

ABB solar inverters

Product manual  
TRIO-TM-60.0-US-480  
(60 kW)





## **IMPORTANT SAFETY INSTRUCTIONS**

*This manual contains important safety instructions that must be followed during installation, operation and maintenance of the ABB TRIO 60kW photovoltaic inverter.*

### **SAVE THESE INSTRUCTIONS!**

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

### **THE INSTALLER MUST READ THIS DOCUMENT IN ITS ENTIRETY BEFORE INSTALLING 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, operate and maintain the ABB TRIO 60kW inverter. This manual covers only inverter, not any equipment (photovoltaic modules, external disconnects, etc) to which it is connected.*

*Warranty requirements are included in the Terms and Conditions of sale included with the inverter order; these include proper installation, operation as intended by ABB, and periodic preventative maintenance. NOTE: Any changes not approved by ABB void the warranty.*

### **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

### TRIO-60.0 string inverters

1 - Introduction and general information



2 - Characteristics



3 - Safety and accident prevention



4 - Lifting and transport



5 - Installation



6 - Instruments



7 - Operation



8 - Maintenance and troubleshooting



9 - Attachments



## **Warranty and conditions of sale**

The terms and conditions of sale, including requirements for maintaining the warranty, are sent with each order. Refer to the terms and conditions when designing the site, installing the inverter and setting up a preventative maintenance program.

In particular, pay attention to physical clearances, any site noise limitations, maximum system input voltage, potential flammability hazards.

*ABB accepts no liability for failure to comply with the instructions for correct installation and is not responsible for equipment it has not supplied.*

*Any modification, manipulation, or alteration of the hardware or software, voids the warranty.*

ABB is not liable for defects or malfunctions arising from improper use of the equipment, failures or problems due to shipping damage or out-of-spec environmental conditions; lack of or incorrect preventative maintenance, tampering or repairs; use or installation by unqualified persons.



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## Scope and target audience

### Purpose

This product manual is a useful guide that will enable workers to safely operate the inverter and maintain it in good working order.



*If the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be compromised.*



### Additional information and documentation

In addition to this product manual, one may download additional product documentation, including the Auroral Manager software required for communicating with the inverter, by visiting [www.abbsolarinverters.com](http://www.abbsolarinverters.com).

*The ABB solar inverter help desk may be reached at 1-877-261-1374, 6am - 6pm (Arizona time) Monday-Friday, excluding major holidays.*

### Operating and maintenance safety

Personnel in charge of using and maintaining the inverter must be properly qualified and educated for the tasks, and must be able to read and correctly interpret this product manual.

The installation must be performed by qualified installers and/or licensed electricians, with experience in photovoltaic systems. Installation must be in accordance with the NEC and any other local electrical codes. The local electrical utility (or authority having jurisdiction) must approve any installation before it is connected to the electrical grid.

Anyone working on or around the photovoltaic system, especially the inverter, must choose and use appropriate personal protective equipment (PPE).

## Symbols and signs

In the manual and/or in some cases on the equipment, the danger or hazard zones are indicated with signs, labels, symbols or icons.

Symbol	Description
	<b>General warning</b> - Important safety information. Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	<b>Dangerous Voltage</b> - Indicates a potentially hazardous situation, in particular a high voltage, which, if not avoided, could result in death or serious injury. The inverter has high voltages and energy levels.
	<b>Hot parts</b> - Indicates a potentially hazardous situation, in particular a hot surface, which, if not avoided, could result in death or serious injury. Some surfaces in the inverter will become hot during operation and must not be touched until the parts have cooled down.
	Risk of injury due to the weight of the equipment. Take care during lifting and transport
	Ground connection point.
	Rated temperature range.
	Direct current
	Alternating current
	The DC input voltage positive terminal
	The DC input voltage negative terminal



## Intended use

ABB is not liable for any damage whatsoever that may result from incorrect or careless operation.

*Do not use the inverter in a way for which is was not intended. The inverter MUST NOT be used by inexperienced staff, or even experienced staff if carrying out operations that fail to comply with the instructions in this product manual, or documentation shipped with the inverter.*



The inverter is designed for transforming continuous electrical current (DC) supplied by photovoltaic array (PV) into alternating electrical current (AC) suitable for feeding to the public distribution grid.

## Limitations in intended use

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*The inverter is designed for use with photovoltaic modules which have floating inputs.*

---

*Only photovoltaic modules may be connected to the inverter input. Do not connect batteries or other power supplies.*

---

*The inverter cannot be connected, on the DC side, in parallel to other inverters to convert energy from a photovoltaic array with power exceeding the nominal power of the single inverter.*

---

*The inverter may only be used in compliance with all its technical specifications.*

---

## Improper or prohibited use

**DO NOT:**

- *Install the inverter in environments subject to flammability or in adverse or disallowed environmental conditions, (temperature and humidity).*
- *Use the inverter with safety devices which are faulty or disabled.*
- *Use the inverter or part of it connected to other machines or equipment.*
- *Modify operating parameters that are not accessible to the operator, or modify the inverter to change its performance or electrical isolation.*
- *Clean with corrosive products that could damage the inverter.*
- *Use or install the inverter or parts of it without having read and understood the contents of the product manual.*
- *Heat or dry rags, or clothing, on inverter. In addition to being hazardous, it would compromise component ventilation and cooling.*

## Introduction

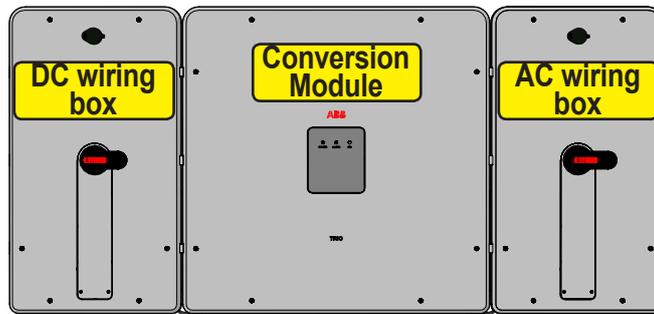
This chapter describes the features of the inverter, and identifies the principal components needed to understand the installation and operating instructions. Some terminology is defined. Technical datasheets, physical dimensions and safety ID plates are explained.

*The customer/Installer takes full responsibility if, when reading this manual, it's not read in the proper order. All information assumes that that presented in previous chapters has been read and understood.*

# Equipment and manufacturer identification

The technical data provided in this manual does not substitute the data supplied on the labels affixed to the equipment.

The labels affixed to the equipment must NOT be hidden by foreign objects and parts (rags, boxes, equipment, etc.); they must be regularly cleaned and always kept in sight.



**ABB** 1 4   

www.abb.com/solar  
**DC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**DCWB-1-TRIO-TM-60.0-US-480** 2

DC RATING	
Nominal Input Operating Voltage	720 V ===
Max. Input Voltage	1000 V ===
Range of Input Operating Voltage	360 - 950 V ===
Range of Input Voltage @Full Power	570 - 800 V ===
Max. Input Current	108 A @ 45 °C amb.
Max. Input Short Circuit Current (P.V. Panels)	165 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X

For more details about product specifications refer to the Instruction Manual

**ABB** 1 4   

www.abb.com/solar  
**SOLAR GRID SUPPORT UTILITY INTERACTIVE TRANSFORMERLESS INVERTER**  
 MODEL: TRIO-TM-60.0-US-480 2

DC RATING	
Nominal Input Operating Voltage	720 V ===
Max. Input Voltage	1000 V ===
Range of Input Operating Voltage	360 - 950 V ===
Range of Input Voltage @Full Power	570 - 800 V ===
Max. Input Current	108 A
Max. Input Short Circuit Current (P.V. Panels)	165 A

AC RATING	
Nominal Output Voltage	480 V - 3Ø
Operating Voltage Range	422 - 528 V-
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 (†) - 60.5 (‡) Hz
Output Power Factor	> 0.995 (‡)
Max. Output Current (for each phase)	77 A (rms)
Max. Continuous Output Power	60000 W @ 45 °C amb.
Max. Output Overcurrent Protection	100 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F), with Output Power Derating  
 Type of Enclosure: NEMA 4X

(†): Adjustable from 57.0 Hz to 59.8 Hz (‡): Adjustable from 60.2 Hz to 64.0 Hz  
 (‡): Adjustable from -1.0 to +1.0 @50max  
 For more details about product specifications refer to the Instruction Manual

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

**ABB** 1 4   

www.abb.com/solar  
**AC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**ACWB-TRIO-TM-60.0-US-480** 2

AC RATING	
Nominal Output Voltage	480 V - 3Ø
Operating Voltage Range	422 - 528 V-
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 (†) - 60.5 (‡) Hz
Max. Output Current (for each phase)	77 A (rms) @ 45 °C amb.
Max. Output Overcurrent Protection	100 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X  
 (†): Adjustable from 57.0 Hz to 59.8 Hz (‡): Adjustable from 60.2 Hz to 64.0 Hz

For more details about product specifications refer to the Instruction Manual

**ABB** 1 4   

www.abb.com/solar  
**DC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**DCWB-2-TRIO-TM-60.0-US-480** 2

DC RATING	
Nominal Input Operating Voltage	720 V ===
Max. Input Voltage	1000 V ===
Range of Input Operating Voltage	360 - 950 V ===
Range of Input Voltage @Full Power	570 - 800 V ===
Max. Input Current (for each channel)	3 x 36 A @ 45 °C amb.
Max. Input Short Circuit Current (P.V. Panels) (for each channel)	3 x 55 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X

For more details about product specifications refer to the Instruction Manual

**ABB** 1 4   

www.abb.com/solar  
**AC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**ACWB-A-TRIO-TM-60.0-US-480** 2

AC RATING	
Nominal Output Voltage	480 V - 3Ø
Operating Voltage Range	422 - 528 V-
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 (†) - 60.5 (‡) Hz
Max. Output Current (for each phase)	77 A (rms) @ 45 °C amb.
Max. Output Overcurrent Protection	100 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X  
 (†): Adjustable from 57.0 Hz to 59.8 Hz (‡): Adjustable from 60.2 Hz to 64.0 Hz

For more details about product specifications refer to the Instruction Manual

The safety approval label contains the following information:

1. Manufacturer
2. Model
3. Rating data
4. Certification marks

**ABB** 1 4   

www.abb.com/solar  
**DC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**DCWB-3-TRIO-TM-60.0-US-480** 2

DC RATING	
Nominal Input Operating Voltage	720 V ===
Max. Input Voltage	1000 V ===
Range of Input Operating Voltage	360 - 950 V ===
Range of Input Voltage @Full Power	570 - 800 V ===
Max. Input Current (for each channel)	3 x 36 A @ 45 °C amb.
Max. Input Short Circuit Current (P.V. Panels) (for each channel)	3 x 55 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X

For more details about product specifications refer to the Instruction Manual

**ABB** 1 4   

www.abb.com/solar  
**AC WIRING BOX**  
 (FOR CONNECTION TO MODEL TRIO-TM-60.0-US-480)

MODEL:  
**ACWB-B-TRIO-TM-60.0-US-480** 2

AC RATING	
Nominal Output Voltage	480 V - 3Ø
Operating Voltage Range	422 - 528 V-
Nominal Output Frequency	60 Hz (factory preset)
Operating Frequency Range	59.3 (†) - 60.5 (‡) Hz
Max. Output Current (for each phase)	77 A (rms) @ 45 °C amb.
Max. Output Overcurrent Protection	100 A

Operating Ambient Temperature: -25 to +60 °C (-13 to +140 °F)  
 Type of Enclosure: NEMA 4X  
 (†): Adjustable from 57.0 Hz to 59.8 Hz (‡): Adjustable from 60.2 Hz to 64.0 Hz

For more details about product specifications refer to the Instruction Manual

In addition to the label showing the inverter data, there are also additional identification labels for the power module and the 2 wiring boxes.

The labels displays the following information:



The diagram shows a rectangular label with several barcode sections and text fields. Callouts point from the following text to specific parts of the label:

- MODEL NAME** points to the top left text.
- Inverter or wiring box model** points to the first barcode.
- Inverter Part Number** points to the second barcode.
- Inverter/wiring box Serial Number** consisting of:
  - YY = Year of manufacture
  - WW = Week of manufacture
  - SSSSSS = sequential number
 points to the P/N field.
- Week/Year of manufacture** points to the SN and WK fields.

Text fields on the label include:

- P/N: P/P/P/P/P/P/P/P/P/P
- WO: XXXXXXXX
- SO: SXXXXXXXX Q1
- SN: YYWWSSSSSS WK: WWYY

*The officially required information is located on the approval label. The identification label is an accessory label which shows the information necessary for the identification and characterisation of the inverter by ABB.*

## Communication identification label



The diagram shows a rounded rectangular label with the following text:

SN: 1737123456  
 MAC: 0013A20040982CA8  
 PK: 4311-0656-0188-0775

An additional label containing the communication identification information is applied on the inverter.

The label displays the following information:

SN: Wireless Serial Number

MAC: Wireless MAC Address

- Included in the SSID of the wireless access point created by the inverter: ABB-XX-XX-XX-XX-XX-XX (where "X" is an hexadecimal character of the MAC Address).

- To use to obtain the "Host Name" <http://ABB-XX-XX-XX-XX-XX-XX.local> (where "X" is an hexadecimal character of the MAC Address).

- The MAC Address is the only piece of information required to register the inverter on the Aurora Vision Portal.

PK: Product Key

Used as password to access the access point or used as username and password in case of loss of the access credentials for the inverter's internal Webserver.

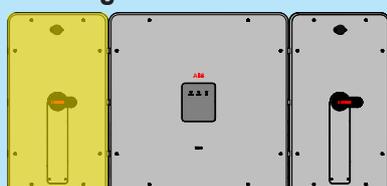
## Inverter models

The inverter model must be chosen by a qualified site designer who knows the site conditions, the devices that will be installed outside the inverter and possible integration with an existing system.

Each of the four items listed below must be specified when ordering a TRIO 60kW inverter. The power module is the same for all configurations. Select the other components depending on desired features.



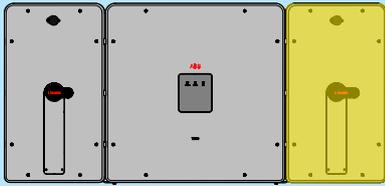
### DC Wiring Box Model Number



### Description

DC Wiring Box Model Number	Description
DCWB-1-TRIO-TM-60.0-US-480	<ul style="list-style-type: none"> <li>- DC terminal block for use with external combiner</li> <li>- DC disconnect switch</li> <li>- Conduit entry</li> <li>- Internal ethernet connection</li> <li>- 1 input channel (MPPT)</li> </ul>
DCWB-2-TRIO-TM-60.0-US-480/15	<ul style="list-style-type: none"> <li>- Input connection on the touch-safe fuse holder (15 strings - 5 pairs for each MPPT)</li> <li>- Positive and negative string fuses</li> <li>- DC disconnect switch</li> <li>- AFCI</li> <li>- DC SPD type II</li> <li>- Conduit entry</li> <li>- Internal ethernet connection</li> <li>- 3 input channels (MPPT)</li> </ul>
DCWB-3-TRIO-TM-60.0-US-480/15	<ul style="list-style-type: none"> <li>- 15 quick Input connections (5 pairs for each MPPT)</li> <li>- Positive and negative string fuses</li> <li>- DC disconnect switch</li> <li>- AFCI</li> <li>- DC SPD type II</li> <li>- External ethernet connection</li> <li>- 3 input channels (MPPT)</li> </ul>

**AC Wiring Box Model Number**



**Description**

ACWB-TRIO-TM-60.0-US-480

- AC terminal block
- Conduit entry



ACWB-A-TRIO-TM-60.0-US-480

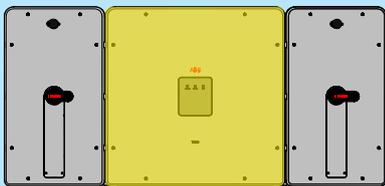
- AC terminal block
- AC SPD type II
- Conduit entry

ACWB-B-TRIO-TM-60.0-US-480

- AC terminal block
- AC disconnect switch
- AC SPD type II
- Conduit entry

All DCWB models can optionally be equipped with power supply for RSD

**Power module Model Number**



**Description**

TRIO-TM-60.0-US-480 power module

Inverter section / power module

**Bracket Model Number**

**Description**

WALL MOUNTING BRACKET;TRIO-50/60-US

Wall mounting bracket; 90 to 16 degrees from horizontal

HORIZONTAL MOUNTING BRACKET;TRIO50/60-US

Mounting bracket; 15 to 0 degrees horizontal

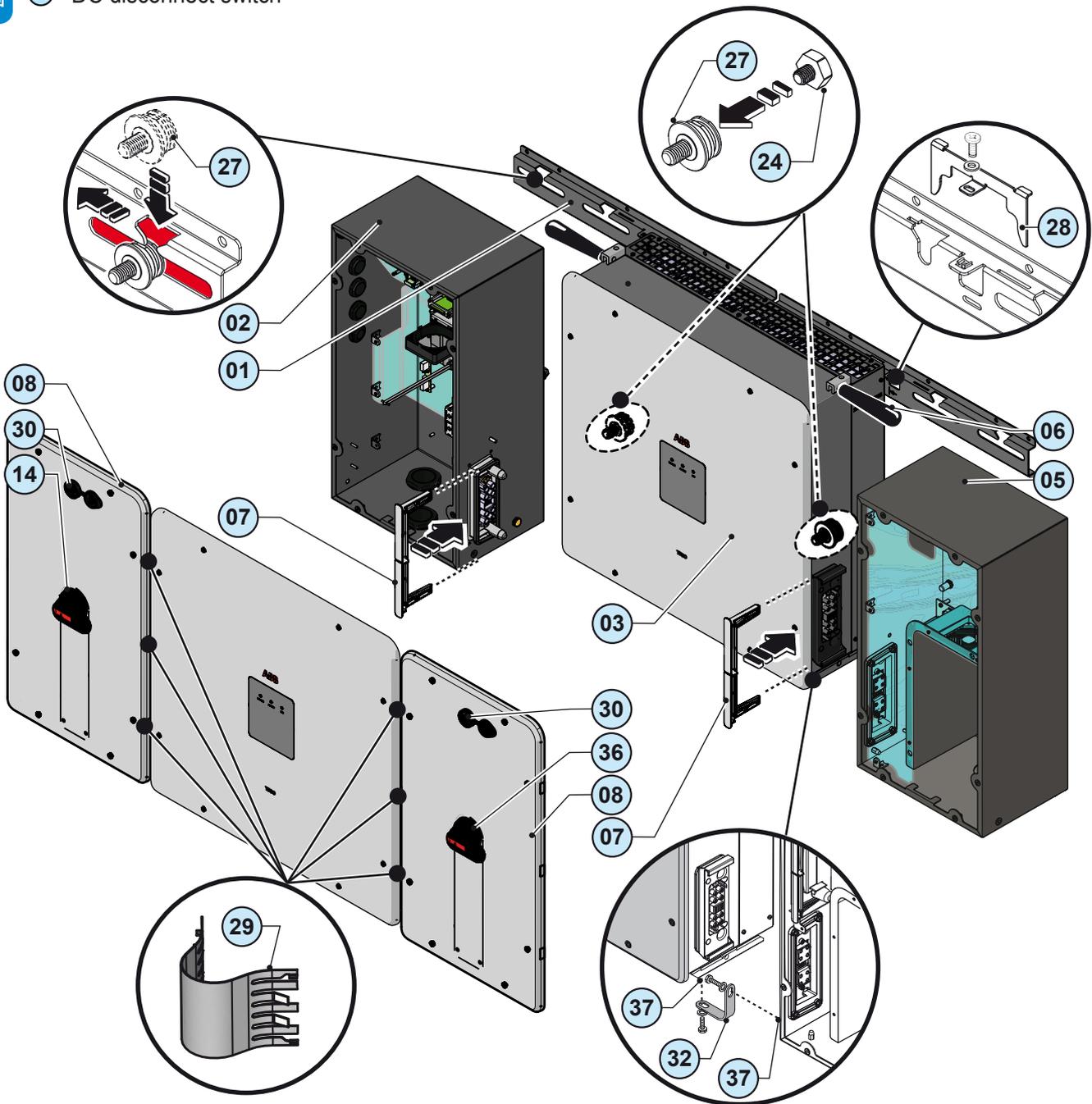
## Component reference designators

- ① Mounting bracket
- ② DC wiring box
- ③ Power module
- ④ Quick disconnect connector cover
- ⑤ AC wiring box
- ⑥ Handles (sold separately)
- ⑦ Metal locking fork
- ⑧ Front cover
- ⑨ Communication and control board
- ⑩ Positive (+) side string fuses
- ⑪ Ground cable attachment points
- ⑫ AC filter board
- ⑬ DC input terminal block
- ⑭ DC disconnect switch
- ⑮ DC surge protection device
- ⑰ AC output terminal block
- ⑱ AC surge protection device
- ⑲ 2" DC conduit opening
- ⑳ Protective Earth (PE) connection point
- ㉑ Anti-condensation valve
- ㉒ Negative (-) side string fuses
- ㉓ Quick disconnect connectors
- ㉔ Spacers for vertical installation
- ㉖ Heatsink
- ㉗ Rear pins attached to inverter back side
- ㉘ Stabilization fork
- ㉙ Conducting springs
- ⑳ Key lock
- ㉓ Ground brackets
- ㉔ WiFi antenna connector
- ㉕ Signal conduit opening for 3/4" (PG21 size)
- ㉖ AFD reset button
- ㉗ AC disconnect switch
- ㉘ Ground bracket attachment points
- ㉙ 2" AC conduit opening
- ㉚ EGC(Equipment Grounding Conductor) terminal block
- ㉛ Plastic locking fork
- ㉜ Ground cable
- ㉝ Cooling section
- ㉞ WiFi antenna
- ㉟ Signal conduit opening for 1/2" (PG13.5 size)
- ㊱ parallel MPPT connection points
- ㊲ input connectors MPPT1
- ㊳ input connectors MPPT2
- ㊴ input connectors MPPT3
- ㊵ external ethernet connector (RJ45)
- ㊶ Signal cable gland (PG21 size)
- ㊷ EGC cable gland (PG21 size)
- ㊸ External ground cable attachment points
- ㊹ EGC conduit opening for 3/4" (PG21 size)
- ㊺ Plastic protection



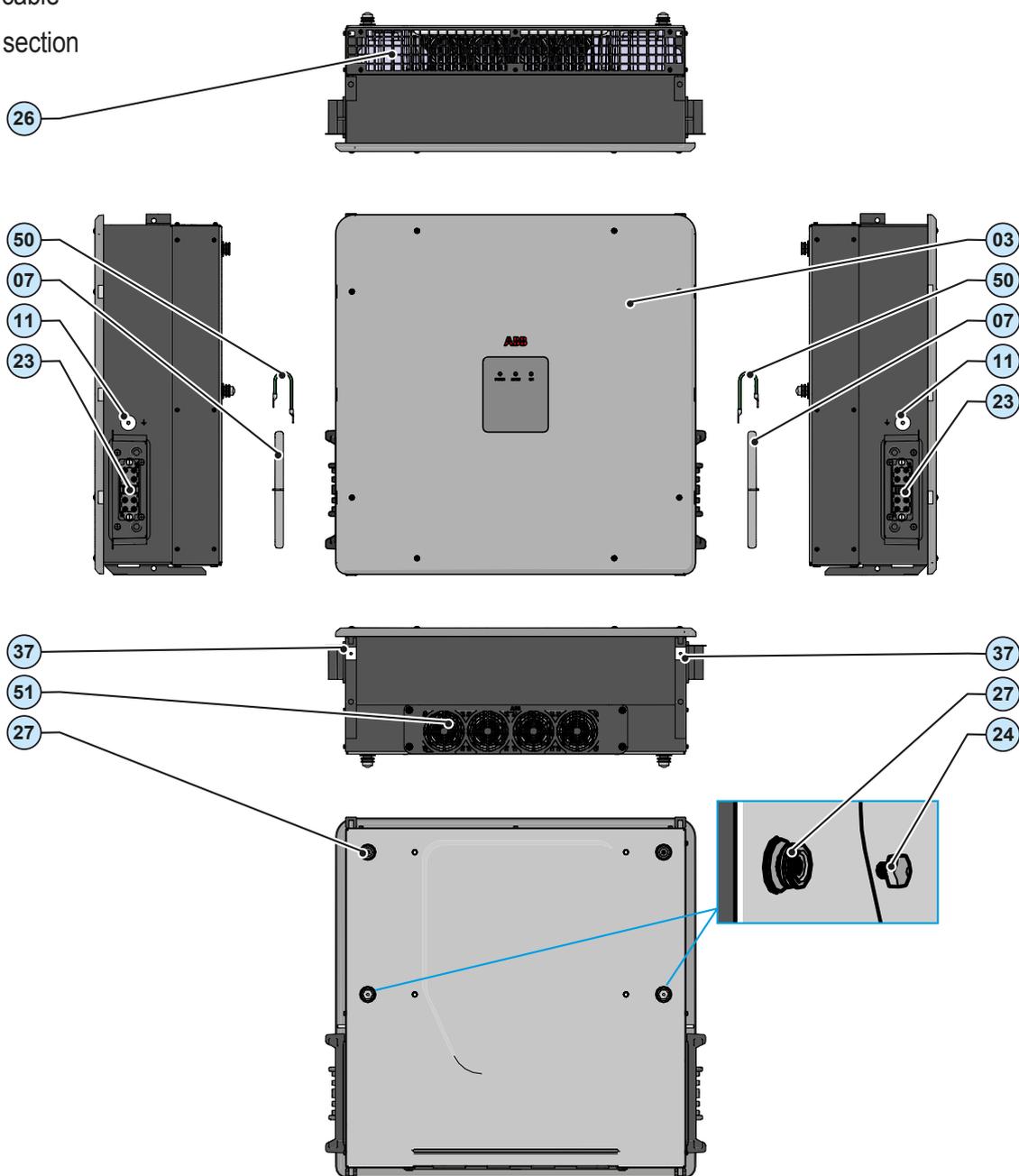
# Inverter

- 01 Mounting bracket
- 02 DC wiring box
- 03 Power module
- 05 AC wiring box
- 06 Handles (sold separately)
- 07 Metal locking fork
- 08 Front cover
- 14 DC disconnect switch
- 27 Rear pins attached to inverter back side
- 28 Stabilization fork
- 29 Conducting springs
- 30 Key lock
- 32 Ground brackets
- 36 AC disconnect switch
- 37 Ground bracket attachment points



