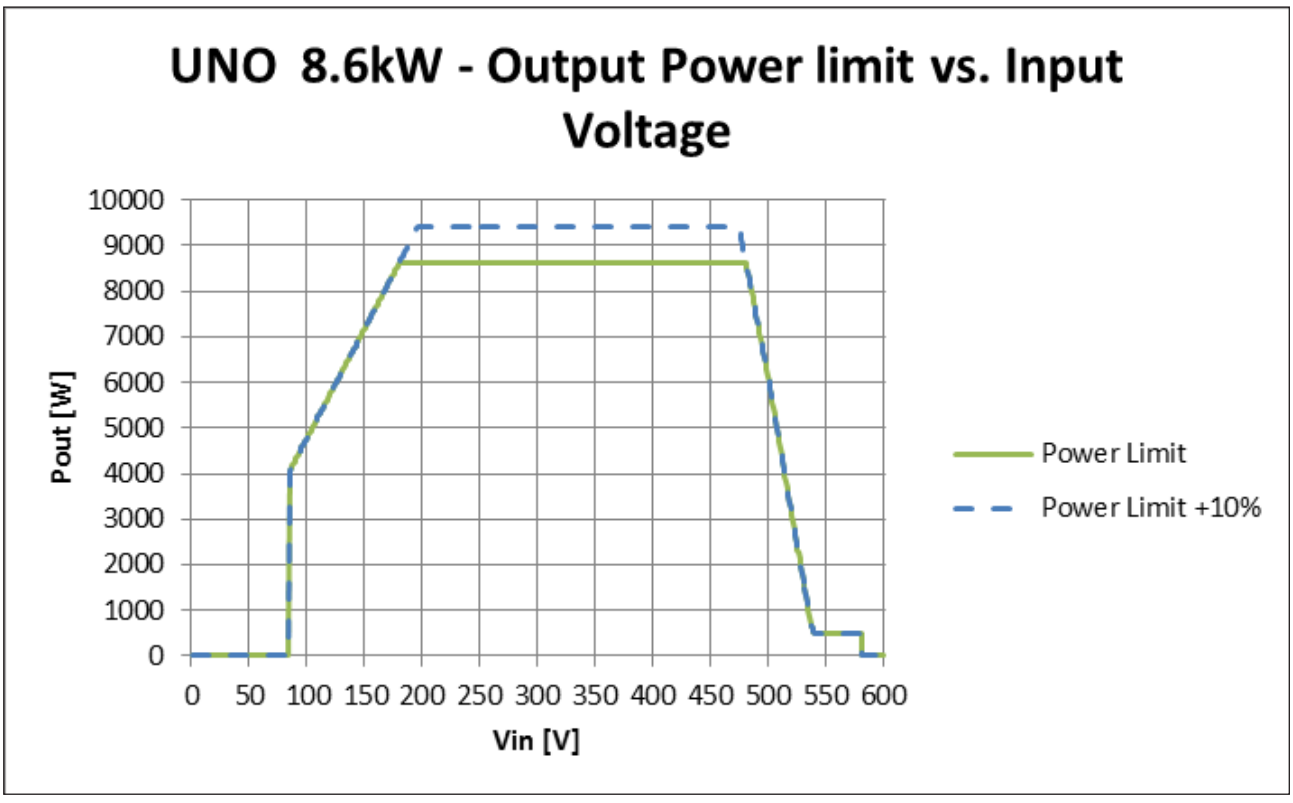




Power reduction due to input voltage

The following graphs show the automatic reduction in output power when the input voltage is too high or too low.





Technical data and types

Type code	UNO-7.6-TL-OUTD-S-US-A			UNO-8.6-TL-OUTD-S-US-A	
Nominal output power		7600W		8600W	
Maximum output power		8300W		9400W	
Rated grid AC voltage	208V	240V	277V	240V	277V
Input side					
Number of independent MPPT channels	2				
Maximum usable power for each channel	5400W				
Absolute maximum voltage (Vmax)	600V				
Start-up voltage (Vstart)	200V (adj. 120-350V)				
Full power MPPT voltage range	200-480				
Operating MPPT voltage range	0.7xVstart-580 (≥ 90V)				
Maximum current (Idcmax) for both MPPT in parallel	48A				
Maximum usable current per channel	24A				
Maximum short circuit current limit per channel	30A				
Number of wire landing terminals per channel	2 pairs				
Array wiring termination	Terminal block, pressure clamp, AWG12-AWG4				
Output side					
Grid connection type	1Ø/2W	Split-Ø/3W	1Ø/2W	Split-Ø/3W	1Ø/2W
Grid voltage range (Vmin-Vmax)	183V-228V	211V-264V	244V-304V	211V-264V	244V-304V
Nominal grid frequency	60Hz				
Adjustable grid frequency range	57Hz-63Hz				
Maximum Current (Iacmax)	36.5A$_{RMS}$	32A$_{RMS}$	27.5A$_{RMS}$	36A$_{RMS}$	31A$_{RMS}$
Power Factor	>0.995(adj. ±0.9, or fixed to ± 0.8 with max 7.6kVA / 8.6kVA)				
Total harmonic distortion (@ rated output power)	<2%				
Grid wiring termination type	Terminal block, pressure clamp AWG10-AWG4				
Input protection devices					
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 protection devices					
Anti-islanding protection	MeetsUL 1741/IEEE 1547 requirements				
External AC OCPD rating	50A$_{RMS}$	40A$_{RMS}$	40A$_{RMS}$	50A$_{RMS}$	40A$_{RMS}$
Over-Voltage protection type	Varistor, 2 (L_1 - L_2 / L_1 - G)				
Efficiency					
Maximum efficiency	97.5%				
CEC efficiency	96.5%				
Operating performance					
Night time consumption	<0.6 W$_{RMS}$				
Stand by consumption	< 8 W$_{RMS}$				
Communication					
User-interface	5.5" x 1.25" Graphic display				
Remote monitoring (1xRS485 included)	VSN700 Data Logger (opt.)				
Environmental					
Ambient air operating temperature range	-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)				
Relative humidity	0-100% condensing				
Acoustic noise emission level	<50 db (A) @ 1m				
Maximum operating altitude without derating	6560ft (2000m)				
Mechanical specifications					
Enclosure rating	NEMA 4X				
Cooling	Natural convection				
Dimensions (H x W x D)	18.9 x 22.8 x 8.8in (480 x 583 x 223mm) Inverter only 29.3 x 22.9 x 8.8 in (745 x 583 x 223mm) Including wiring box				
Weight	81.5lb (37kg)				
Shipping weight	103.5lb (47kg)				
Mounting system	Wall bracket				
Conduit connections	Bottom: (2) plugged 1/2" openings, (2) plugged 1" openings, (2) Concentrik KOs 3/4", 1" Sides: (2) Concentrik KOs 3/4", 1"				
DC switch rating (per contact) (A/V)	25A / 600Vdc				
Safety					
Isolation level	Transformerless - floating array				
Safety and EMC standard	UL 1741, IEE1547, IEE1547.1, CSA-C22.2N. 107.1-01, UL1998 UL1699B, FCC Part 15 Class B				
Safety Approval	$_{c}$CSA$_{us}$				
Warranty					
Standard warranty	10 years				
Extended warranty	15 & 20 years				
Available models					
With DC switch and wiring box	UNO-7.6-TL-OUTD-S-US-A			UNO-8.6-TL-OUTD-S-US-A	

*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

Contact us

www.abb.com/solarinverters

UNO-7.6-8.6-TL-OUTD-US-A Product Manual
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