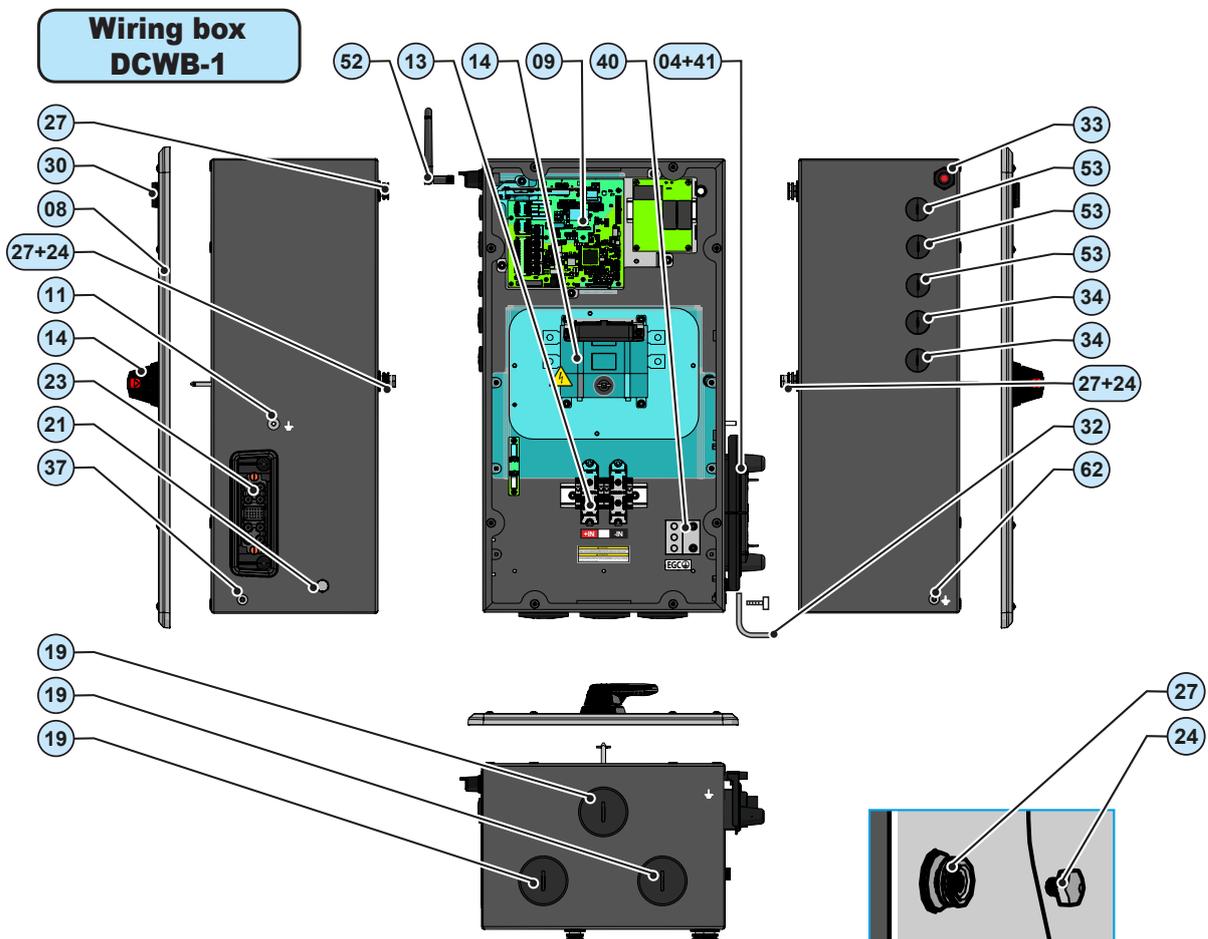
# Power module

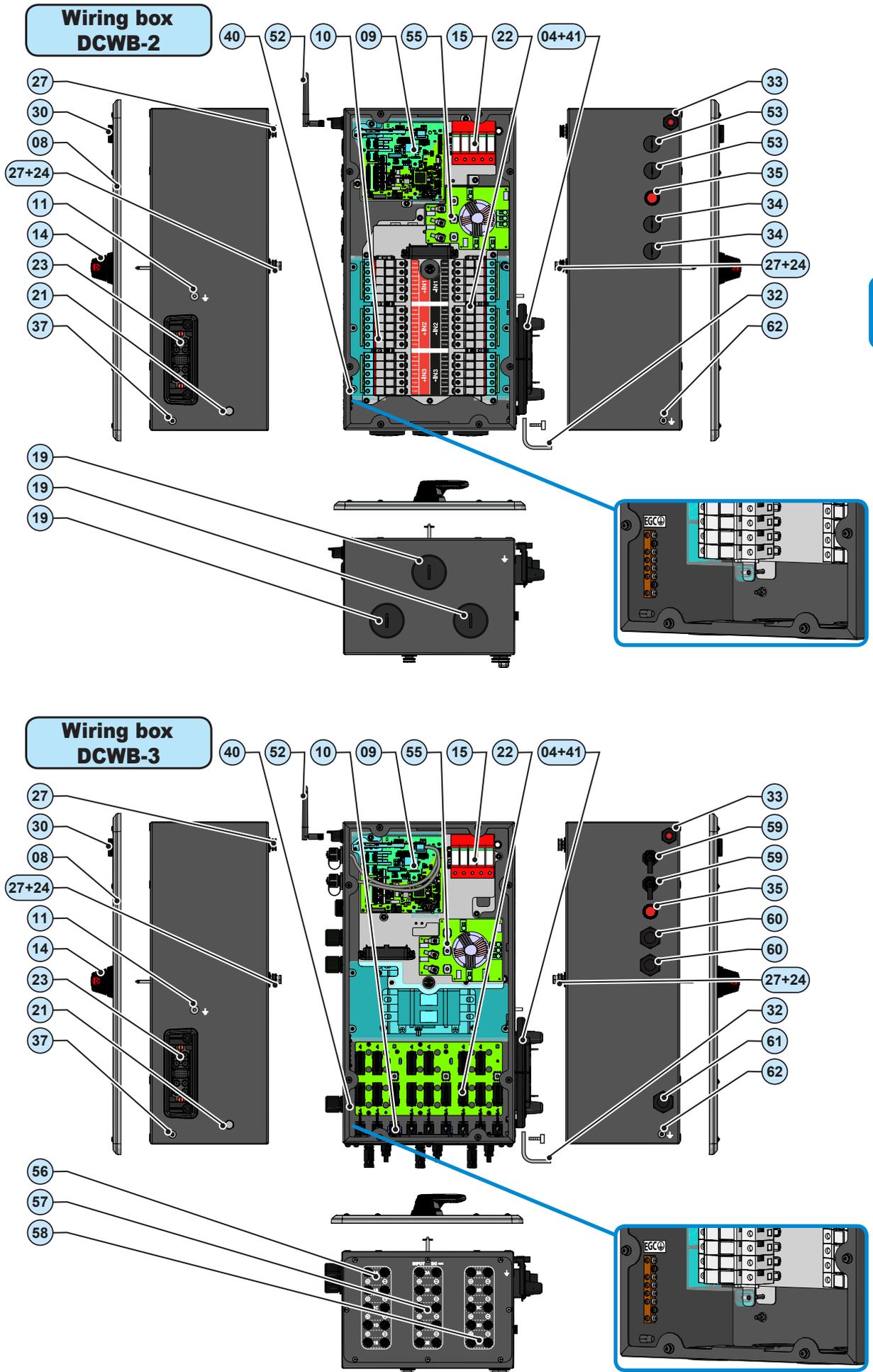
- ③ Power module
- ⑦ Metal locking fork
- ⑪ Ground cable attachment points
- ⑲ Quick disconnect connectors
- ⑳ Spacers for vertical installation
- ㉔ Heatsink
- ㉗ Rear pins attached to inverter back side
- ㉛ AC disconnect switch
- ㉟ Ground bracket attachment points
- ㉚ Ground cable
- ㉝ Cooling section



## DC wiring box

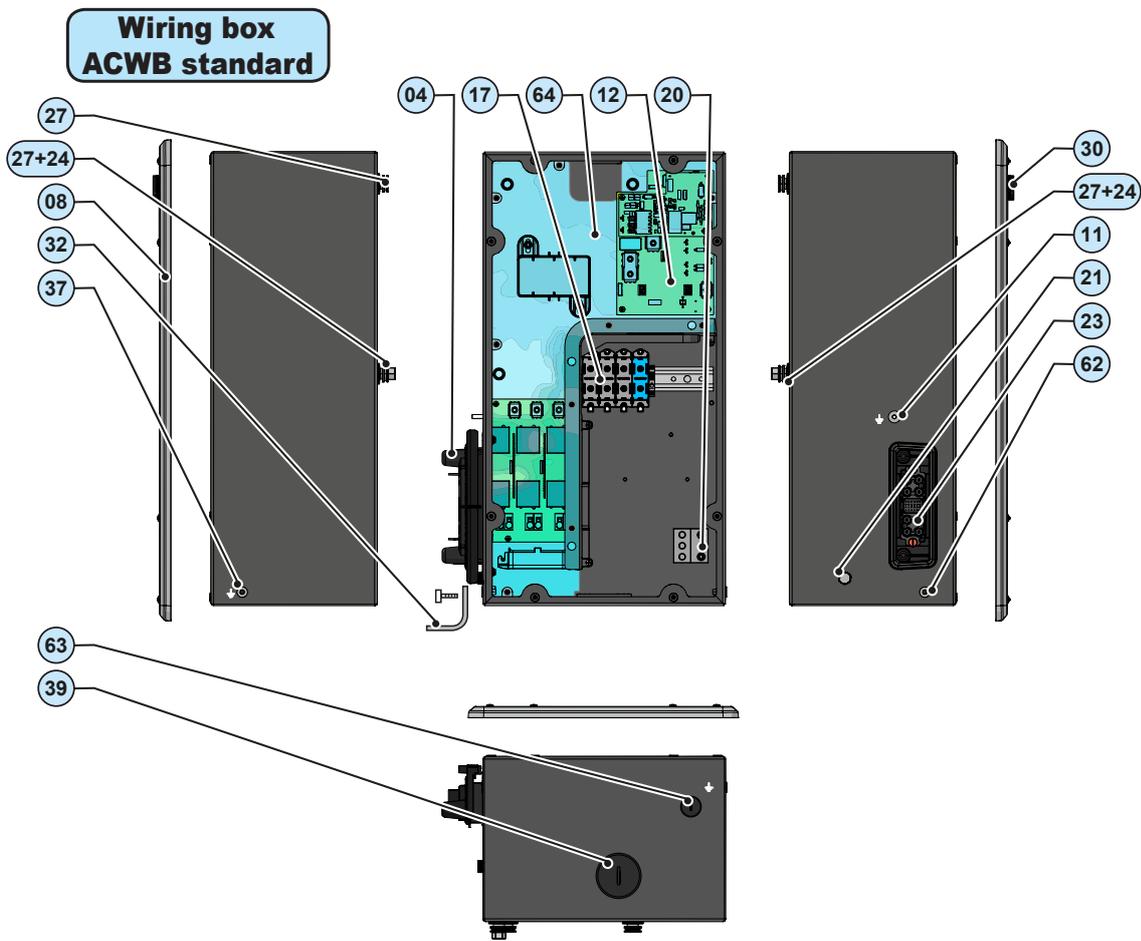
- 04 Quick disconnect connector cover
- 08 Front cover
- 09 Communication and control board
- 10 Positive (+) side string fuses
- 11 Ground cable attachment points
- 13 DC input terminal block
- 14 DC disconnect switch
- 15 DC surge protection device
- 19 DC conduit opening 2"
- 21 Anti-condensation valve
- 22 Negative (-) side string fuses
- 23 Quick disconnect connectors
- 24 Spacers for vertical installation
- 27 Rear pins attached to inverter back side
- 30 Key lock
- 32 Ground brackets
- 33 WiFi antenna connector
- 34 Signal conduit opening for 3/4" (PG21 size)
- 35 AFD reset button
- 37 Ground bracket attachment points
- 40 EGC(Equipment Grounding Conductor) terminal block
- 41 Plastic locking fork
- 52 WiFi antenna
- 53 Signal conduit opening for 1/2" (PG13.5 size)
- 55 parallel MPPT connection points
- 56 input connectors MPPT1
- 57 input connectors MPPT2
- 58 input connectors MPPT3
- 59 external ethernet connector (RJ45)
- 60 Signal cable gland (PG21 size)
- 61 EGC cable gland (PG21 size)
- 62 External ground cable attachment points

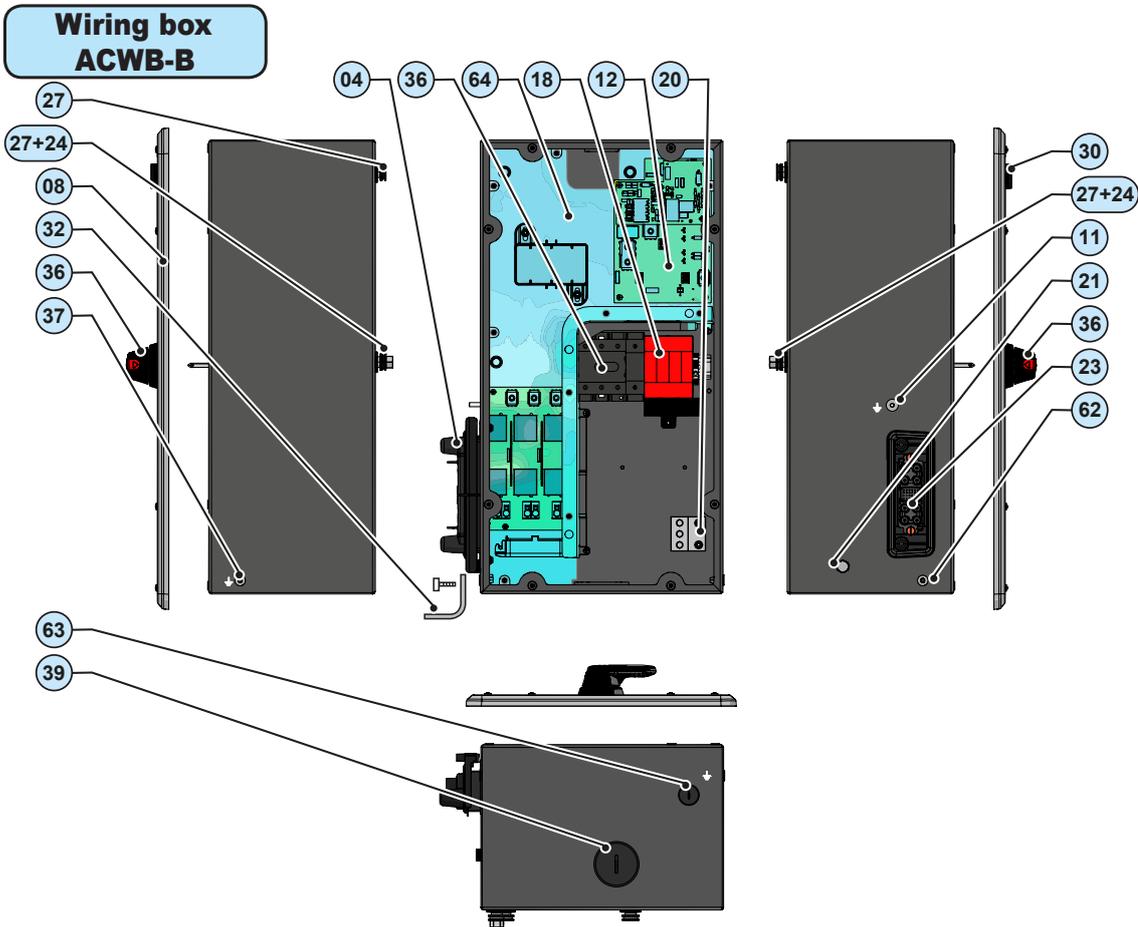
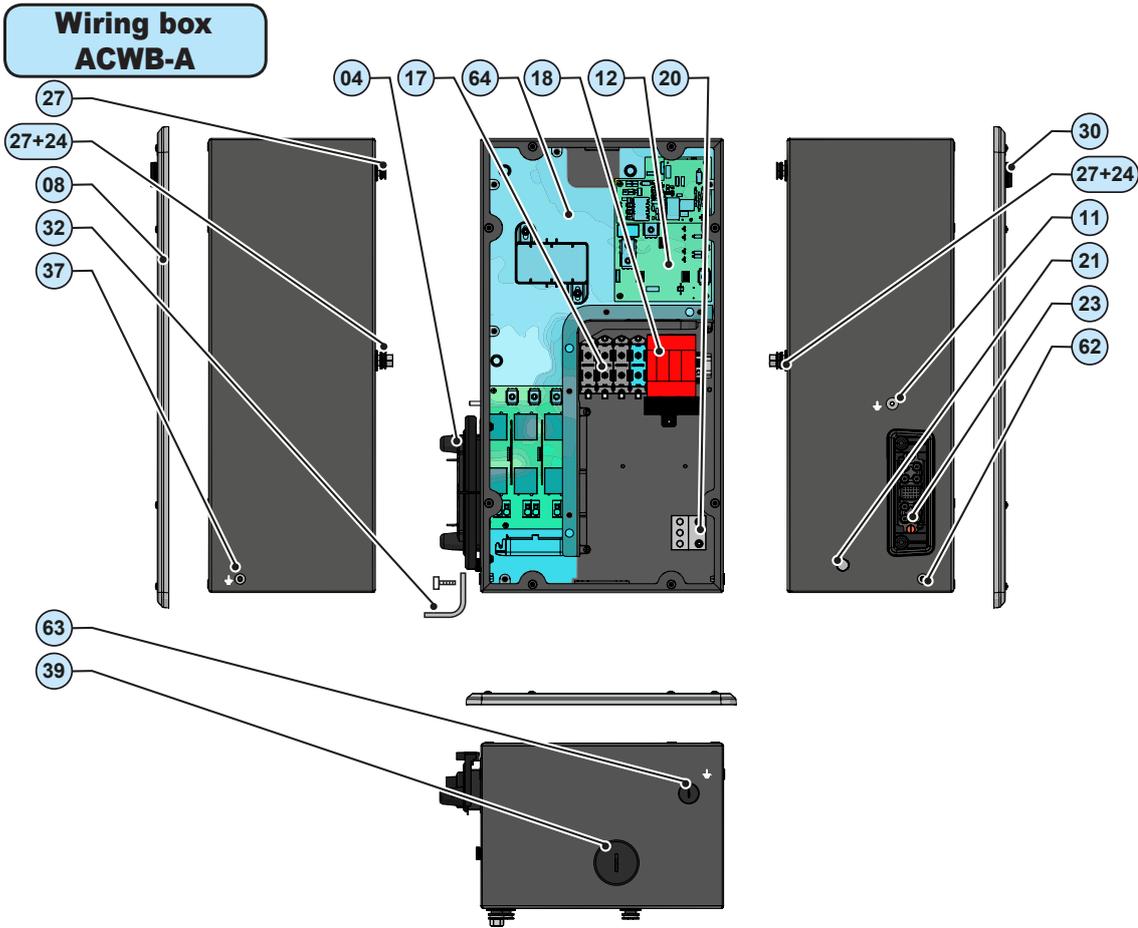




## AC wiring box

- 04 Quick disconnect connector cover
- 08 Front cover
- 11 Ground cable attachment points
- 12 AC filter board
- 17 AC output terminal block
- 18 AC surge protection device
- 21 Anti-condensation valve
- 23 Quick disconnect connectors
- 24 Spacers for vertical installation
- 27 Rear pins attached to inverter back side
- 30 Key lock
- 32 Ground brackets
- 36 AC disconnect switch
- 37 Ground bracket attachment points
- 39 AC conduit opening 2"
- 40 EGC(Equipment Grounding Conductor) terminal block
- 62 External ground cable attachment points
- 63 EGC conduit opening for 3/4" (PG21 size)
- 64 Plastic protection





## Principal wiring box components



**AC line disconnect switch <sup>(36)</sup>**  
**TRIO-TM-60.0 wiring box ACWB-B**  
 Model: OT100F4N2 or equivalent

**AC disconnect switch**

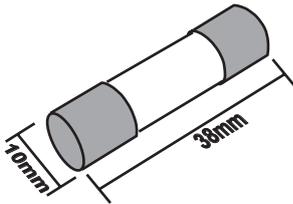
Voltage	Utilisation category	Current
500Vac	AC22A	100A



**DC line disconnect switch <sup>(14)</sup>**  
**TRIO-TM-60.0 wiring box DCWB-1 / DCWB-2 / DCWB-3**  
 Model: OTDC180U22 or equivalent

**DC disconnect switch**

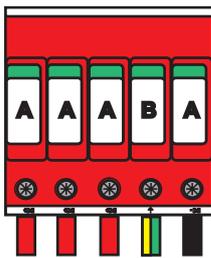
Voltage	Utilisation category	Current
1000Vdc	UL98B	180A (60A for each pole)



**String fuses <sup>(22)</sup>**  
**TRIO-TM-60.0 wiring box DCWB-2 / DCWB-3**

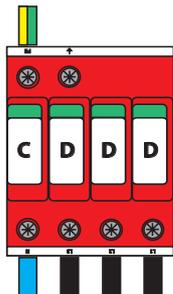
The standard string protection fuses installed on the inverter have the following features:

Voltage	Rating	Type
1000Vdc	15 A (Max. Rating 20A)	gPV



**DC overvoltage surge arresters <sup>(15)</sup> class 2**  
**TRIO-TM-60.0 per wiring box DCWB-2 / DCWB-3**

The DC overvoltage surge arresters installed in this wiring box model are of the Dehn DG M PV2 SCI SN1868FM (5 cartridges) type. The surge arresters consist of interchangeable cartridges type DG MOD PV SCI 500 (A) and DG MOD PV 500 (B).



**AC overvoltage surge arresters <sup>(18)</sup> class 2**  
**TRIO-TM-60.0 wiring box ACWB-A / ACWB-B**

The AC surge arresters installed are type Dehn DG MU 3PY 480 4W+G R - 908 346 (or equivalent), composed of four interchangeable cartridges, type DG PLU 385 (D) and DG PLU 180 (C).



*In the event of damage to the surge arresters caused by atmospheric agents, spare part kits are available.*

# Characteristics and technical data



Table: Technical Data		TRIO-TM-60.0-US-480
<b>Input</b>		
Absolute Maximum DC Input Voltage (V <sub>max,abs</sub> )	1000 V	
Start-up DC input voltage (V <sub>start</sub> )	420...700 Vdc (Default 500 V)	
Operating DC input voltage range (V <sub>dcmín...Vdcmax</sub> )	0.7xV <sub>start</sub> ...950 Vdc (min 360 V)	
Rated DC Input Voltage (V <sub>dc,r</sub> )	720 Vdc	
Rated DC input power (P <sub>dc,r</sub> )	61800 W	
Number of Independent MPPT	3 (DCWB-2 and DCWB-3 versions) / 1 (DCWB-1 version)	
Maximum DC input power for each MPPT (P <sub>MPPT,max</sub> )	21000 W	
MPPT input DC voltage range (V <sub>MPPTmin</sub> ... V <sub>MPPTmax</sub> ) at P <sub>ac,r</sub>	570...800 Vdc	
Maximum DC Input Current (I <sub>dcmax</sub> ) for each MPPT	36 A	
Maximum input short circuit current for each MPPT (I <sub>scmax</sub> )	55 A (165A in case of parallel MPPT)	
Number of DC inputs pairs for each MPPT	5 (DCWB-2 and DCWB-3 versions)	
DC connection type	Input lugs (DCWB-1), Conduit entry (DCWB-2) and PV quick fit connector <sup>(3)</sup> (DCWB-3)	
<b>Input protection</b>		
Reverse polarity protection	Yes, from limited current source	
Input over voltage protection for each MPPT - varistor	Yes, 1 for each MPPT	
Input over voltage protection for each MPPT - plug In modular surge arrester	Type II (on DCWB-2 or DCWB-3 only)	
Photovoltaic array isolation control	According to US standard	
DC switch rating for each MPPT (version with DC switch)	1000 V / 60 A for each MPPT (180 A in case of parallel MPPT)	
Fuse rating (version with fuses)	15A (gPV / 1000Vdc) <sup>(4)</sup>	
<b>Output</b>		
AC grid connection type	3Ø grounded WYE system only, 3W + GND (no N connection) or 4W + GND (with N connection)	
Rated AC power (P <sub>acr @cosφ=1</sub> )	60000 W	
Maximum AC output power (P <sub>acmax @cosφ=1</sub> )	60000 W	
Maximum apparent power (S <sub>max</sub> )	60000 VA	
Rated AC grid voltage (V <sub>ac,r</sub> )	480 Vac	
AC voltage range (V <sub>acmin</sub> ...V <sub>acmin</sub> )	422...528 V Vac <sup>(1)</sup>	
Maximum AC output current (I <sub>ac,max</sub> )	77 A	
Contributory fault current	92 A	
Rated Output Frequency (fr)	60 Hz	
Output Frequency Range (f <sub>min</sub> ...f <sub>max</sub> )	57...63 Hz <sup>(2)</sup>	
Nominal power factor and adjustable range	> 0.995, 0...1 inductive/capacitive with maximum S <sub>max</sub>	
Total current harmonic distortion	<3%	
Maximum AC cable	AWG 3/0 without AC Switch, AWG 1/0 with AC Switch (ACWB -B)	
AC Connections Type	Screw terminal block, Conduit entry	
<b>Output protection</b>		
Anti-islanding Protection	According to US standard	
Maximum external AC overcurrent protection	100 A	
Output overvoltage protection - Varistors	Yes	
Output overvoltage protection - plug In modular surge arrester	Type II (ACWB -A and ACWB -B)	
<b>Operating performance</b>		
Maximum efficiency (η <sub>max</sub> )	> 98.0%	
Weighted efficiency (EURO)	> 98.0%	

Table: Technical Data

TRIO-TM-60.0-US-480

<b>Communication</b>	
Embedded communication interfaces	2x RS485, 2x Ethernet (RJ45), WLAN (IEEE802.11 b/g/n @ 2.4 GHz)
Communication protocol	Modbus RTU / TCP (Sunspec compliant); Aurora Protocol
Remote monitoring services	Standard Level access to Aurora Vision monitoring Cloud
Advanced features	Integrated Web User Interface; Embedded logging and direct transferring of data to Cloud
<b>Environmental</b>	
Ambient temperature range	-25...+60°C / -13...+140°F with derating over +45°C / +113°F
Storage temperature	-40°C...+85°C / -40°F...+185°F
Relative Humidity	4...100 % with condensation
Sound pressure level, typical	75 dB(A) @ 1 m
Maximum operating altitude	2000 m / 6561 ft
Environmental class	Outdoor
<b>Physical</b>	
Environmental Protection Rating	Certified to NEMA 4X (NEMA 3R for fan tray)
Cooling System	Forced air through external heatsink
Dimensions (H x W x D)	725 mm x 1491 mm x 315 mm / 28.5" x 58.7" x 12.4"
Weight	95 kg / 209 lb total
	66 kg / 145 lb power module
	15 kg / 33 lb for AC wiring box (full options) 14 kg / 31lb for DC wiring box (full options)
Assembly System	Wall bracket or horizontal support
<b>Safety</b>	
Safety class	I
Isolation Level	Transformerless (TL)
CE Marking	TUV
Safety and EMC Standards	UL 1741, Rule 21, HECO tested per UL 1741 SA, UL1699B, UL 62109-1:2014, UL 50E (Type 4x), IEEE1547, IEEE1547.1, CSA C22.2 107.1-01-2001, CSA TIL M-07, FCC Part 15 Sub-part B Class B Limited

1. The output voltage range may vary according to the grid standard of the country of installation
2. The output frequency range may vary according to the grid standard of the country of installation
3. Please refer to the document "String inverters – Product manual appendix" available at [www.abb.com/solarinverters](http://www.abb.com/solarinverters) for information on the quick-fit connector brand and model used in the inverter.
4. Maximum installable size 20A

**Note. Features not specifically mentioned in this data sheet are not included in the product**

## Tightening torques

To maintain the NEMA 4X protection rating of the system and for correct installation, the following torques must be used:

DC Wiring box <sup>02</sup>	N-m	ft-lb
Wiring boxes front cover <sup>08</sup>	2.4 N-m	1.8 ft-lb
DC input terminal block <sup>13</sup> 3/0 AWG (DCWB-1 model)	20 N-m	14.7 ft-lb
Mounting screws for ground brackets <sup>32</sup>	11N-m	8.0 ft-lb
Signal terminal block (26...15AWG)	0.25 N-m	0.18 ft-lb
External ethernet connector counterpart - fastening ring nut (DCWB-3 model)	1.2 N-m	0.9 ft-lb
External ethernet connector counterpart - holding ring nut (DCWB-3 model)	1.0 N-m	0.7 ft-lb
Signal cable gland (PG21 size) <sup>60</sup> (DCWB-3 model)	5.0 N-m	3.7 ft-lb
EGC cable gland (PG21 size) <sup>61</sup> (DCWB-3 model)	5.0 N-m	3.7 ft-lb
Parallel MPPT connection points <sup>55</sup>	4.0 N-m	3.0 ft-lb

Power module <sup>03</sup>	N-m	ft-lb
Mounting screws for ground brackets <sup>32</sup>	11N-m	8.0 ft-lb

AC Wiring box <sup>05</sup>	N-m	ft-lb
Front cover <sup>08</sup>	2.4 N-m	1.8 ft-lb
AC output terminal block <sup>17</sup> 3/0 AWG (ACWB Standard and ACWB-A version)	20 N-m	14.7 ft-lb
AC disconnect switch <sup>36</sup> 1/0 AWG (ACWB-B version)	6 N-m	4.4 ft-lb
Mounting screws for ground brackets <sup>32</sup>	11 N-m	8.0 ft-lb

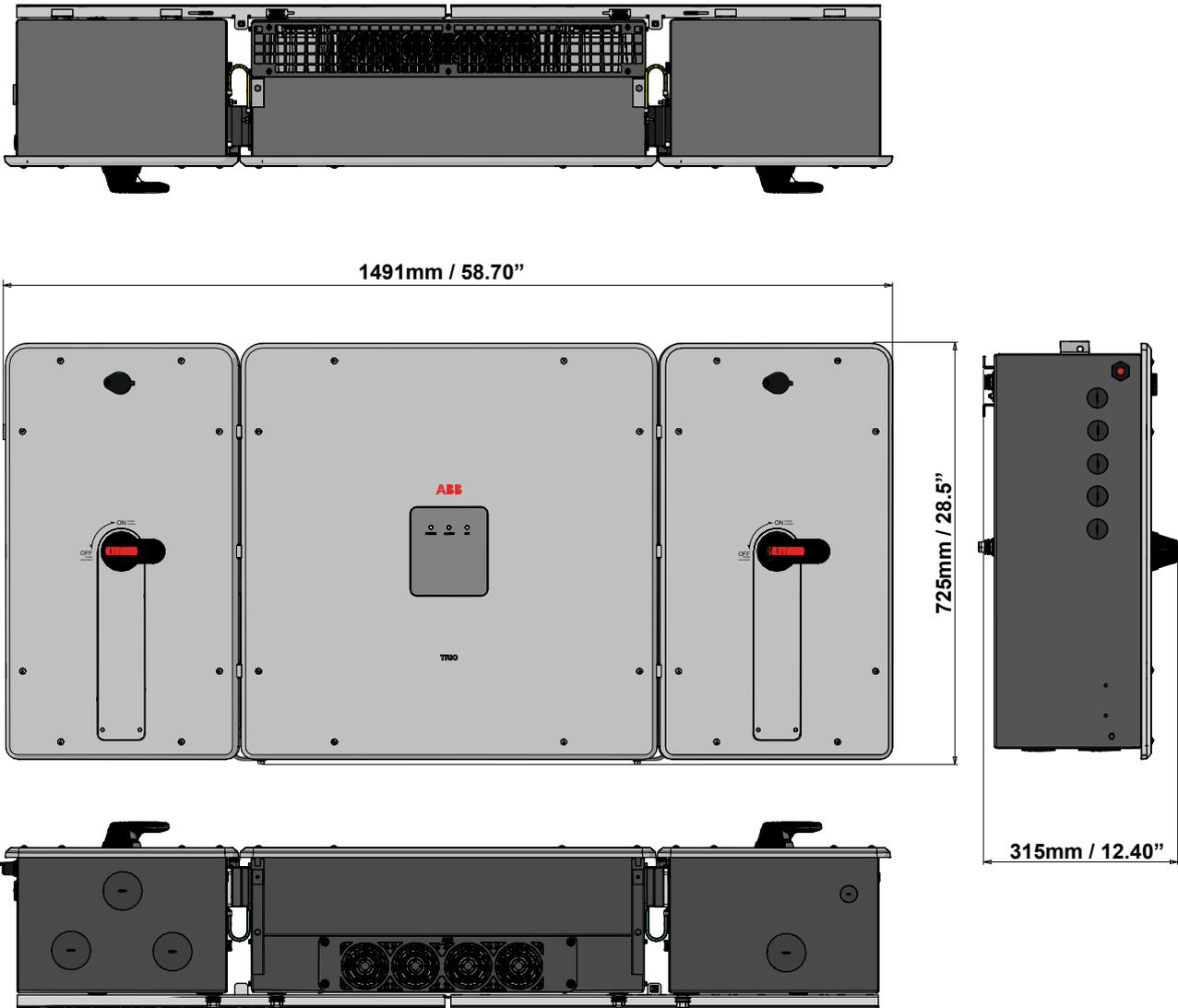
## Cable gland clamping range and conduit openings diameter

DC Wiring box <sup>02</sup>	N-m	ft-lb
Signal conduit opening for 1/2" <sup>53</sup> (DCWB-1 and DCWB-2 models)	21mm	0.82"
Signal conduit opening for 3/4" <sup>34</sup> (DCWB-1 and DCWB-2 models)	28.5mm	1.11"
DC conduit opening 2" <sup>19</sup> (DCWB-1 and DCWB-2 models)	61mm	2.4"
Signal cable gland (PG21 size) <sup>60</sup> (DCWB-3 model)	13...18mm	0.51...0.7"
EGC cable gland (PG21 size) <sup>61</sup> (DCWB-3 model)	13...18mm	0.51...0.7"

AC Wiring box <sup>05</sup>	N-m	ft-lb
EGC conduit opening for 3/4" (PG21 size) <sup>63</sup>	28.5mm	1.11"
AC conduit opening 2" <sup>39</sup>	61mm	2.4"

# Overall dimensions

The overall dimensions include the vertical or horizontal wall installation bracket and are expressed in millimetres and inches.





## Characteristics of a photovoltaic generator

A PV electric system consists of an assembly of photovoltaic modules that transform solar radiation into DC electrical energy and can be made up of:

**Strings:** number (X) of PV modules connected in series

**Array:** group of X strings connected in parallel



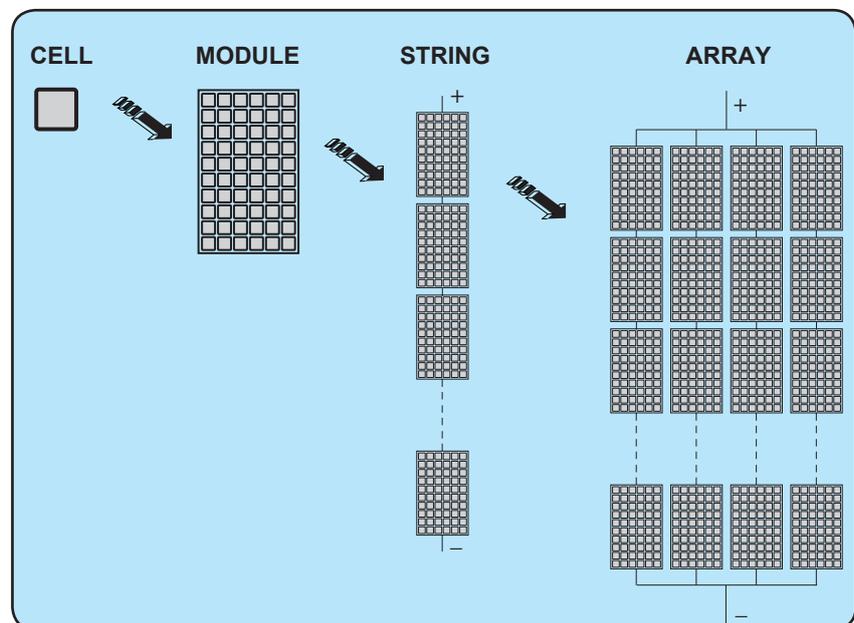
### Strings and arrays

The string technology was developed to significantly reduce the installation costs of a photovoltaic system, mainly associated to wiring on the DC side of the inverter and subsequent distribution on the AC side. A photovoltaic module consists of many photovoltaic cells mounted on the same support.

- A string consists of a certain number of module connected in series.
- An array consists of two or more strings connected in parallel.

Large photovoltaic systems can include multiple arrays connected to one or more inverters.

The greater the number of panels in each string, the lower the cost and the less complex the wiring connections of the system.



## Description of the equipment

This equipment is a string inverter which converts the direct current of a photovoltaic generator into alternating current and feeds it into the public distribution grid.

Photovoltaic panels convert solar radiation into "DC" electrical energy; in order to use it, it is transformed into "AC" alternate current. This conversion, known as inversion from DC to AC, is done in an efficient way by the ABB inverters, without using any rotary elements, rather only via static electronic systems.

In order to allow inverter operation in safe thermal and electrical conditions, the unit automatically reduces the value of the power fed into the grid under adverse environmental conditions or unsuitable input voltage values.

When connected in parallel with the grid, the alternating current from the inverter flows directly into the domestic or industrial distribution circuit, which is in turn connected to the public distribution grid.

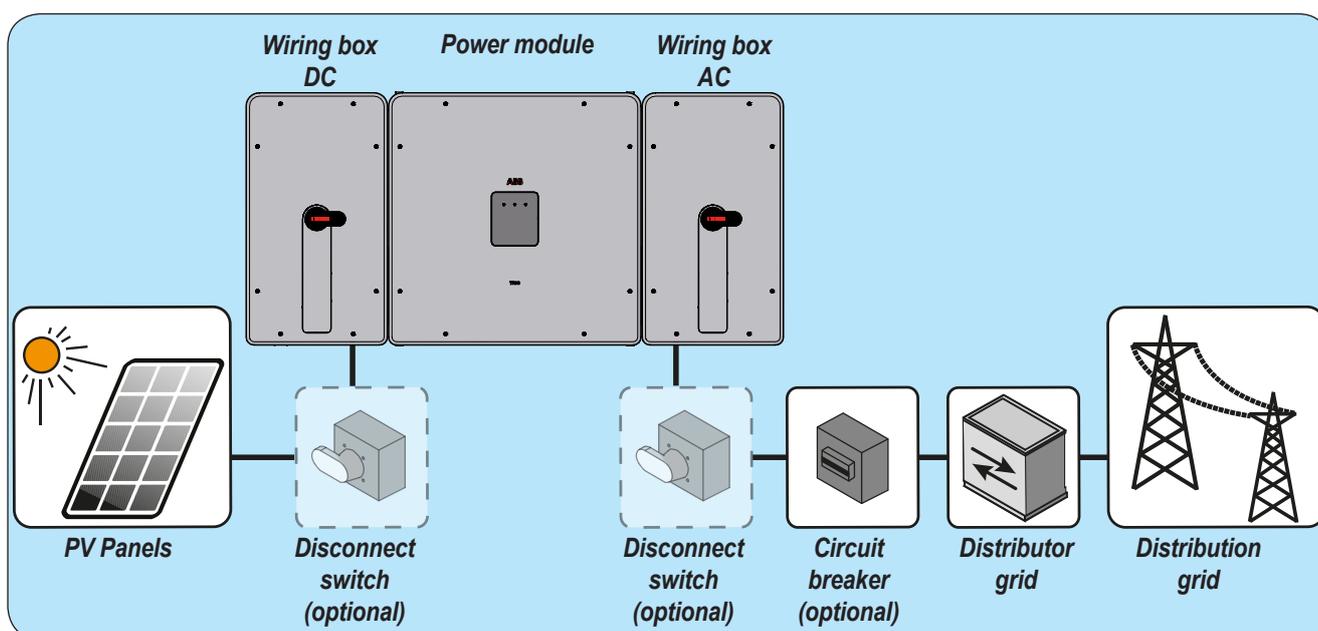
This way the solar energy system compensates for the energy drawn from the utilities connected to the grid to which it is linked.

When the photovoltaic system is not generating sufficient energy, the power required to ensure proper operation of connected loads is taken from the public distribution grid. While if too much energy is produced, it is directly fed to the grid, thus becoming available to other users.

According to national and local standards and regulations the produced energy can be sold to the grid or credited to the user against future consumption, thus granting a great saving of money.



## Operating diagram



## Mutual connection of multiple inverters

If the photovoltaic system exceeds the capacity of a single inverter, it is possible to connect multiple inverters to the system, each of them in turn connected on the DC side to an appropriate section of the photovoltaic generator, and on the AC side to the distribution grid.

Each string inverter will work independently of the others and its own photovoltaic module will supply the maximum power available to the grid.



## Notes on the system sizing

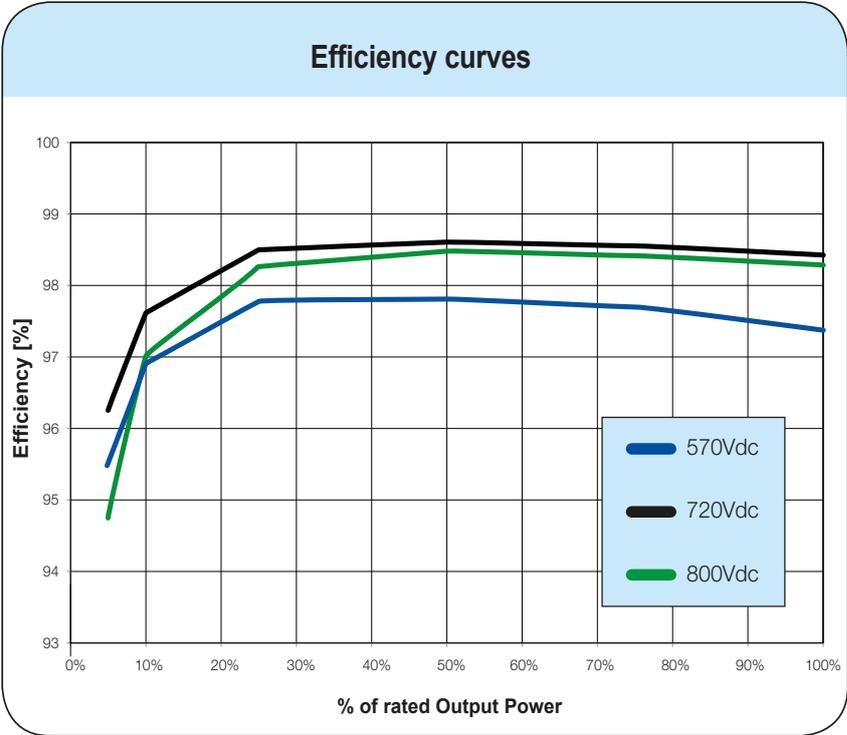
*Decisions on how to structure a photovoltaic system depend on a series of factors and considerations, such as the type of panels, the space availability, the future location of the system, energy production goals over the long term, etc.*

A configuration program that can help to correctly size the photovoltaic system is available on the ABB website (<http://stringsizer.abb.com>).

# Efficiency curves

Graphs of the inverter efficiency for various input voltages are below:

TRIO-TM-60.0-US-480



*The efficiency curves are linked to technical parameters that are continually being developed and improved and should therefore be considered approximate.*

## Automatic power limiting (Power Derating)

When needed, the inverter automatically reduces the power fed to the grid.

Power limiting may occur due to the following:

- Installation site ambient temperature is too hot (thermal derating)
- Output power percentage set by user
- Grid overfrequency (set by user)
- Grid overvoltage  $U > 10\text{min}$  (enabled by user)
- Anti-islanding
- Grid undervoltage
- Input voltage too high
- Input current too high.
- Cease-to-energize region of California Rule 21 reached.

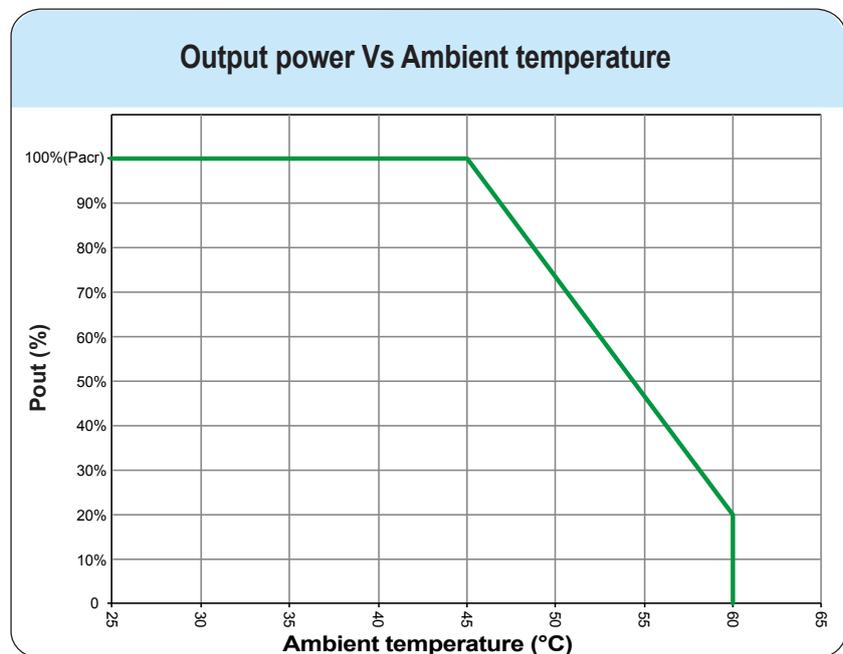


## Power derating due to environmental conditions

The power reduction value and the inverter temperature at which it occurs depend on the ambient temperature and on many operating parameters. Example: input voltage, grid voltage and power available from the photovoltaic field.

The inverter can therefore reduce the power during certain periods of the day according to the value of these parameters.

TRIO-TM-60.0-US-480



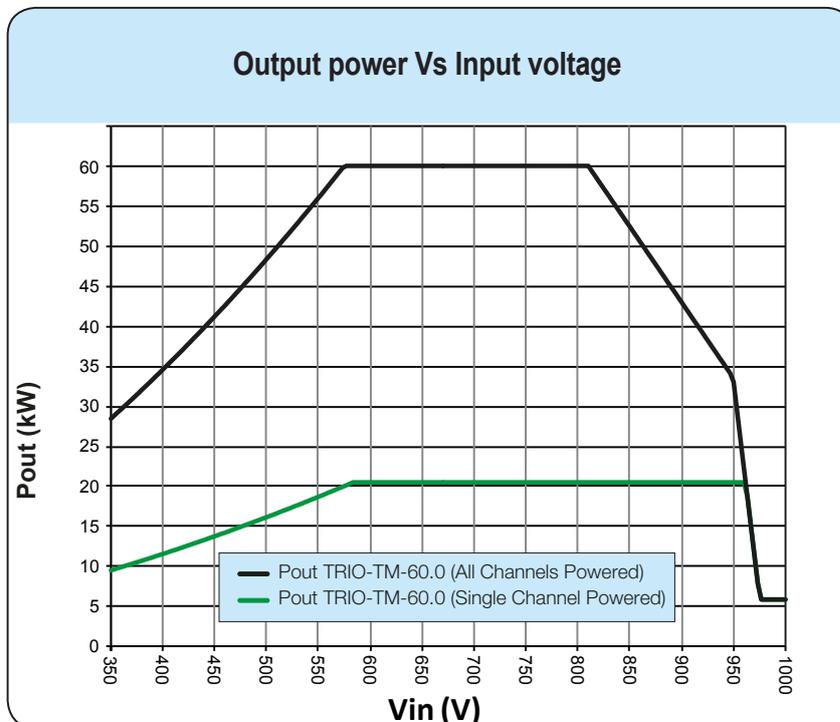
## Power reduction due to the input voltage

The reduction of the power supplied where the DC input voltage values are too high or too low is adjusted automatically.

TRIO-TM-60.0-US-480

\* The curves on the graph, indicate how “All channels powered”, are valid if the input voltages (of each input channel) are balanced.

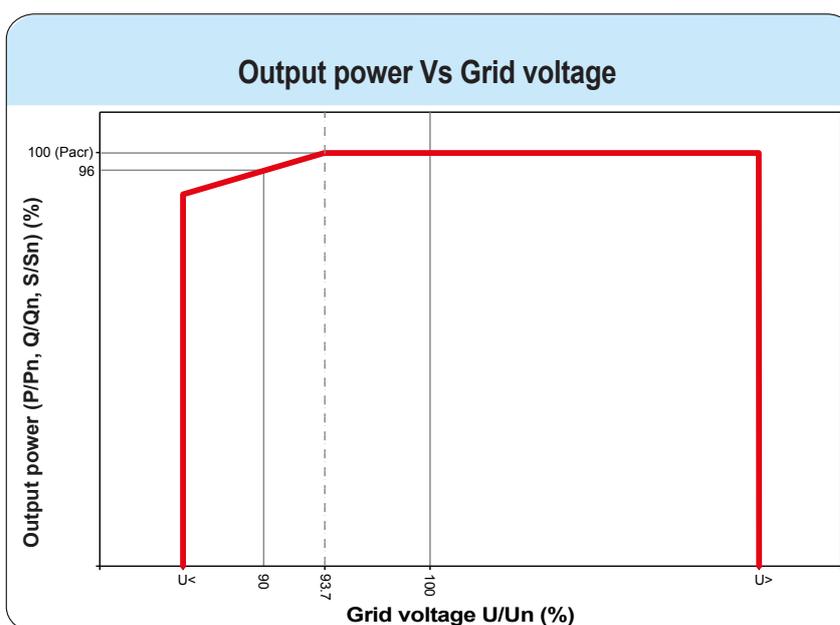
\* The curves on the graph are valid with nominal value of grid voltage.



## Power reduction due to the grid voltage

The reduction of the power supplied where the grid voltage values are too high or too low is adjusted automatically.

TRIO-TM-60.0-US-480



The  $U<$  and  $U>$  values could change based on the grid country standard selection

## P - Q curve capability

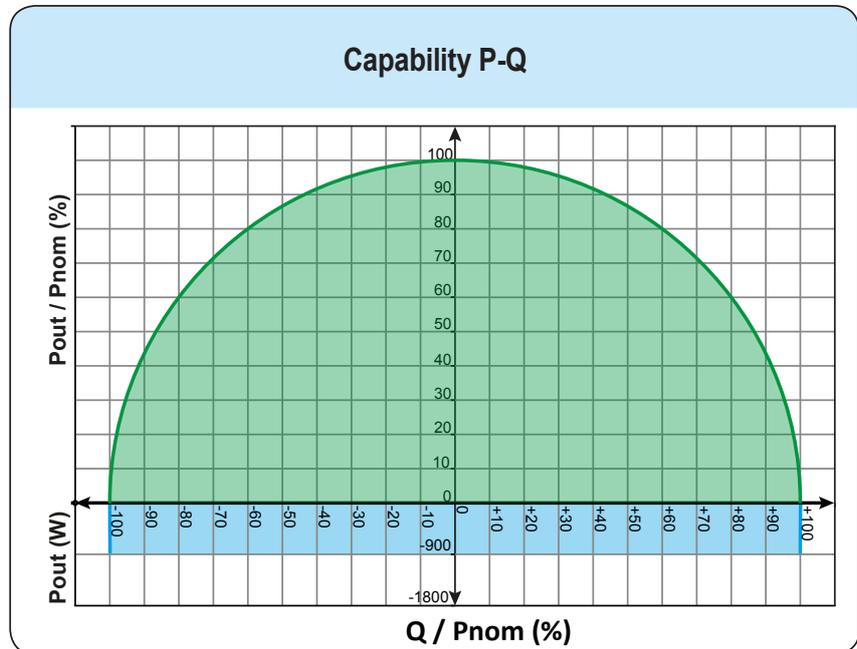
Based on the country grid standard the P-Q capability curve can be reduced.

Conditions:

### TRIO-TM-60.0-US-480

- Ambient temperature 45 °C
- Rated output voltage (Unom) 480Vac
- Rated active power (Pnom) 60kW
- Nominal apparent power (Snom) 60kVA
- Rated reactive power (Qnom) 60kVAR
- Cos -0 ... 1 ... 0 +
- Capability with grid voltage between 0.937xUnom ... 1.1xUnom

TRIO-TM-60.0-US-480



## Functionality and components of the equipment

### Highlights

- 3 Independent MPPT
- Transformerless inverter
- Double stage topology for a wide input range
- Large set of specific grid codes available which can be selected directly in the field
- Both vertical and horizontal installation
- Wireless access to embedded user interfaces
- Ethernet daisy chain enabled
- Modbus TCP/RTU Sunspec compliant
- Remote monitoring and firmware update via Aurora Vision® (logger free)



### Improved commissioning and maintenance

Thanks to the built-in Web User Interface (WUI) the installer can commission the inverter wirelessly and change advanced parameters by using any standard WLAN enabled device (smartphone, tablet or PC).

Integrated logging capability allows remote monitoring of the plant without the need of any additional external loggers.

Remote firmware update of the inverter system and components via Aurora Vision®.

### Data transmission and control

Embedded multi communication interfaces (WLAN, Ethernet, RS485) combined with a Sunspec compliant Modbus protocol (RTU/TCP) allow the inverter to be easily integrated with any third party monitoring and-control systems.



*Please contact the ABB technical support or get access to Sunspec alliance website for getting the Modbus register map supported by the inverter.*

The RS-485 serial interface can be configured to communicate using also the proprietary “Aurora” protocol.

### Aurora Vision® Plant Management Platform

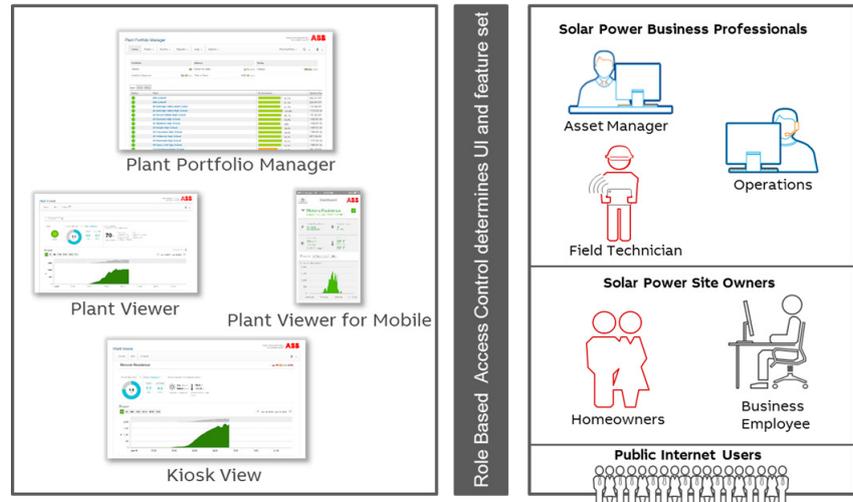
Integrated logging capability allows remote monitoring of the plant without the need of any additional external loggers.

Aurora Vision is a cloud based platform enabling remote monitoring and asset management of ABB devices in range of solar power application.

Aurora Vision consists of a three different product:

1. **Plant Portfolio Manager** is a full featured web based application used by solar power professionals to monitor and manage a portfolio of solar power plants using ABB inverters.
2. **Plant Viewer** is an easy to use web based serviced application used by non-solar power professionals (such as homeowners or small business owners) to monitor solar power plants they own.
3. **Plant Viewer for Mobile** is the mobile version of **Plant Viewer** enabling non-solar power professionals to remotely monitor their own PV plants by using smart phones, tablets and iPod Touch with IOS and Android operating systems.

All three product previously mentioned work together to allow solar power professional and site owners to collaboratively manage solar power plant.



Please contact the ABB technical support for getting your own plant portfolio manager account (mainly for installers and plant administrators). Please get your Plant Viewer and Plant Viewer for Mobile by accessing the website [www.auroravision.net](http://www.auroravision.net) and click on "Register with Plant Viewer" button (mainly for site owners).

## Configurable relay

The inverter is equipped with a configurable switching relay, which can be used in different operating configurations that can be set using the internal webserver. A typical example of application is closing the contact when an alarm is triggered.

## Remote switch-on/switch-off

This command can be used to perform a software switch off/switch on the inverter via an external (remote) command (see chapter 5 and 7 for more details).

The switching on of the inverter, when this functionality is activated, besides being dictated by the presence of normal parameters which allow the inverter to be connected to the grid, also depends on the external control for switching on/off.

## Reactive power feed into the grid

The inverter is able to produce reactive power and can feed this power into the grid via the phase factor setting (see chapter 5 for more details). Power feeding modes vary according to the country of installation and the grid companies.

## Limiting the active power fed into the grid

The inverter can limit the amount of active power fed into the grid by the inverter to the desired and settable value (see chapter 5 for more details).

## Surge protection devices (SPD) status

The inverter monitors the status of the surge protection devices (on models where installed), and generates a warning in the event of a fault.

## Communication interface

The inverter provide the following communication interface:

**- Integrated Wi-Fi channel (IEEE 802.11 b/g/n@2.4GHz)**

The use is recommended to access wirelessly to embedded web server by using any WLAN standard device (PC, tablet, smartphone) for commissioning and parameter setting

**- 2x Ethernet ports (10/100BaseTx - external RJ45 plugs)**

The ports are configured by default for enabling daisy chain connection of the inverters over the Ethernet bus.

In order to improve the reliability of the communication with the inverters it is also allowed to create ring shape layout by using this Ethernet bus

**- 2x RS485 ports (internally located)**

Mainly recommended for replacement of old product or service operations.



## Accessing to web server

The recommended way to access to the inverter web server is the Wi-Fi communication interface.

Any standard WLAN devices with a common browser can be used for this purpose.

- Once powered, the inverter will automatically create a wireless network (approx. 60 seconds after its switch-on) that will be visible as an Access Point from the user devices previously mentioned (tablet, smartphone, etc.).
- Enable the wireless connection on the device which is being used for the board setup (tablet, smartphone or PC) and connect it to the Access Point created by the inverter system: the name of the wireless network created by the system that the connection should be established with, will be: **ABB-XX-XX-XX-XX-XX-XX** where “X” is a hex digit of the wireless MAC address (MAC address can be found on the “Communication Identification Label” placed on the side of the inverter).
- When required type the “product key” (including the dashes. Example: 1234-1234-1234-1234) as the network password to access the inverter’s access point. The product key is printed on the “wireless identification label” on the side of the inverter.

The access to the web server is allowed by user account and admin account (both protected by password) defined during the commissioning procedure.

In order to recover the user/admin password push “forgot password” button and follow the procedure.

## Ethernet bus connection

By default the 2 Ethernet ports of the inverters are already configured for enabling communication over daisy chain layout.

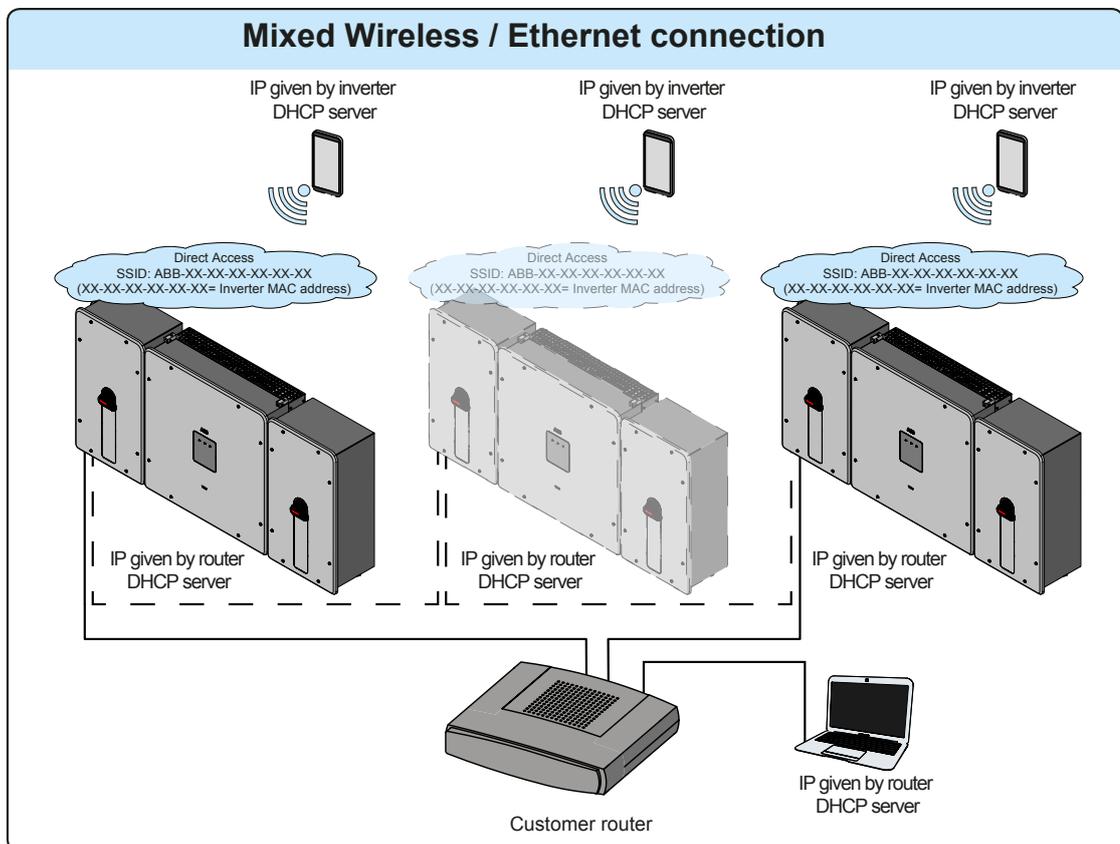
Once physically connected the inverters do not need specific settings: after the first time the inverter is turned on, the inverters automatically get all needed network parameters with or without the presence of DHCP server. If an internet connection is available on site the inverters are automatically configured to transmit telemetry data to Aurora Vision Cloud without the need of installing any additional devices (logging capability are already integrated into the inverter by default).



*Aurora Vision Plant Management platform is the ABB cloud solution allowing customer to remotely monitor and manage its own solar plants. Please refer to <http://new.abb.com/power-converters-inverters/solar> or contact ABB technical support for further information on how getting an Aurora Vision account*

With the inverters connected over Ethernet daisy chain and with an available internet connection it will be always possible, via Aurora Vision Cloud, to upgrade remotely the firmware of the inverters.

In order to improve the communication services and allow reaching of all the inverters in the chain also in presence of fault it is recommended to create a ring shape layout by connecting both the first and the last inverters of the chain to the local Ethernet switch( as shown in the picture)



*Please refer to chapter 5 for further information about the installation.*

## Topographic diagram of the equipment

This new addition to the TRIO family, with 3 independent MPPT and power rating of 60 kW (480 Vac), has been designed with the objective to maximize the ROI in large systems with all the advantages of a decentralized configuration for both rooftop and ground-mounted installations.

### Modular design

The TRIO-TM-60.0 has a modular design to guarantee maximum flexibility, thanks to the different versions available.

The separate and configurable AC and DC compartments increase the ease of installation and maintenance with their ability to remain separately wired from the inverter module inside the system.

The TRIO comes with the most complete wiring box configurations available including up to 15 DC inputs with fast connectors, string protection fuses, AC and DC switches and type II AC and DC surge arresters.



### Design flexibility

The internal circuitry is with double stage conversion and therefore consists of:

- DC/DC input converter (booster)
- DC-AC output inverter

The DC-DC converter and the DC-AC inverter both work at a high switching frequency and are therefore small and relatively light.

Each input converter is dedicated to an array with a maximum power point tracking (MPPT) function in order to maximize the exportation of energy from the photovoltaic generator.

This inverter version is of the type without transformer, that is without galvanic isolation between the input and the output. This allows ultimately an increase in conversion efficiency.

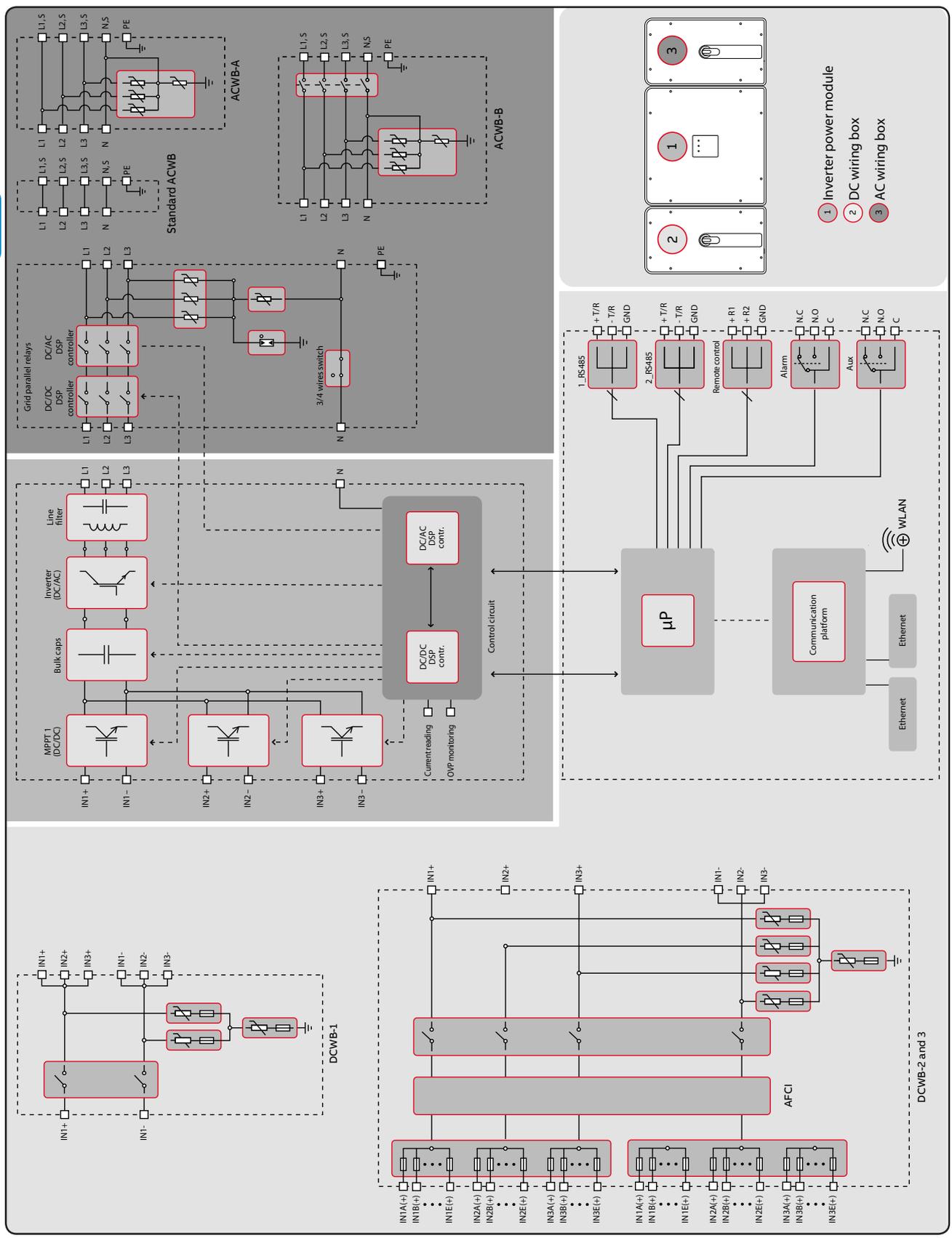
The operation and the protection management of the inverter is controlled by two independent DSPs (Digital Signal Processors) and a central microprocessor.

The connection to the distribution grid is thus kept under control by two independent computers, in full compliance with the electric field norms both for power supply to the systems as well as security.

In doing all this, we guarantee optimal operation of the whole assembly and a high performance in all irradiation conditions and always ensuring full compliance with the relevant directives, standards and regulations.

Embedded multi communication interfaces (WLAN, Ethernet, RS485) combined with a Sunspec compliant Modbus protocol (RTU/TCP) allow the inverter to be easily integrated with any third party monitoring and control systems.

The diagram summarises the internal structure of the inverter.



## Safety devices

### Anti-Islanding

In the event of a local utility company grid outage, or when the equipment is switched off for maintenance, the inverter must be physically disconnected to ensure protection of people working on the grid, all in accordance with the relevant national standards and laws. To prevent possible islanding (the condition in which a distributed generator continues to power a location even though electrical grid power from the electric utility is no longer present), the inverter is equipped with an automatic disconnection system called an Anti-islanding system.



### Photovoltaic panel ground fault

This inverter must be used with photovoltaic modules connected with “floating” connections -- that is with positive and negative terminals that are not grounded. An advanced ground fault protection circuit continuously monitors the ground connection and disconnects the inverter when a ground fault is detected. The ground fault condition is indicated by a red LED on the front panel.

### Arc Fault Detection (AFD)

This safety function allows the inverter to recognize series electrical arcing on DC cables. If arcing is detected, the inverter turns itself OFF, disconnects from the grid, and remains disconnected until manually reset.

An AFD fault is reset by pressing the button on the left side of the DC wiring box, but a thorough check of the DC cables and panels must be completed first, to locate the source of the arcs.

For DCWB-2 and DCWB-3 models only, the AFD performs a self-test when the system is started.

*For DCWB-1 model the Arc Fault Circuit Protection required by NFPA 70 Article 690.11 must be provided in the combiner box feeding the inverter.*

### String fuses

In the DC wiring box ② -2 and -3 models, the negative side (-) string fuses ②② and the positive side (+) string fuses ⑩ are preinstalled at the factory. They protect the inverter from currents exceeding the limit, independently for each string.

*The sizing of the fuses must therefore be carefully assessed during installation.*

## Surge protection devices (SPD)

As additional protection to prevent damage caused by lightning discharges and electrostatic induction phenomena, DC surge protection devices ⑮ (-2 and -3 models) and AC surge protection devices ⑱ (-A / -B models) are integrated inside the wiring boxes.

## Ground fault detection and interruption scheme

As required by UL1741 CRD 2010, the TRIO-TM inverter incorporates two separate methods for detecting a ground fault in the ungrounded PV array. These are described below: :

### Method 1: Pre-Start (Static RISO)

Any time conditions are suitable for the inverter to be connected to the grid, internal circuitry measures the insulation resistance (RISO) of the PV array conductors to ground. If the result of this static insulation resistance test is less than the pre-programmed threshold, the connection is aborted, the inverter will show an error, and illuminate the red LED GF indicator on the inverter's front panel. This test is conducted prior to any attempt to connect to the grid; e.g., at daybreak and any other time during the day where the inverter has been disconnected from the grid.

### Method 2: Post Grid Connection (Dynamic Leakage Current)

While the inverter is connected to the grid, the inverter circuitry continuously checks for ground fault conditions using a differential measurement of the three-phase AC lines, searching for any values that would indicate leakage of current to ground. Measurement of the ground leakage current is carried out simultaneously by two independent and redundant processors. If either processor detects an unacceptable value as defined below, the inverter will immediately be disconnected from the grid, and will illuminate the red LED GF indicator on the inverter front panel.

The inverter responds differently depending on the level and duration of leakage current detected. If any of the following conditions are detected in measured values of differential current (IDIF) or a rapid change of IDIF over time ( $\Delta IDIF/\Delta t$ ), the inverter will automatically disconnect from the grid and the red front panel GF LED will illuminate:

- If  $IDIF > 300 \text{ mA}$  for a period of 300 msec
- If  $\Delta IDIF/\Delta t > 30 \text{ mA/sec}$  for a duration of 300 msec
- If  $\Delta IDIF/\Delta t > 60 \text{ mA/sec}$  with duration of 150 msec
- If  $\Delta IDIF/\Delta t > 150 \text{ mA/sec}$  with duration of 40 msec

As a further safety precaution, in compliance with UL1741 CRD 2010, the inverter conducts an isolation monitor interrupter self-test before connecting to the grid, or every 24 hours, whichever is sooner. This test confirms that the circuitry needed to perform the isolation test is operating normally, and has not been damaged.

Ground fault errors are permitted to occur up to four times within a 24-hour period, after which a fifth ground fault error within a 24 hour period requires a manual reset. The system must be given a thorough examination before the reset, the cause of the ground fault located and

corrected. This is intended to ensure equipment with a ground fault is not connected to the grid.

### Other safeguards

The inverter also has:

- Constant monitoring of the grid voltage to ensure the voltage and frequency remain within operating limits;
- Internal temperature control to automatically limit the power (if necessary) to prevent overheating.

*The numerous control systems and redundancy ensure safe operation.*



### Safety information and instructions

**ABB** accepts no liability for failure to comply with the instructions for correct installation. ABB is not responsible for equipment upstream or downstream from the inverter. .

*It is essential to provide installers, operators and maintenance personnel with correct information. They must therefore read and comply with the information and instructions in the product manual.*

The instructions provided in the product manual do not replace the safety devices and operation labels on the product, and they do not replace the safety regulations in force in the country of installation.



*Do not use the PV system if any operating anomalies are identified. .*

All repairs must be completed by trained ABB authorized service personnel, using ABB-approved components.

### Signs and labels

*The labels on the equipment must NOT be removed, damaged, defaced, hidden, etc.*

The labels must be regularly cleaned and kept in sight, i.e. NOT hidden by foreign objects and parts (rags, boxes, equipment, etc.)

The technical data provided in this manual does not in any case replace that shown on the labels affixed on the equipment.

## Environmental conditions and risks

*The inverter is designed to be installed outdoors, in environmental conditions meets ambient temperature, air circulation and other specifications.*



*Do not install the inverter in a flammable or explosive environment.*

Operator must be properly trained and qualified personnel to come into close proximity to the equipment, and highlight, with notices or other means where necessary, the hazardous areas or operations at risk: magnetic fields, hazardous voltages, high temperatures, possible discharges, generic hazard, etc.

## Thermal and electrical hazards

Do not remove covers until voltage has been completely removed from the inverter. Wait and check for voltage discharge and component cool off time.

When the device has just been switched off, it may have hot parts as a result of overheating of the heated surfaces (e.g.: transformers, accumulators, coils, etc.) be careful where you touch.

## Clothing and protection of personnel

NFPA standards (which OSHA recommends and consults) require the equipment owner to field-label electrical equipment with labels containing the available incident energy and required level of PPE, to protect both in-house and contract workers from electric shock and arc flash.

Label requirements are determined by site-specific arc flash studies and depend on the inverter model, types and exact locations of external disconnects upstream and downstream of the inverter, by voltages and power levels at any given installation.

NFPA 70E Article 130.3 states that the analysis must be reviewed at least every 5 years or whenever a major modification occurs. This means that the label should include a date, and the date must be documented.

The system is not ready for commissioning until PPE labels have been installed.

Personnel must not wear clothes or accessories that could start fires or generate electrostatic charges or, in general, clothing that can compromise personal safety.



Maintenance operations may only be performed *after* the inverter has been disconnected from the grid and from the PV array.

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All operations on the equipment must be performed with adequately insulated clothing and instruments.

E.g.: insulating gloves, class 0, RC category

The maintenance technician must:

- ensure that the inverter is properly locked out/tagged out, so no one else can switch on or operate the device during the maintenance operations
- report any anomaly or damage due to wear or aging so that the correct safety conditions can be restored.

The installer or maintenance technician must always pay attention to the work environment.

During operation, **consider that the noise emitted by the inverter** could possibly exceed the safety thresholds (less than 80 dBA), therefore, suitable ear protection must be worn.

## Residual risks



Despite the warnings and safety systems, there are still some residual risks that cannot be eliminated.

These risks are listed in the following table with some suggestions to prevent them.

### Table of residual risks

RISK ANALYSIS AND DESCRIPTION	SUGGESTED REMEDY
Noise pollution due to installation in unsuitable environments or where individuals routinely work and/or animals dwell most of the time.	Reassess the environment or the place of installation.
Suitable local ventilation that does not cause overheating of the equipment and is sufficient not to create discomfort to people in the room.	Restore suitable ambient conditions and air the room.
External weather conditions, water seepage, low temperatures, high humidity, etc.	Maintain ambient conditions suitable for the system.
Overheating of surfaces at temperature (transformers, coils, etc. ) can cause burns.	Use suitable PPE. Wait for the parts to cool down before opening the inverter. Do not restrict cooling openings or heatsinks.
Inadequate cleaning compromises cooling and does not allow the safety labels to be read.	Clean the equipment, labels and work environment
Accumulation of electrostatic energy can generate hazardous discharges.	Ensure components have discharged their energy before working on them.
Inadequate training of staff.	Ask for a supplementary course.
During installation, temporarily mounting the equipment or its components may be risky.	Prevent unauthorized access to the installation area. Use sufficient people and PPE.
Accidental disconnections of the quick-fit connectors with the equipment in operation, or wrong connections, may generate electric arcs	Prevent unauthorized access to the installation area and lock out/ tag ou the inverter before working on it.
Use the same brand for the counterparts of the quick-fit connectors installed on the inverter	Mismatched connectors may void the warranty and cause potential damage



## Lifting and transport

# 4

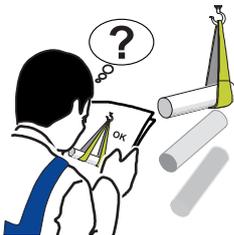
### Transport and handling



Protect the inverter from shocks, humidity, corrosive environments (e.g. salt), vibration, etc during transport and handling.

**During handling, do not make any sudden or fast movements that can create dangerous swinging.**

### Lifting



Equipment used for lifting the inverter must be rated for its weight. Do not lift more than one inverter at a time.

### Unpacking and incoming inspection

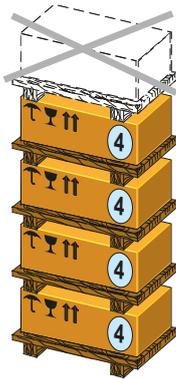
Packaging (cardboard, cellophane, staples, adhesive tape, straps, etc.) may cause cuts and/or injuries if not handled with care. It should be removed with the proper equipment.

*Packaging must be disposed of in accordance with any local regulations.*

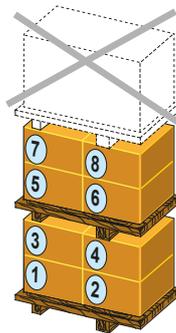
When the packaging is opened, confirm the inverter and components are not damaged and that nothing is missing.

Immediately report any damage or missing parts to the delivery carrier and to ABB Service.

## Storage



Up to 4 power module pallets , each with one power module, may be stacked.



A maximum of 8 wiring boxes, 4 per pallet, may be stacked.



*DO NOT stack with other equipment or products.  
Assembly 01 brackets and/or accessory components are in separate packages and may be stacked separately*

## Weights

Item	Weight	Lifting points (Qty)	Min. cable length	Holes for Eyebolts
Power module	145 lbs	4	14 feet	M 12 Handles 06 and eyebolts may be ordered
DC wiring box	≤31 lbs	-	-	-
AC wiring box	≤33 lbs	-	-	-

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## Lifting

The power module is too heavy to be lifted by one person.

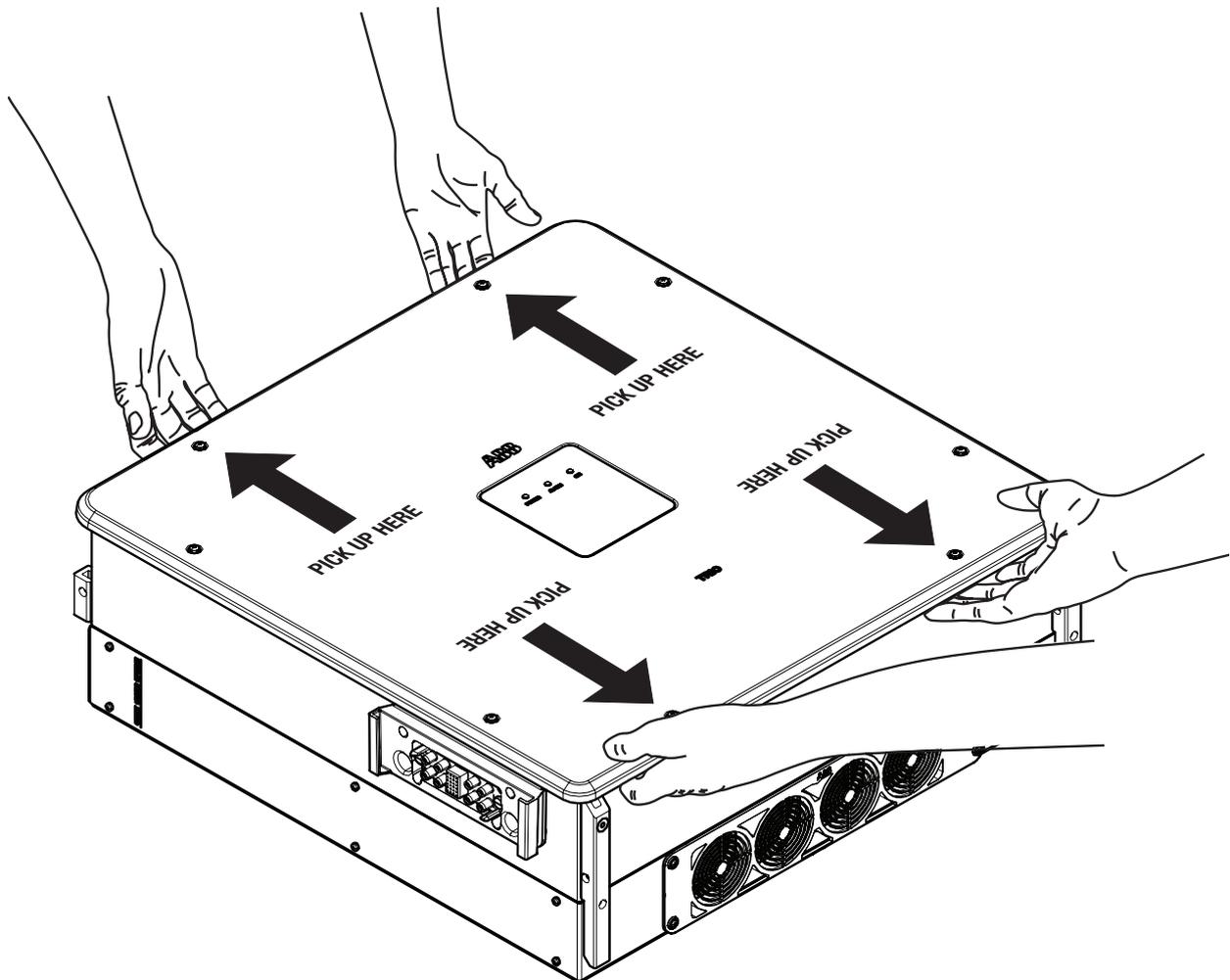
The inverter has 2 threaded holes in its sides for handles or eyebolts.

- If handles ①6 for manual lifting were ordered, install them in four locations.
- If eyebolts were ordered, install two for a vertical lift. Install four for a horizontal lift.

*Use ropes, cords or chains long enough to avoid stressing the frame.*

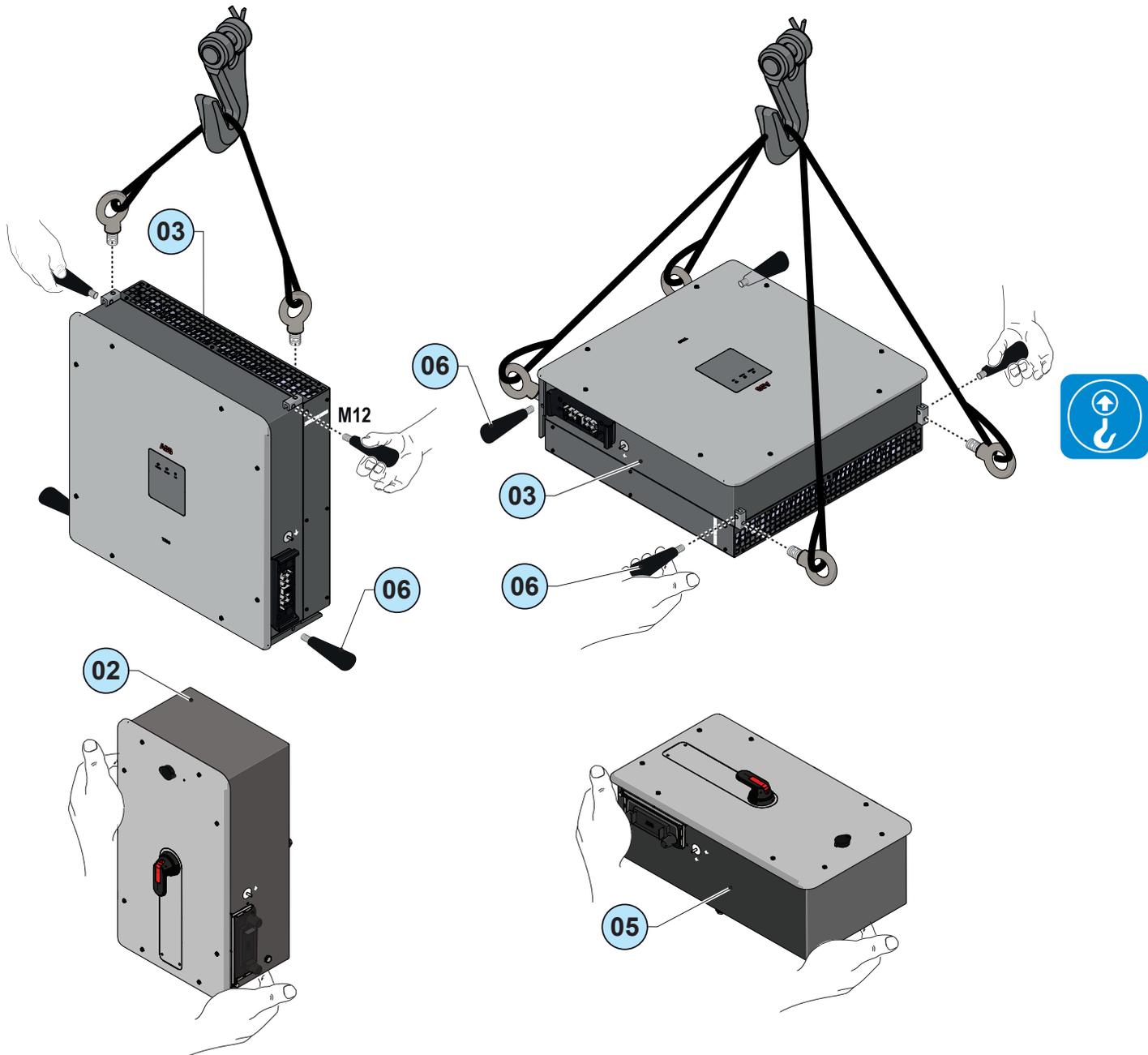
*The power module may be lifted horizontally or vertically.*

it is preferable not to lift the inverter from the cover. If it should be necessary, respect the lifting points at the screws (shown in the figure).



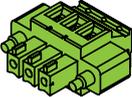
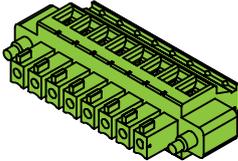
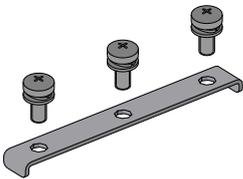
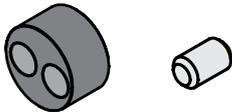
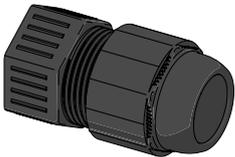
Lifting points:

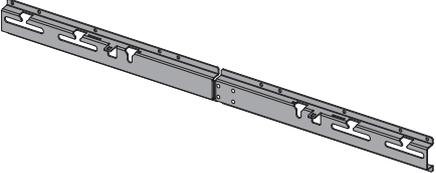
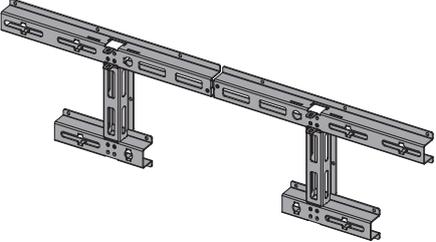
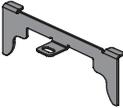
Wiring boxes may be lifted by hand, without handles or eye bolts:



## Packing list

All hardware required for installation is shipped with the inverter.

Components included in all DC wiring box models		Qty
	Configurable relay connectors	2
	Communication and control signal connectors	2
	M6 hex nuts to clamp ground cables to the wiring boxes	2
	M6x16 hex screw for connection of a cable on the external ground connection point	1
	M6 serrated lock washers (4 for ground cables and 2 for the external ground connection point)	6
	Bar for parallel input channels configuration + M5x12 screws (equipped with cut and flat washer)	1 + 3
	Wireless antenna	1
	Keys for the front cover of AC and DC wiring boxes	4
	Quick installation guide (QIG)	
Components included with DCWB-3 model only		Qty
	Two-hole gasket for signal cable glands <sup>(34)</sup> PG 21 + cap	3 + 3
	Airtight connector for ethernet cable connection	2

Components included in the mounting bracket kit		Qty (vertical kit)	Qty (horizontal kit)
	Bracket 01 for vertical wall mounting.	1	0
	Bracket 01 for horizontal wall mounting.	0	1
	countersunk M5 x 14 hex screws for assembling the attachment bracket	4	10
	M6x16 hex screws (4 to clamp ground brackets and 2 for cage nuts)	6	6
	Stabilization forks to attach the power module to the wiring box	2	2
	M6 cage nuts	2	2
	M6 hex nuts to clamp ground cables to the power module	2	2
	Back spacers 24 for wall alignment (vertical installation)	4	0
	Ground cables 50 for wiring box/power module connection	2	2
	Ground brackets 32 for wiring box-power module connection	2	2
	M6 flat washer (4 for ground brackets and 2 for cage nuts)	6	6
	M6 serrated lock washers (4 for ground connection bracket and 4 for ground cables)	8	8
	Conducting springs	6	6



## Spare parts kits

The following spare parts may be ordered from ABB:

Part Number	Part description	Quantity
TRIO HANDLING KIT	Handles and eyebolts for lifting the power module	4 handles 2 eyebolts
KIT 10 FUSES 12A	12A fuses (gPV - 1000Vdc)	10
KIT 10 FUSES 15A	15A fuses (gPV - 1000Vdc)	10



### Installation warnings



*The inverter must be correctly installed, in a suitable location, to operate properly and safely.*



*Installers must know and understand applicable NEC requirements and any local codes for photovoltaic systems.*



*Installers must know and understand OSHA and other applicable safety requirements, including lockout/tagout procedures.*



*Remember that when the photovoltaic panels are exposed to sunlight they provide continuous DC voltage to the inverter. Before installation may begin, photovoltaic panels must be shaded or isolated.*



*Before installation may begin, the inverter must be disconnected from the grid (power disconnect switch open and external AC disconnect locked out/tagged out) .*



*Limit installation to licensed electricians experienced in PV plant wiring.*



*Obtain approval of the local AHJ before connecting the inverter to the electrical grid*



*The equipment owner must post the PPE level (per NFPA TDE-2012, Table 13*

## Installation planning

### Sizing the ground cable(s)

ABB inverters must be grounded at the protective earth (PE) connection point (20) ⊕ terminal.

*Size the cable(s) in accordance with NEC and any local codes.*

*The conductor must be large enough to handle the maximum ground fault current that the PV system might experience.*

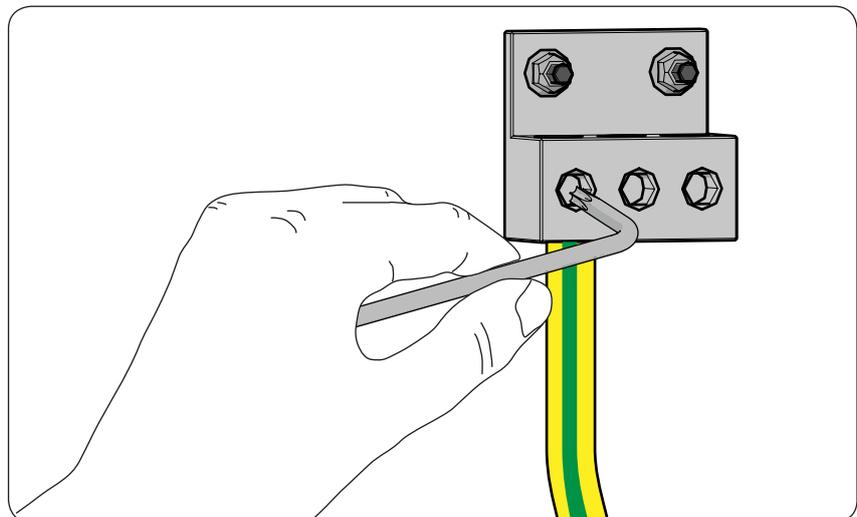
*The warranty is void if the inverter isn't connected to ground through the appropriate terminals.*

Follow site wiring diagrams and grounding plans. At a minimum expect this to include:

- A PV array equipment ground, to be landed in the inverter DCWB.
- A site ground, to be landed in the ACWB (with the same section as the one installed on the ground protection terminal (20) on the connection point located on the underside of the power module and marked with the symbol ⊕).

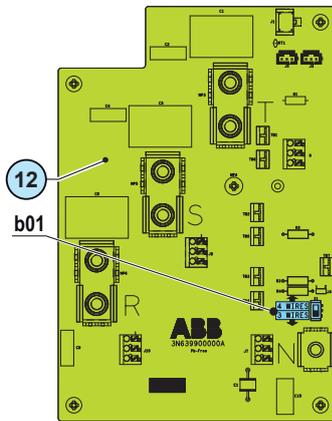
*Installation of a second protective earthing cable is also required by regulations in force in certain countries of installation.*

- Inverter (AC wiring box) protective earth (PE) connection point (20):  
The terminal block accept 3 wires 4AWG to 0AWG, copper or aluminum  
(Torque to 14Nm / 10.3 ft-lb)



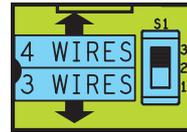
## Choice of grid output connection type (AC side)

The medium voltage transformer, i.e. the grid (distribution system), must face the inverter as a **grounded WYE**, whose Neutral may or may not be brought to the inverter:



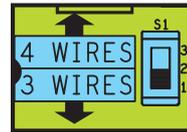
### 1. Lines 1,2,3, Neutral + GND (“four-wire”)

The DIP switch S1 (b01) on the AC Filter board (12) inside the ACWB must be set for “4 WIRES” before the inverter is commissioned



### 2. Lines 1, 2 3 + GND (“three-wire,” and in this case, the inverter creates its own “virtual” neutral)

The DIP switch S1 (b01) on the AC Filter board (12) inside the ACWB must be set for “3 WIRES” before the inverter is commissioned



**Delta connections to the grid are NOT permitted.**  
**Caution! Connect the ground before the grid connections.**



## Sizing the AC cable

The AC output conductors must be sized according to operating temperature range and continuous current ratings.

- Size conductors per NEC Article 310.
- Use 90°C wire only;
- Inverter terminal blocks:
  - ACWB Standard and -A → 4AWG to 3/0AWG, copper or aluminum, (AC output terminal block (17)).
  - ACWB-B → 7AWG to 1/0AWG, copper (AC disconnect switch terminal block (36)).

Note that undersized wiring may cause nuisance tripping (disconnection) of the inverter. Too-high wiring impedance increases the AC voltage seen at the inverter terminals. In compliance with UL1741 and IEEE1547, the inverter may need to disconnect from the grid under otherwise normal grid operating conditions: IEEE1547 default settings mandate the inverter operate only if its terminal voltage is in the  $[+10\%/-12\%] \cdot V_{nom}$  range. To limit these issues, the system designer must consider the worst case grid voltage conditions and wiring run lengths between the inverter to the point of common connection, and size wiring appropriately. For North America, based on ANSI B values, the worst case voltage range is  $\pm 6\%$  of  $V_{nom}$  and line voltage drop in this case should be limited to *less than* 3% of  $V_{nom}$ . Lower is better, so not to dissipate harvested power as heat.

## AC overcurrent protection

AC output overcurrent protection is not provided in the inverter; it is the responsibility of the end user to provide overcurrent protection for the AC output circuit. To reduce the risk of fire, connect only to a dedicated circuit provided with overcurrent protection in accordance with the NEC (ANSI/NFPA 70):

TRIO-TM-60.0-US-480	
Type	Typical installations use a 3-pole/600V rated bi-directional thermalmagnetic circuit breaker, UL489 or equivalent.
Maximum Current/Voltage	100 A / 600 V

- When installing a PV system incorporating a TRIO 60kW, verify that the PV module is listed for use in 1000Vdc systems in accordance with local electrical codes.
- It is the responsibility of the installer to provide external disconnect switches and Overcurrent Protection Devices (OCPD) as required by National Electric Codes and other prevailing regulations.
- An automatic overcurrent device (e.g., circuit breaker) must be installed between the TRIO inverter and the AC utility grid. The maximum acceptable current rating is 100 Amps.
- The ACWB-B wiring box includes an integrated AC disconnect switch; however, because this switch is behind the front cover, it is intended as an equipment disconnecting means and may not be accepted by the authority having jurisdiction (AHJ) in lieu of an external disconnect. It is made available as an additional disconnect for cases where the AHJ may require disconnects at both ends of the inverter AC line. Before purchasing this inverter option, consider discussing its intended usage with the AHJ in question.
- The TRIO is designed without an isolation transformer and must be installed per NFPA 70, 690.35 with an ungrounded PV array.

## Sizing the configurable relay (ALARM and AUX)

Different types of devices (light, sound, etc.) can be connected to the relay, provided they comply with the following requirements:

### Alternating current

Maximum Voltage: 240 V AC

Maximum Current: 1 A

### Direct current

Maximum Voltage: 30 V DC

Maximum Current: 0.8 A

The device (light, audible signal) to be connected at the other end of the wires will determine requirements for both the wire size and insulation type, and the N/O or N/C connection.

### Wire requirements

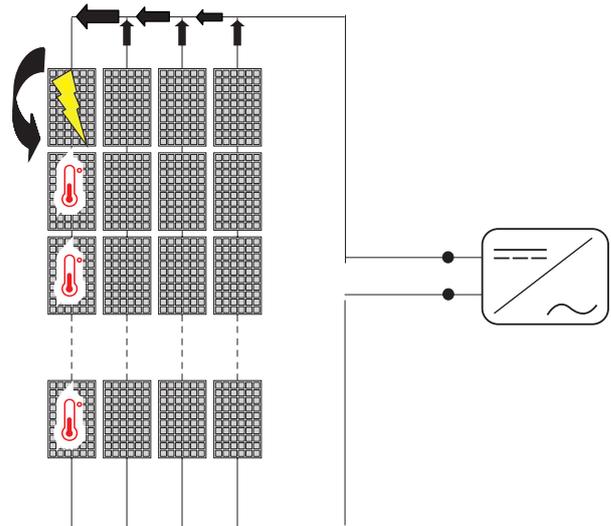
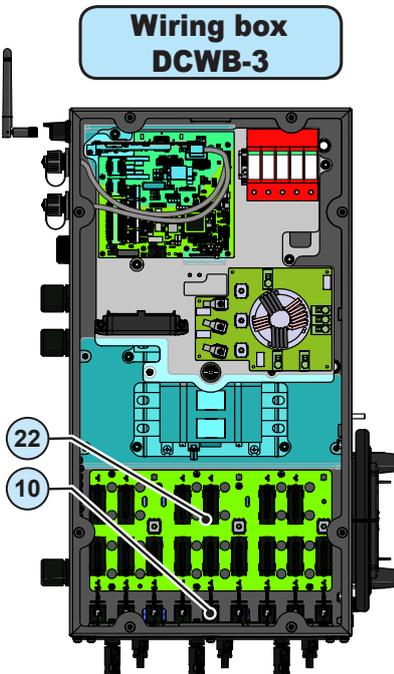
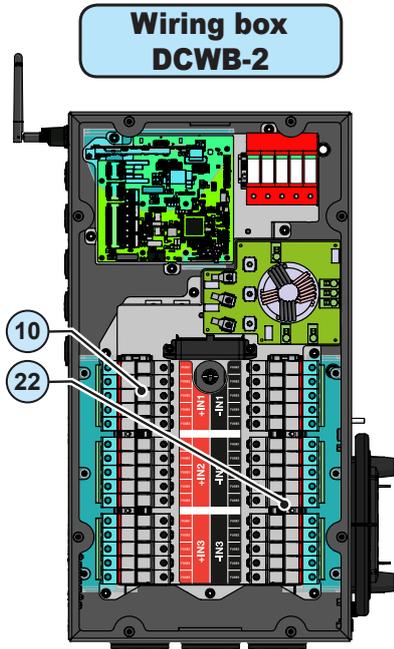
Conductor cross-section: from 25AWG to 15AWG



## String Fuse sizing (DCWB-2 and DCWB-3 models only)

The correct sizing of the ⑩ positive side (+) and ⑫ negative side (-) string fuses to be used to protect from “return currents” is very important because it reduces the risk of fire and damage to the PV array.

A “return current” can be generated in the event of a fault and short circuit at the ends of one or more PV modules. This can result in all the current supplied by the strings not involved in the fault, but in the same array, to pass through the faulty string.



Fuses must be sized for each single string in the PV array. Incorrectly sized fuses can result in damage to the fuse itself and an inverter malfunction.

DCWB-2 models have fuse holders for each individual string conductor pair. Fuses are sized for single-string currents only. Strings may be not paralleled in the PV array.

The maximum string fuse size is 20A.

Take into the following two conditions when sizing the string fuses:

1. The nominal current of the fuse ( $I_{rated}$ ) must not exceed the maximum series fuse rating found on the PV modules’ technical datasheet and/or product label. This must be in compliance with standard UL 1703:

$$I_{rated} < \text{Maximum series fuse rating}$$

2. The fuse rating ( $I_{rated}$ ) must be based on the string current and on the sizing guidelines provided by the fuse manufacturer to avoid untimely tripping. As a general guideline, the photovoltaic modules’ short circuit current ( $I_{sc}$ ) and the following formula give an estimate of the fuse rating.:

$$I_{rated} > 1.25 * 1.25 * I_{sc}$$

Fuses must be chosen from among the standard commercially available ratings, selecting the size that is closest to the calculated value.

This estimate takes into consideration derating factors and corrections such as:

- increase in the effective irradiation of the installation area
- Increase in the I<sub>sc</sub> based on high PV module temperature
- fuse thermal derating
- maximum return current of the PV modules

12A and 15A fuses are available from ABB:

Code	Description	Quantity
KIT 10 FUSES 12A	Kit of 12A fuses	10
KIT 10 FUSES 15A	Kit of 15A fuses	10



*For more precise calculations, taking into account actual installation conditions, consult documents supplied by the fuse manufacturer.*



## Installation procedure for quick-fit connectors

In the inverter models, where the quick-fit connectors are used, is possible to find one of the following four types:

- Weidmüller PV-Stick
- Weidmüller WM4
- MultiContact MC4
- Amphenol H4.

Please refer to the document “String inverters – Product manual appendix” available at [www.abb.com/solarinverters](http://www.abb.com/solarinverters) for information on the quick-fit connector brand and model used in the inverter.

The model of connectors installed on your inverter must be matched by the same model of the respective corresponding parts to be used (checking the conforming corresponding part on the manufacturer's website or with ABB).



Using corresponding parts that are not compliant with the quick-fit connector models on the inverter could cause serious damage to the unit and lead to invalidation of the warranty.



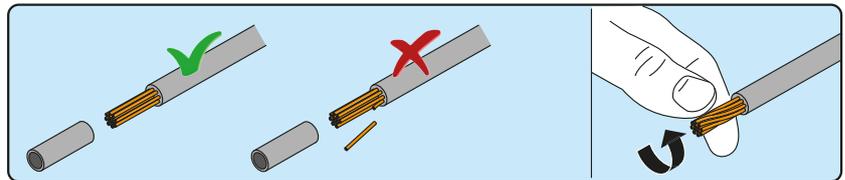
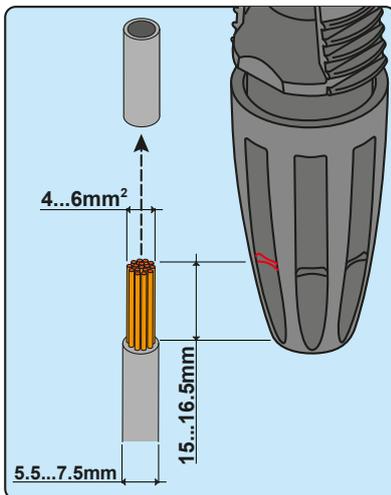
**CAUTION:** To avoid damage to the equipment, when attaching cables, pay particular attention to polarity.



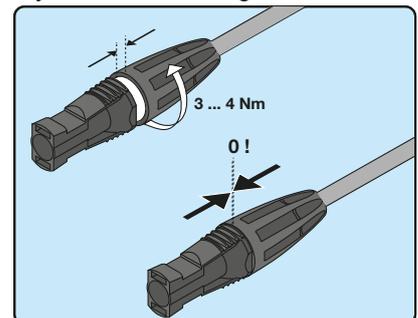
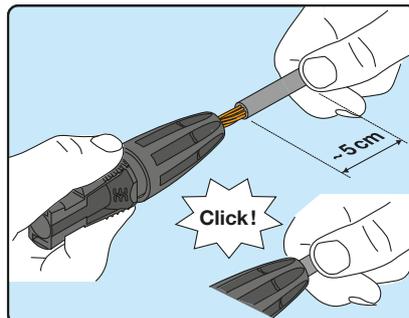
### 1. WEIDMÜLLER PV-Stick quick-fit connectors

Installation of Weidmüller PV-Stick connectors does not require any special tooling.

- Strip the cable to which you want to apply the connector (after verifying that it complies with the connector limits).

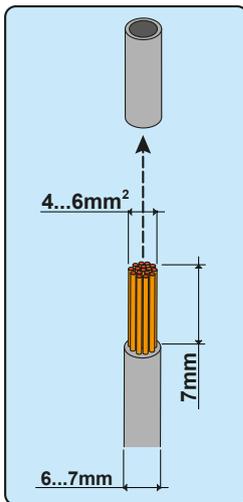


- Insert the wire into the connector until you hear a locking "click".



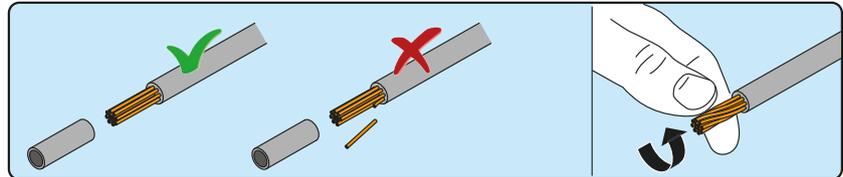
- Tighten the knurled ring nut for optimal clamping.

## 2. WEIDMÜLLER WM4 quick-fit connectors

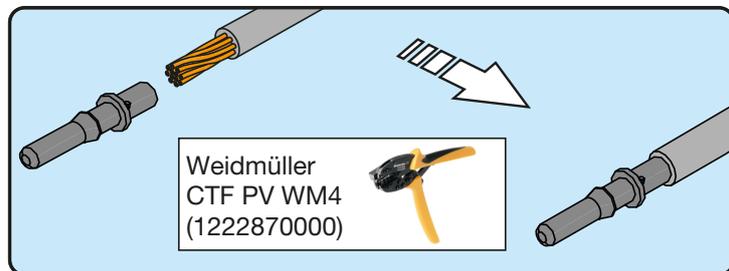


Installation of Weidmüller WM4 connectors requires crimping to be carried out with suitable equipment.

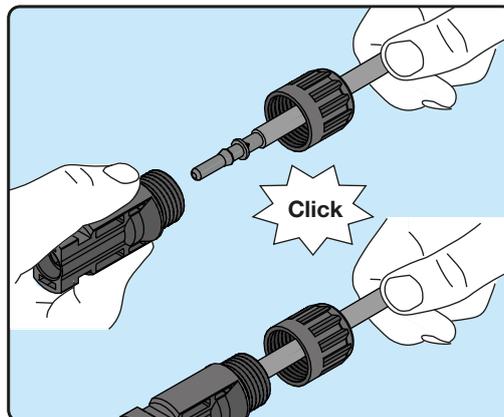
- Strip the cable to which you want to apply the connector (after verifying that it complies with the connector limits).



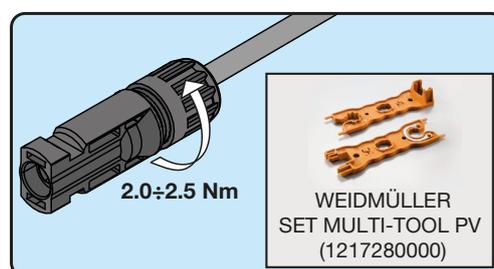
- Apply the terminal to the conductor using the designated pliers.



- Insert the cable with the terminal into the interior of the connector, until you hear the click indicating that the terminal is locked inside the connector.



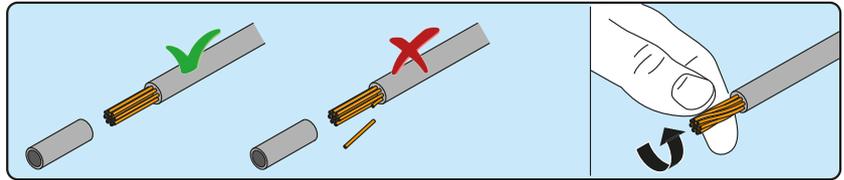
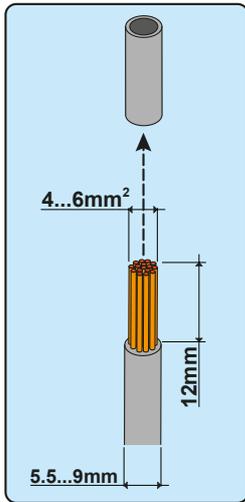
- Firmly tighten the cable gland using the relevant tool to finish the operation.



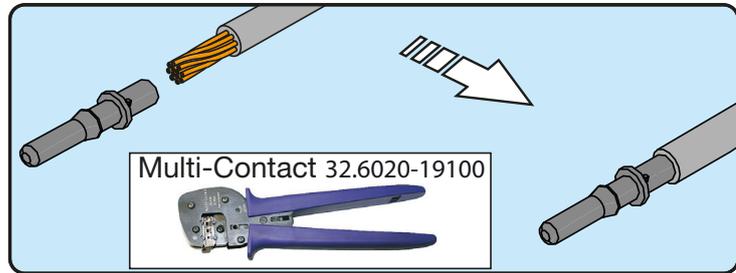
### 3. MULTICONTACT MC4 quick-fit connectors

Installation of Multicontact MC4 connectors requires crimping to be carried out with suitable equipment.

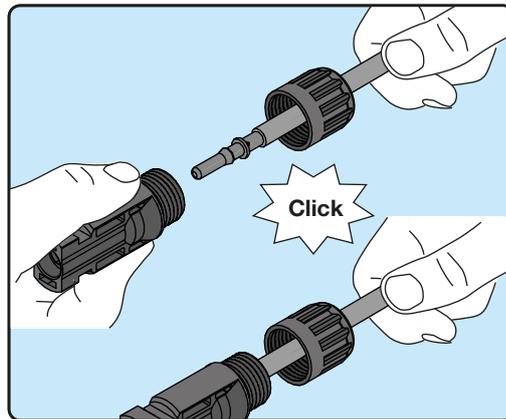
- Strip the cable to which you want to apply the connector (after verifying that it complies with the connector limits).



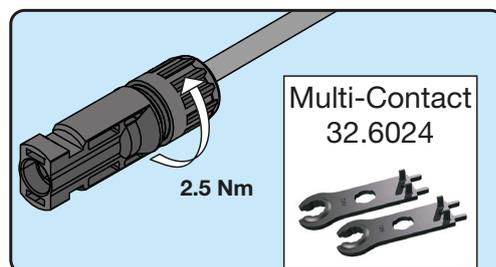
- Apply the terminal to the conductor using the designated pliers.



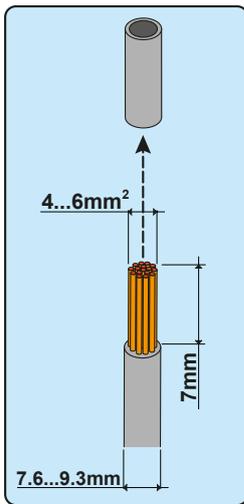
- Insert the cable with the terminal into the interior of the connector, until you hear the click indicating that the terminal is locked inside the connector.



- Firmly tighten the cable gland using the relevant tool to finish the operation.

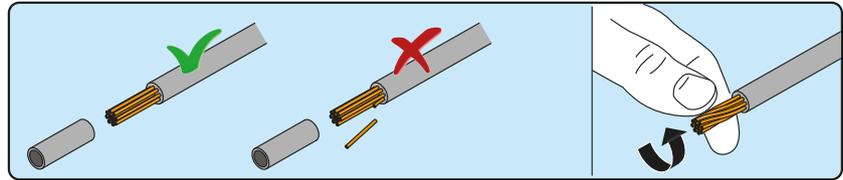


#### 4. AMPHENOL H4 quick-fit connectors

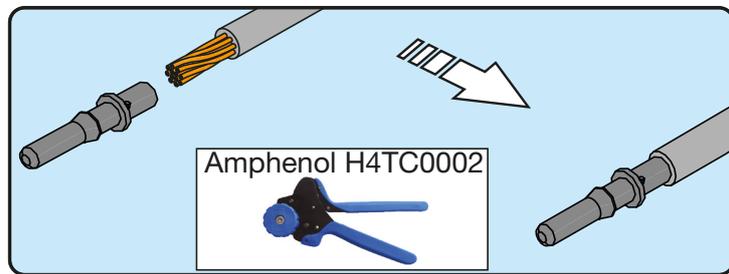


Installation of Amphenol H4 connectors requires crimping to be carried out with suitable equipment.

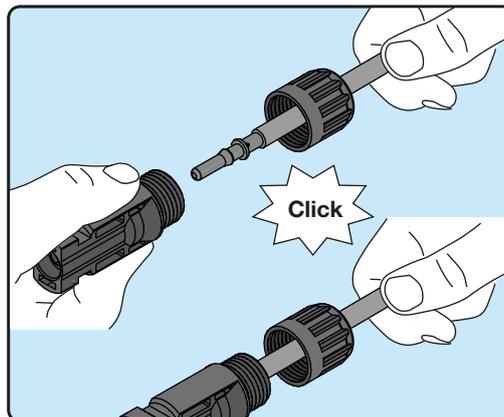
- Strip the cable to which you want to apply the connector (after verifying that it complies with the connector limits).



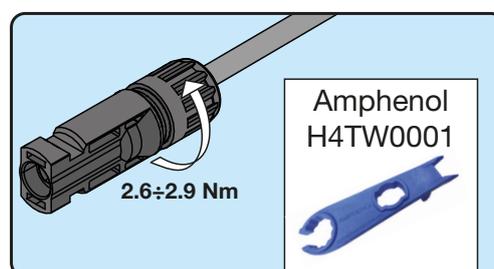
- Apply the terminal to the conductor using the designated pliers.



- Insert the cable with the terminal into the interior of the connector, until you hear the click indicating that the terminal is locked inside the connector.

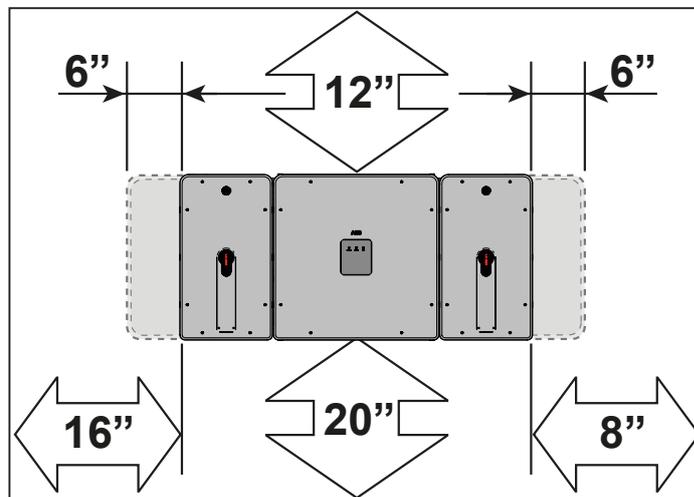


- Firmly tighten the cable gland using the relevant tool to finish the operation.

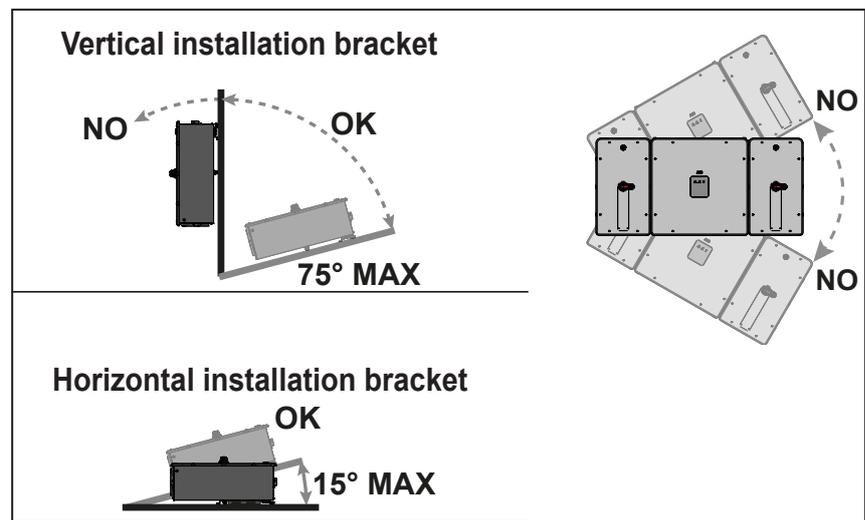


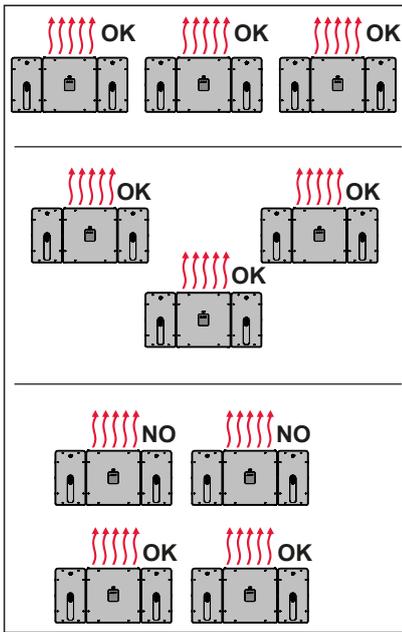
## Installation site and position

- Consult technical data to confirm the environmental specifications will be met
- Installation of the unit in a location exposed to direct sunlight is acceptable.
- Do not install in closed spaces where air does not freely circulate,
- Do not install in spaces inhabited by people or animals due to the potential audible noise level of an operating inverter.
- Always ensure that the airflow around the inverter is not restricted or blocked, so as to prevent overheating.
- Do not install the equipment near flammable substances
- Do not install the equipment on wooden walls or supports, or other flammable substances.
- Maintain minimum clearance from objects blocking air circulation and maintain minimum spacing between inverter as indicated in the figures.



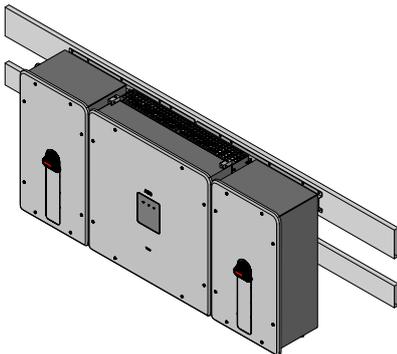
- Install on a wall or strong structure capable of bearing the weight
- Ensure sufficient working area in front of the inverter for wiring box access
- If possible, install at eye level so that the LEDs can be easily seen
- Install at a height that takes account of the weight of the equipment
- All installations over 6500' (2,000 meters) must be assessed by ABB Technical Sales to determine the proper datasheet derating
- Install vertically or horizontally (i.e. with the inverter on its back), with a maximum inclination as indicated in the figure



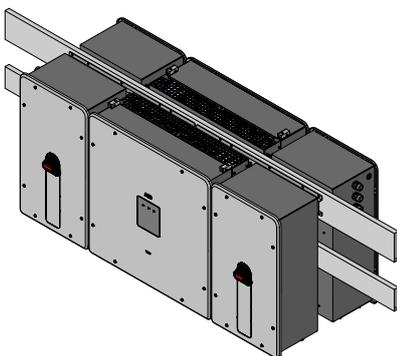


- Position multiple inverters side by side, maintaining minimum clearances, measured from the outermost edge of the inverter. Keep in mind clearance and approach required for any removal or replacement!

- Multiple inverters can also be placed in a staggered arrangement. Minimum clearances for staggered arrangements include the width of inverter plus additional allowances for inverters arranged above or below



- The vertical installation is also permitted on a structure which must be composed of a support for the attachment of the bracket and one for the support of the rear pins.



- The vertical installation of two inverters positioned back to back is also permitted on a structure which must be composed of a support for the attachment of the brackets and one for the support of the rear pins.



*Do not block access to the external AC and DC disconnects.*

*Please refer to the warranty terms and conditions to avoid any possible warranty exclusions due to improper installation.*

## Wireless signal environmental checks

The inverter can be commissioned and monitored using the wireless communication channel. The WLAN board of the inverter uses radio waves to transmit and receive data, it is therefore important to assess this factor in order to have optimal installation.

- Walls in reinforced cement and surfaces covered in metal (doors, shutters, etc.) can reduce the reach of the device (approximately 55 yards in free space).
- It is therefore recommended that before installing the inverter, the strength of the wireless signal is checked, using a mobile device (smartphone, tablet or notebook) and connecting to the wireless router from a position close to the installation site of the inverter.

The radio signal level between the inverter and the wireless router can be improved in a number of ways:



1. Change the direction of the antenna.

The antenna has a dead zone at its tip, which should not be positioned facing the wireless router, as shown in the figure.



2. Find a new position for the router considering the different types of materials which the radio signal will have to pass through:

Material	Relative signal reduction
Open field	0% (strength of approximately 50 meters)
Wood / Glass	From 0 to 10%
Stone / Plywood	From 10 to 40%
Reinforced concrete	From 60 to 90%
Metal	Up to 100 %

The quality of the RF signal can be assessed during the installation stage where the signal is displayed in dBm.

3. Install a wireless signal repeater and place it in an area between the inverter and the router, trying to make sure that the most critical obstacles are avoided.

## Installations above 2000 meters



*On account of the rarefaction of the air (at high altitudes), particular conditions may occur that should be considered when choosing the place of installation:*

- Less efficient cooling and therefore a greater likelihood of the device going into derating because of high internal temperatures.
- Reduction in the dielectric resistance of the air which, in the presence of high operating voltages (DC input), can create electric arcs (electrical discharges) that may damage the device.

As the altitude increases, the failure rate of some electronic components increases exponentially because of cosmic radiation.



*All installations at altitudes exceeding 2000 meters are prohibited on the basis of the criticalities indicated above.*

## Installations with a high level of humidity



*Never open the inverter in the case of rain, snow or a level of humidity >95%.  
Always carefully seal all unused openings.*

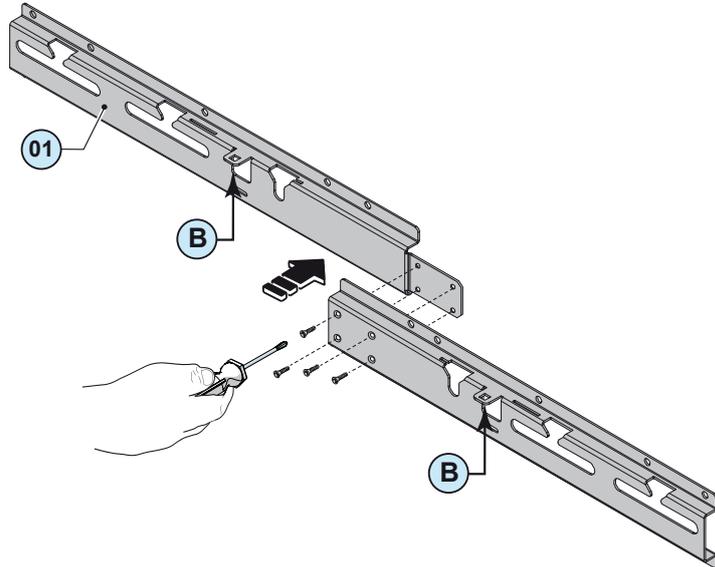
Even though the device is equipped with an anti-condensation valve, air with extremely high levels of humidity can lead to the creation of condensation inside the inverter.

As the inverter is almost completely insulated from the outside, condensation can also form after installation in certain weather conditions.

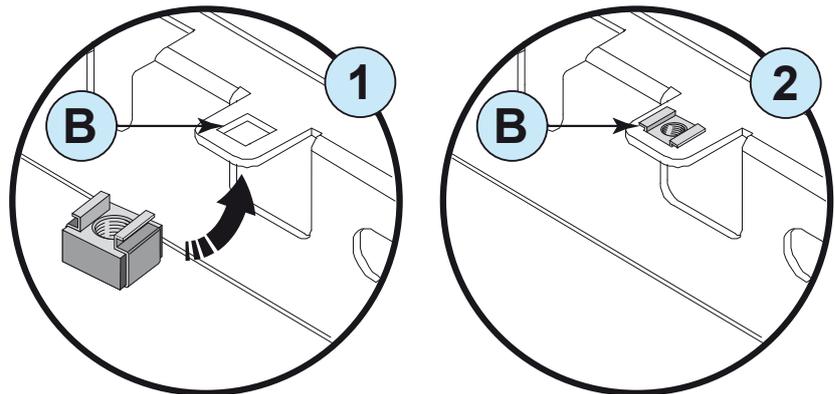
# Assembly instructions

## Vertical mount

1. Use 4 of the countersunk M5x14 screws to connect the two bracket pieces together.
2. Insert the 2 cage nuts into their seats **(B)** on the bracket.

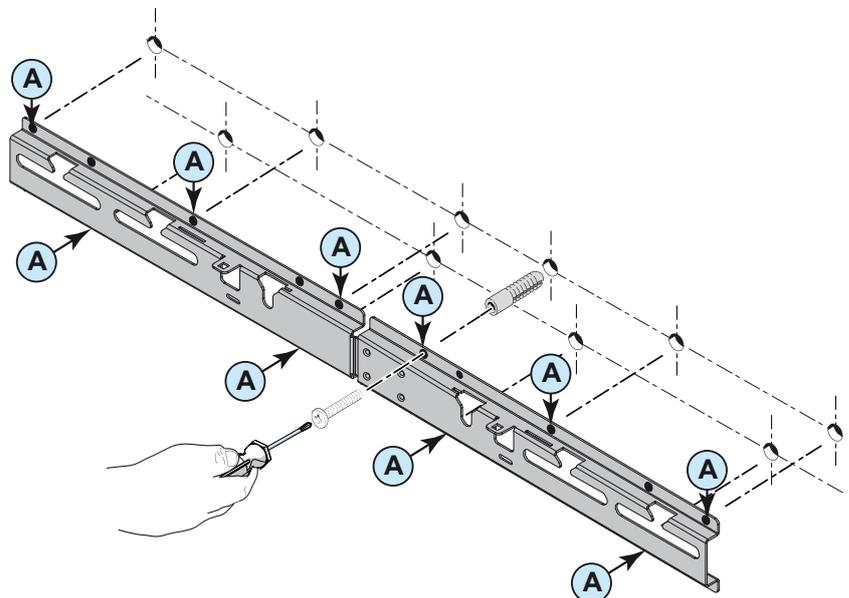


3. Position the bracket **(01)** on the vertical support and use it as drilling template. It is the installer's responsibility to choose an appropriate number and distribution of attachment points. The choice must be based on the type of wall, frame or other support, the type of anchors to be used, and their ability to support 4 times the inverter's weight (4 x 260 lbs=1040 lbs for all models).



Attach the bracket to the wall with at least 10 attachment screws. Put at least four screws in the upper side and at least four in the lower side, with the remainder (up to 20 total) in either location. Depending on the type of anchor chosen, drill the required 10 holes (minimum) **(A)** to mount the bracket.

4. Attach the bracket to the wall or frame



5. Install spacers **24** in the two lower rear attachment pins **27** of the power module. This will prevent backwards tilt when the power module is hung on the bracket.



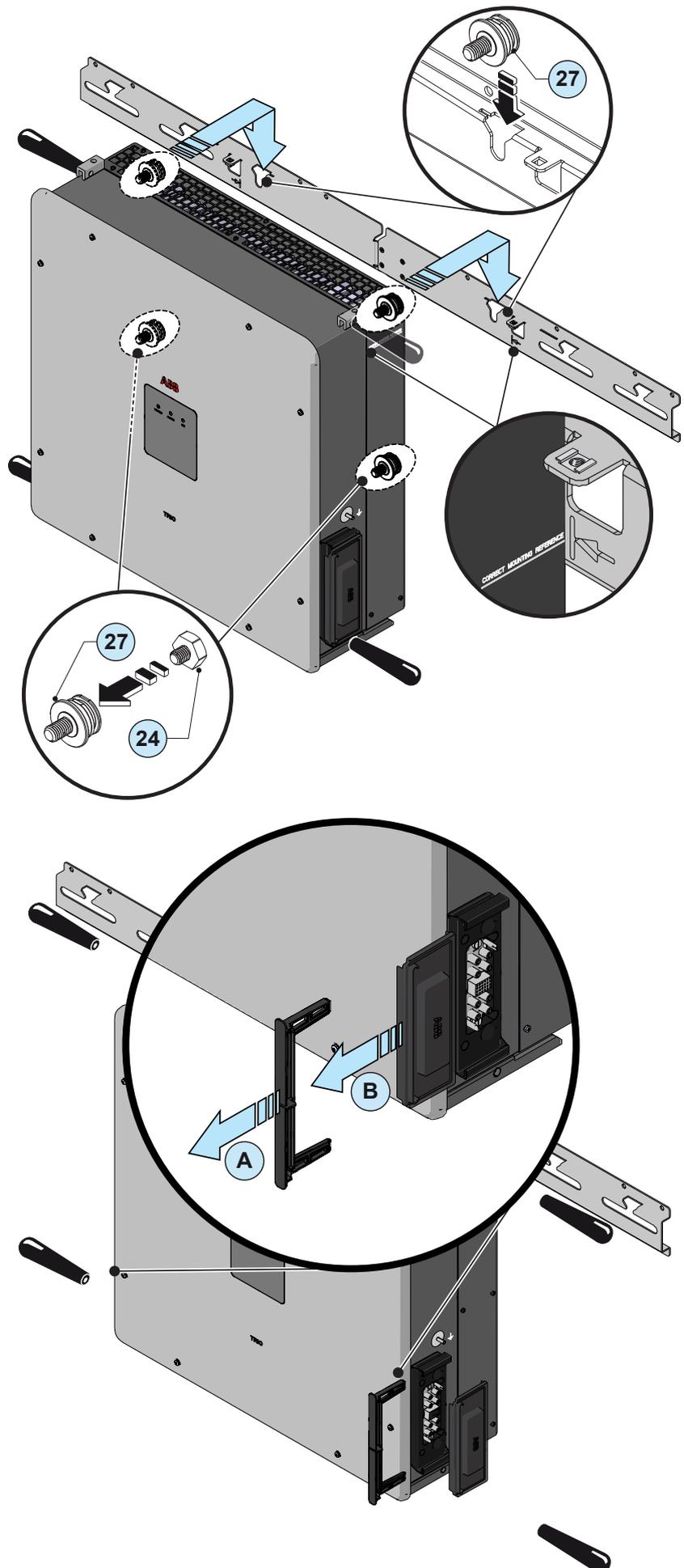
Risk of injury due to the heavy weight of the equipment.

6. Lift the power module up to the bracket using the (optional) handles **06** or the (optional) M12 eyebolts, or another appropriate lifting device. The power module is pre-equipped with metal expansions which allow it to be temporarily put vertically on the floor to make it easier the installation of handles or eyebolts.

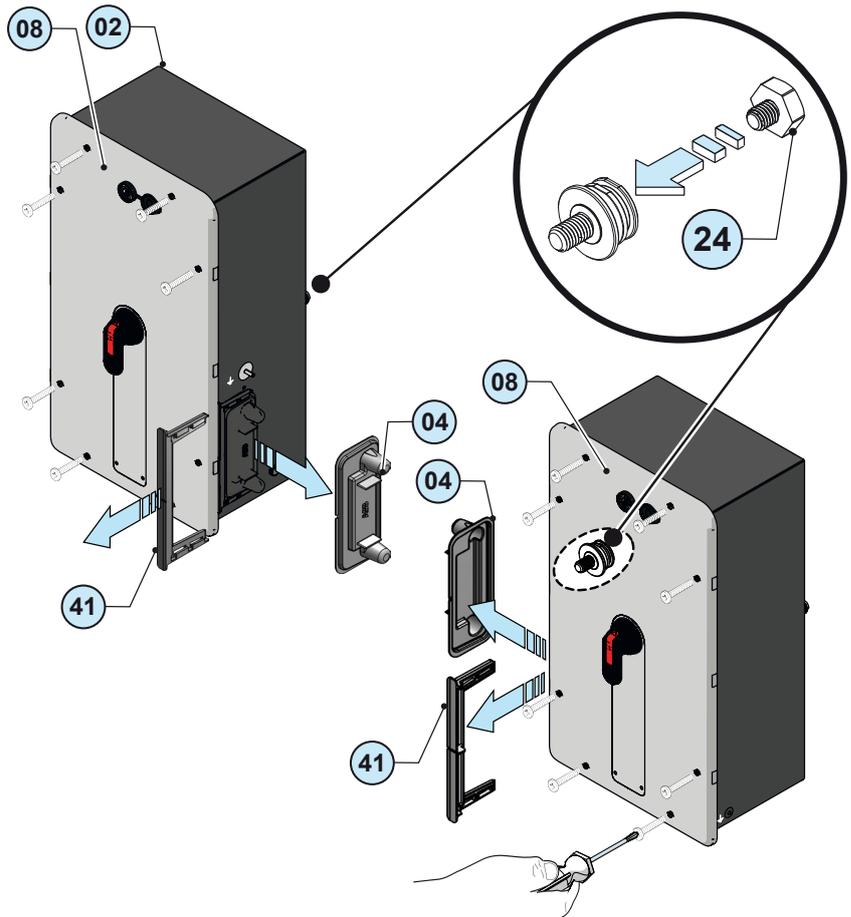
7. Slide the heads of two upper rear attachment pins **27** into the slots **T** on the bracket and confirm that the slots **L** on the bracket are aligned with the line on the sides of the power module. This indicates that they have been correctly positioned.

8. Remove handle or eye bolts (if used)

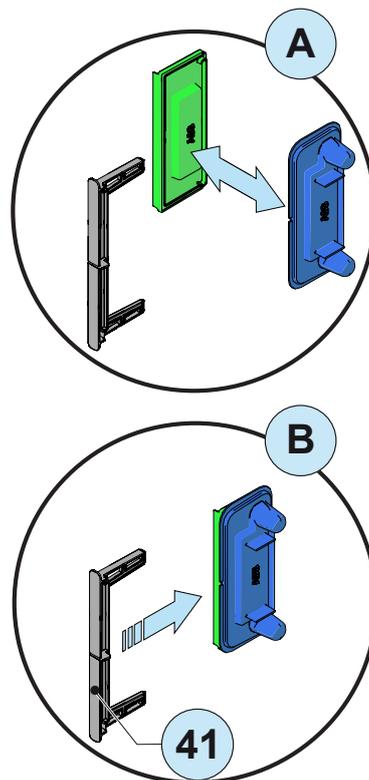
9. Remove the quick disconnect connector covers as follows:
- Pull the metal locking fork outwards **A**
  - Pull off the quick disconnect cover **B**
- Save both parts. They will be needed in a later step.



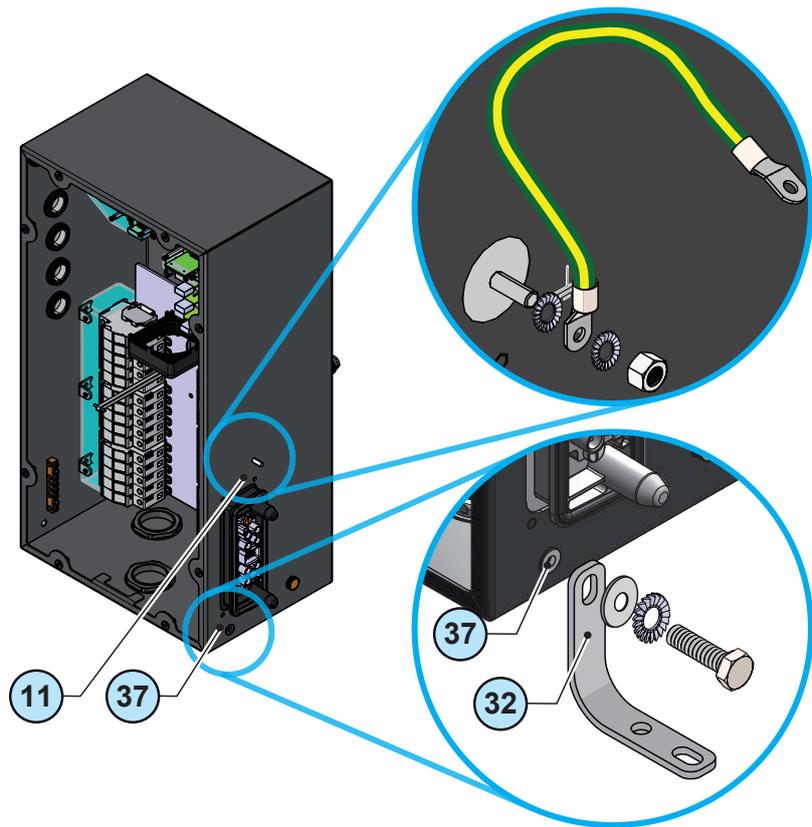
10. Set the wiring box disconnect switches to "0"; otherwise it will not be possible to remove the front cover 08.
11. Unscrew the 8 screws holding the front covers 08 of the DC wiring box 02 and AC wiring box 05 in place. Don't lose the screws!
12. Open the key locks. Remove each wiring box's cover.
13. Install spacers 24 in the lower rear attachment pin 27 of each wiring box. This will prevent backwards tilt when the wiring box is hung on the bracket.



14. Remove the covers from the quick disconnect connectors, one on each wiring box. Then follow these steps to store these caps. They will be needed if the assembly ever needs to be separate:
  - A couple a power module connector cover (green in the figure) with one from a wiring box (in blue in the figure).
  - B Slip the plastic locking fork 41, which was used to secure the wiring box cover, over the two covers. **Be sure the fork is plastic, not metal.**
  - C Keep the parts available in a safe place. They could be used during maintenance operation.
  - Repeat the same operation for the other wiring box.

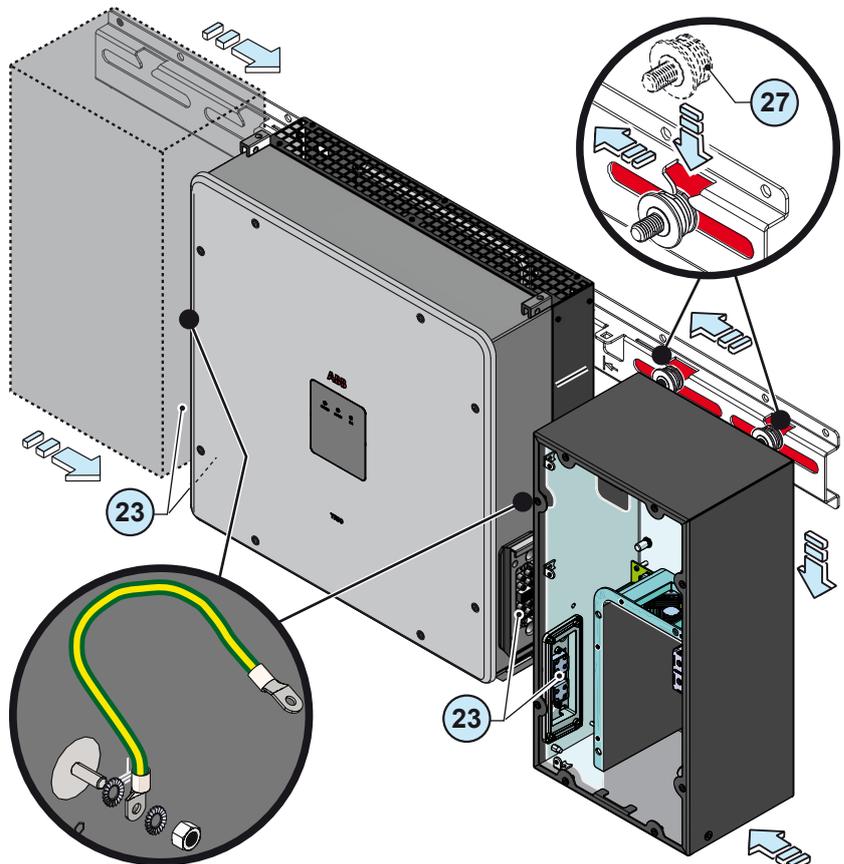


15. Attach the two green/yellow ground wires to the attachment points ①① on each wiring box with the following hardware stackup: lock washer, ground cable, lock washer and hex nut shipped with the inverter (torque to 11N-m or 8ft-lb). Let the loose end of the cable hang downwards.
16. Locate the ground fork and note that it is not symmetrical. When installed at the attachment point ③⑦, the 2 holes will face downwards -- Loosely attach the ground bracket ③② to the attachment point ③⑦ on each wiring box with the M6 flat washer, M6 lock washer and the M6 hex screw, all of which are in a plastic bag shipped with the inverter. For the moment, leave screws loose and not tightened.



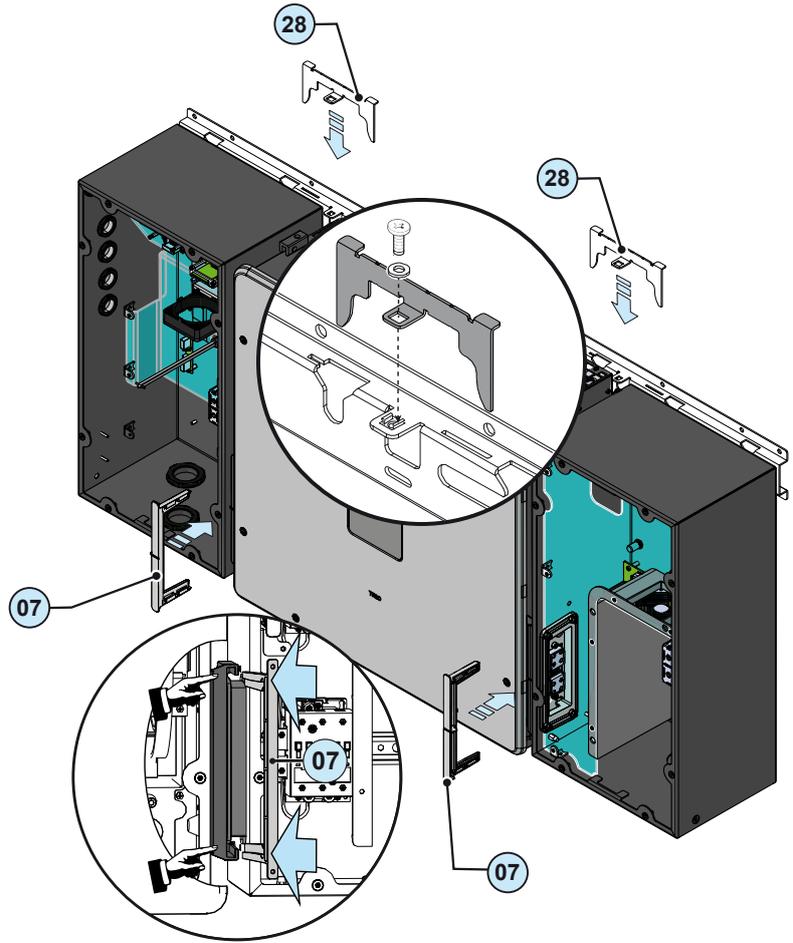
Risk of injury due to the heavy weight of the equipment.

17. Carefully lift one wiring box up to the level of the bracket. Insert the rear studs ②⑦ on the upper back of the wiring box into the bracket slots, but do not slide the wiring box up to the power module just yet. Repeat this procedure for the other wiring box. The quick disconnects ②③ won't touch.
18. Attach the two wiring box ground cables (loose end of the cables) to the power module with the following hardware stackup: lock washer, ground cable, lock washer and hex nut (torque to 11N-m or 8ft-lb).
19. Slide each wiring box horizontally along the bracket ①①, into the power module. Confirm the quick disconnects ②③ are completely seated.



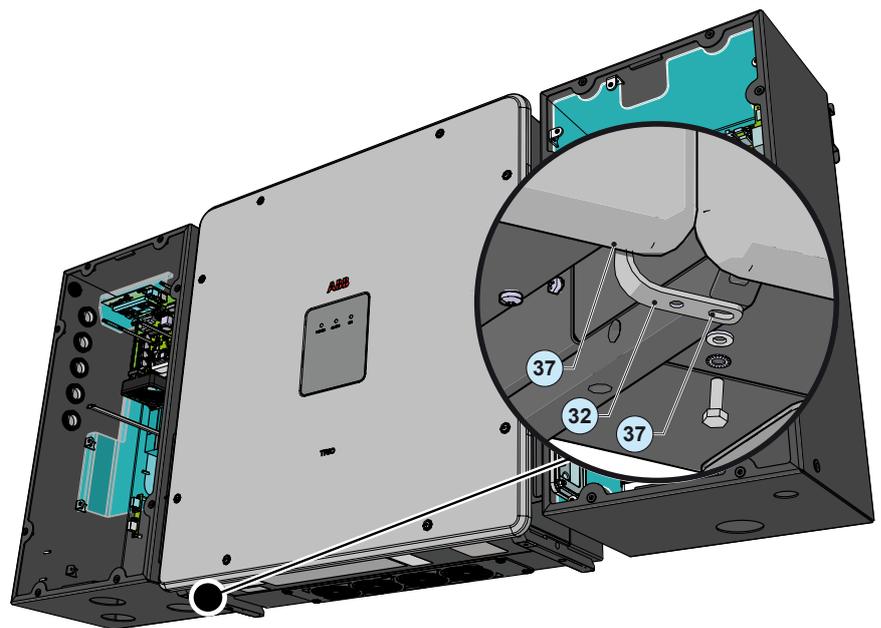
20. After sliding the wiring boxes inward, install the metal locking fork 07 into the seats on the quick disconnects 23. Through this step the wiring boxes will be attached to the power module.

21. Insert the stabilization forks 28 into the guides and tighten the screws on the cage nuts (which were previously mounted on the dedicated bracket slots).



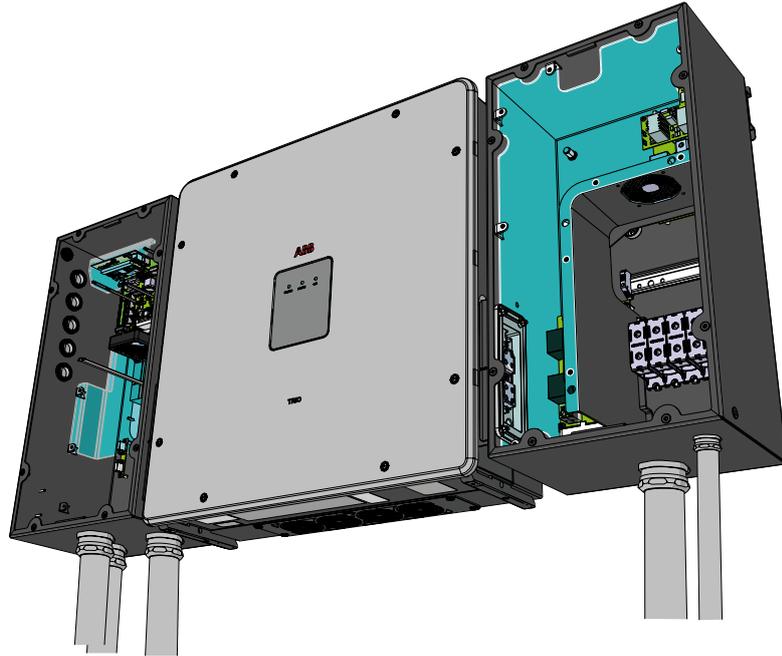
22. Attach the ground brackets 32 at the threaded inserts 37 on the lower side of the power module with the M6 flat washer, M6 lock washer and the M6 hex screw, all of which are shipped with the inverter. Torque to 11N-m (8ft-lb).

23. Torque the two screws (previously installed on step 14 of this procedure) on the 2 ground brackets 32 located on the side of each wiring box. Torque to 11N-m (8ft-lb).



24. Remove the plug and install the conduit on the bottom side of the AC and DC (-1 and -2 models) wiring box. Use FMC (Flexible Metal Conduit) for the final two to three feet connecting to the inverter so that the inverter can be installed easily.

The input connection on DCWB-3 is made on the external quick-fit connectors and conduits are not present.



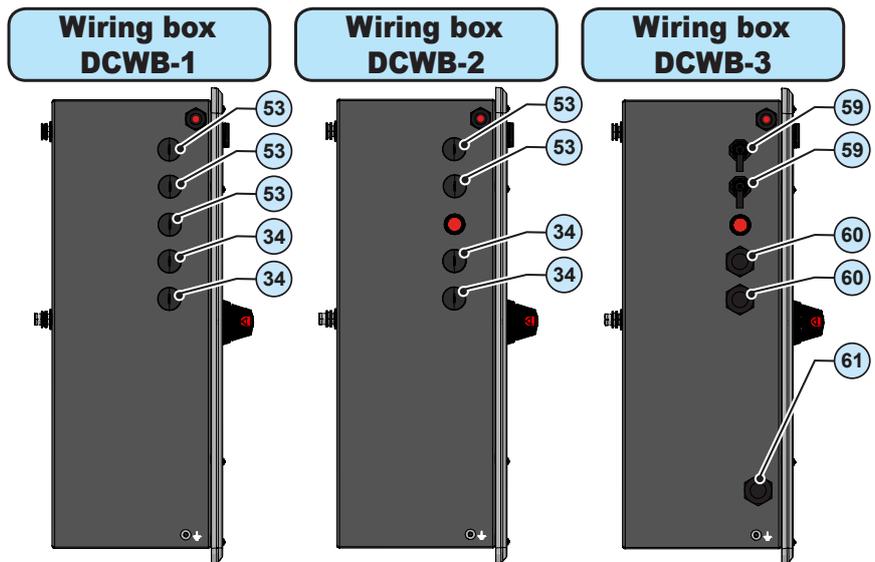
To connect low voltage conductors remove the plug and install the conduit on the left side of the DC wiring box. The conductors must be routed to the inverter in separate conduit from AC or DC power conductors. Based on the DC wiring box models there are different configuration of conduit openings/cable glands available for cable passing.

Also in this case use FMC (Flexible Metal Conduit) for the final two to three feet connecting to the inverter so that the DC wiring box can be installed easily.

25. All conduits must be attached using liquid-tight fittings to maintain UL 50 NEMA Type 4X enclosure integrity.

26. Run the AC, DC and low voltage cables through the opening(s).

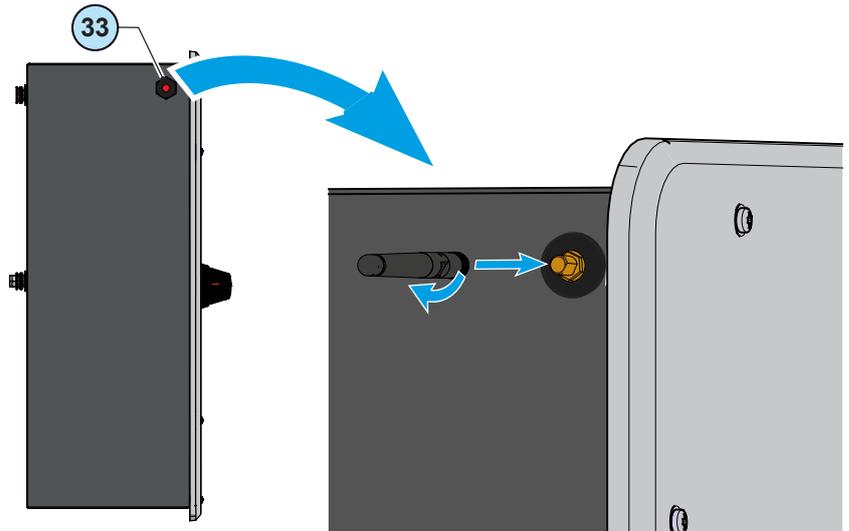
Only in the DCWB-3 the input connection is made on the external connectors.



- ③④ Signal conduit opening for 3/4" (PG21 size)
- ⑤③ Signal conduit opening for 1/2" (PG13.5 size)
- ⑤⑨ external ethernet connector (RJ45)
- ⑥① Signal cable gland (PG21 size)
- ⑥① EGC cable gland (PG21 size)

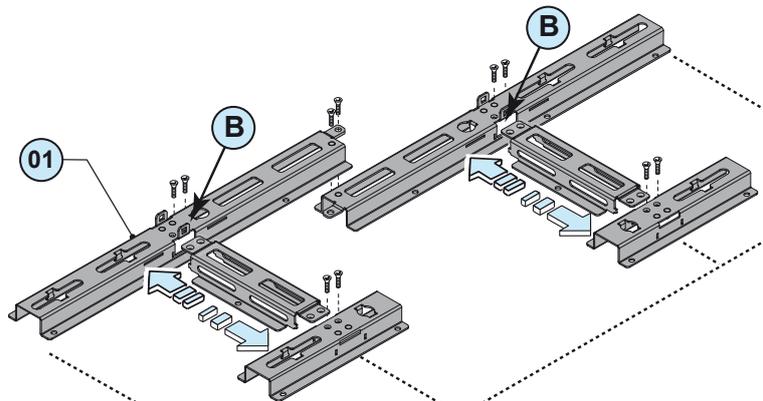


26. Remove the protective cover from the support of the wireless antenna located on the left side of the DC wiring box. Install the wireless antenna by screwing it into the specific connector.

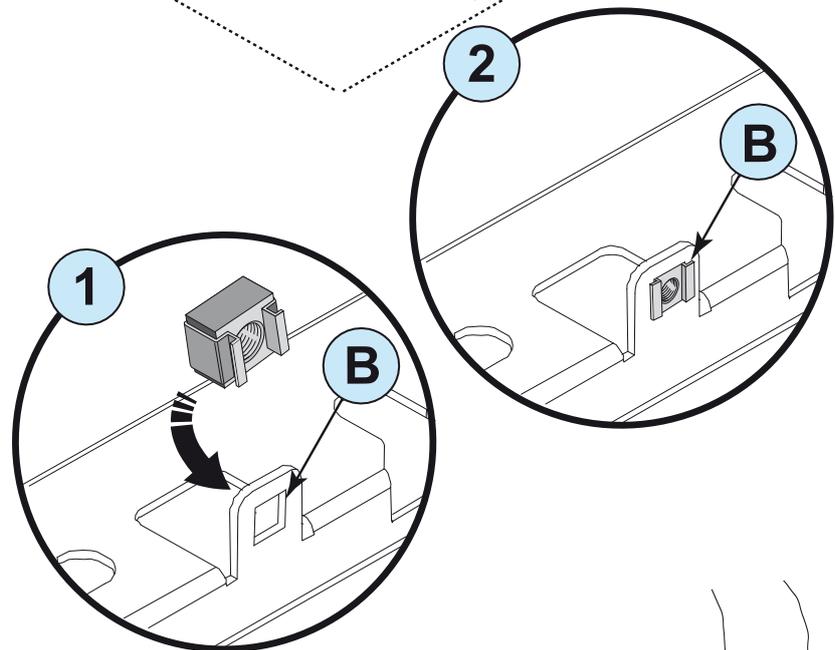


## Horizontal mount

1. Connect the 6 pieces of the horizontal bracket ① together with the 10 screws shipped with the bracket (refer to figure at right).



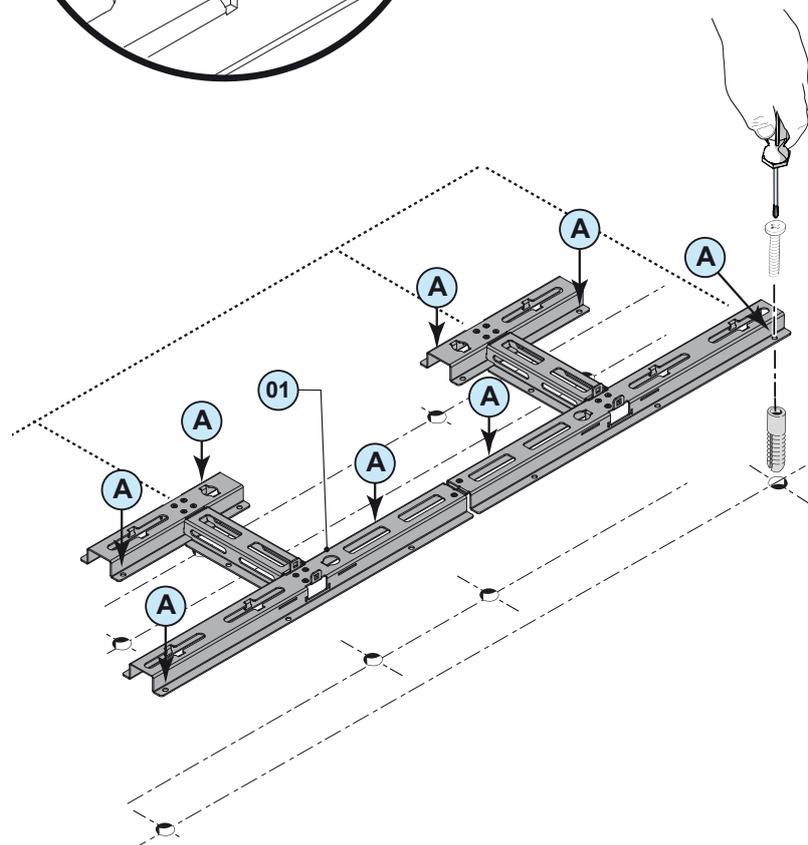
2. Install the 2 cage nuts into their seats ② on the bracket.



3. Position the bracket ① so that it is perfectly flat and use it as a drilling template.

The anchoring must ensure that the inverter is correctly attached. The type and size of anchoring depend on the type of support. Choose bolts and anchors appropriate for the structure on which the inverter is to be attached.

4. Attach the bracket to the surface and ensure that it is not distorted in shape.





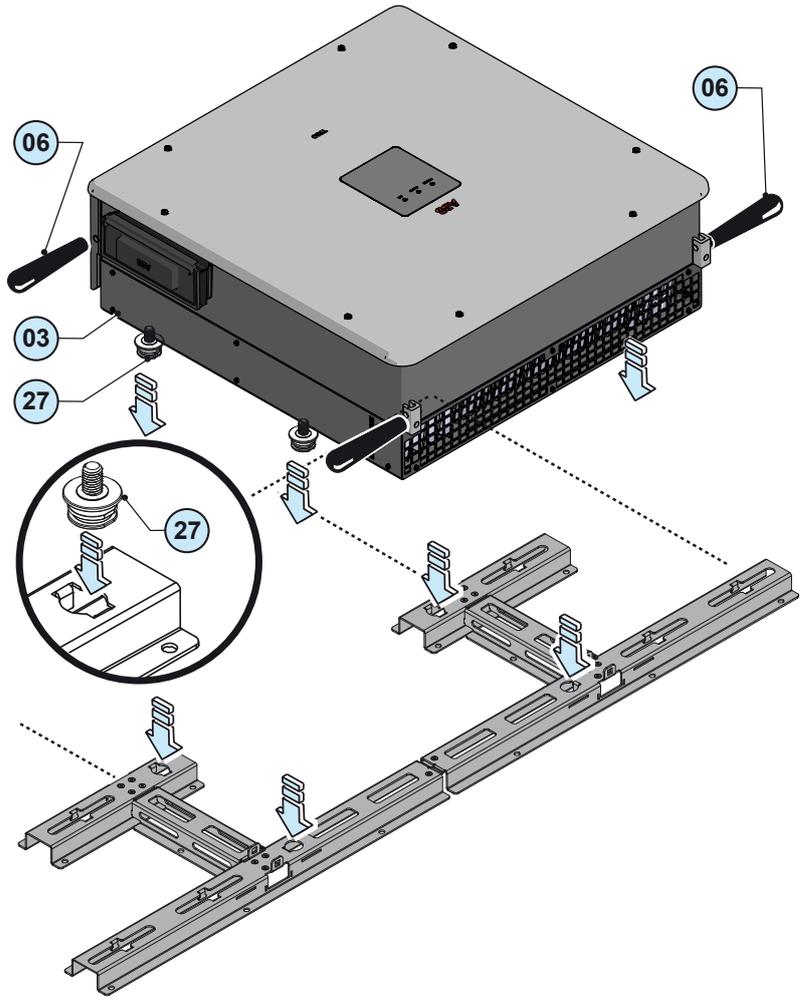
Risk of injury due to the heavy weight of the equipment.

5. Lift the power module using four handles (06) (or four M12 eyebolts) or other adequate lifting tools.

The power module is pre-equipped with metal expansions which allow it to be temporarily put vertically on the floor to make it easier the installation of handles or eyebolts.

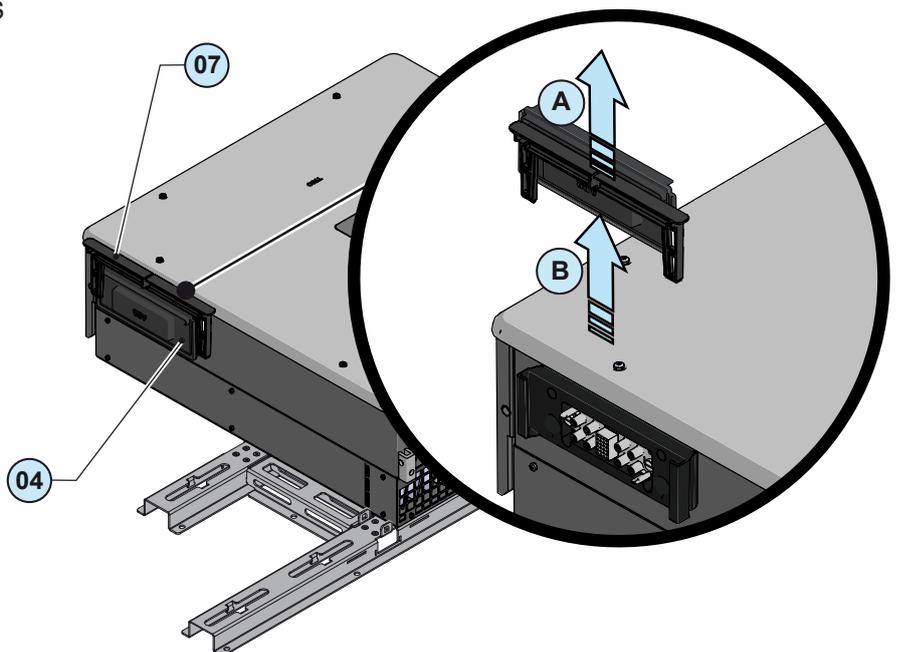
6. Lower the power module over the center of the bracket, aligning the top of the power module with top side of the bracket.

7. Check that all 4 rear pins (27) are firmly positioned in the slots on the bracket.

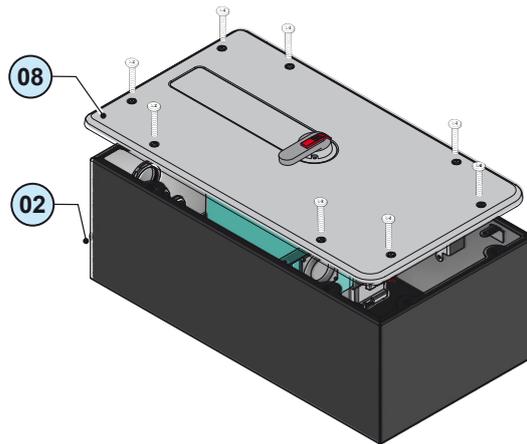


8. Remove handles or eye bolts (if used)

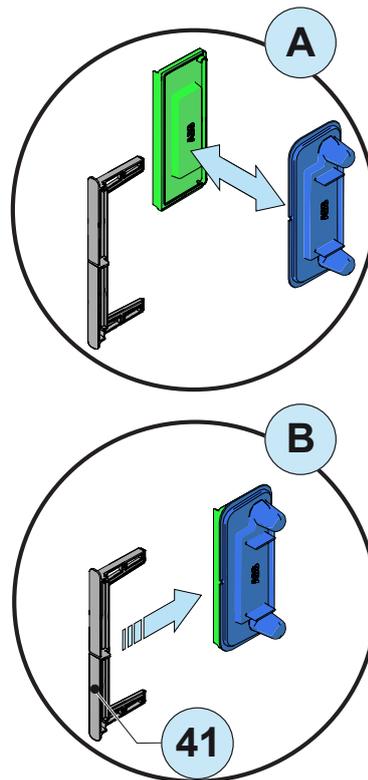
9. Remove the quick disconnect connector covers as follows:
  - Pull the metal locking fork outwards (A)
  - Pull off the quick disconnect cover (B)
 Save both parts. They will be needed in a later step.



10. Set the wiring box disconnect switches to "0"; otherwise it will not be possible to remove the front cover ⑧.
11. Unscrew the 8 screws holding the front covers ⑧ of the DC wiring box ② and AC wiring box ⑤ in place. Don't lose the screws!
12. Open the key locks and remove the covers of each wiring box.

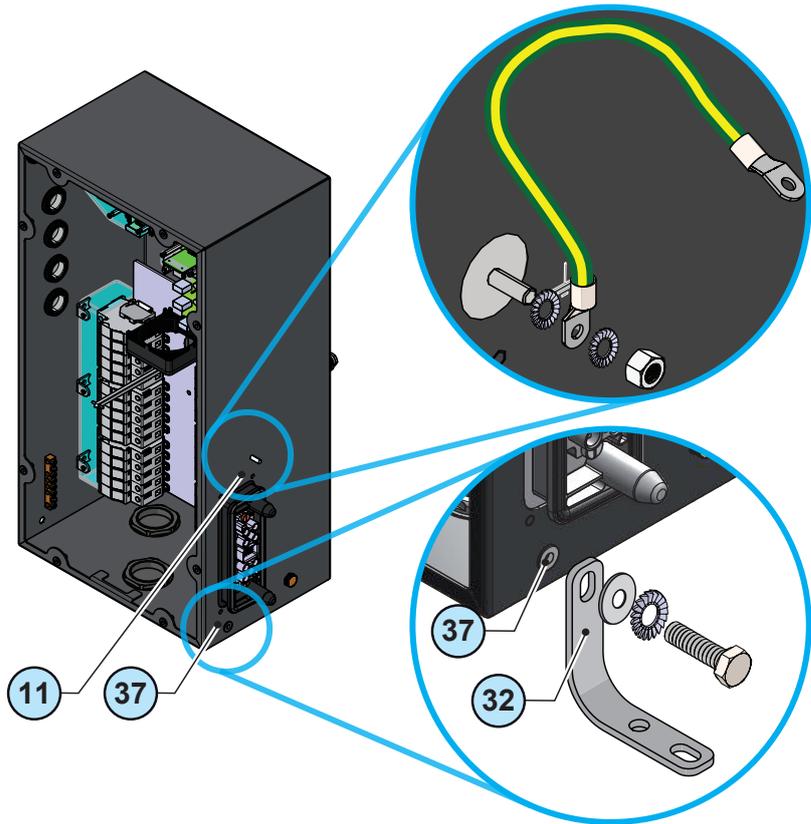


13. Remove the covers from the quick disconnect connectors, one on each wiring box. Then follow these steps to store these caps. They will be needed if the assembly ever needs to be separate:
  - A couple a power module connector cover (green in the figure) with one from a wiring box (in blue in the figure).
  - B Slip the plastic locking fork 41, which was used to secure the wiring box cover, over the two covers. **Be sure the fork is plastic, not metal.**
  - C Keep the parts available in a safe place. They could be used during maintenance operation.
  - Repeat the same operation for the other wiring box.



14. Attach the two green/yellow ground wires to the attachment points ①① on each wiring box with the following hardware stackup: lock washer, ground cable, lock washer and hex nut shipped with the inverter (torque to 11N-m or 8ft-lb). Let the loose end of the cable hang downwards.

16. Locate the ground bracket and note that it is not symmetrical. When installed at the attachment point ③⑦, the 2 holes will face downwards -- Loosely attach the ground bracket ③② to the attachment point ③⑦ on each wiring box with the M6 flat washer, M6 lock washer and the M6 hex screw, all of which are in a plastic bag shipped with the inverter. For the moment, leave screws loose and not tightened.

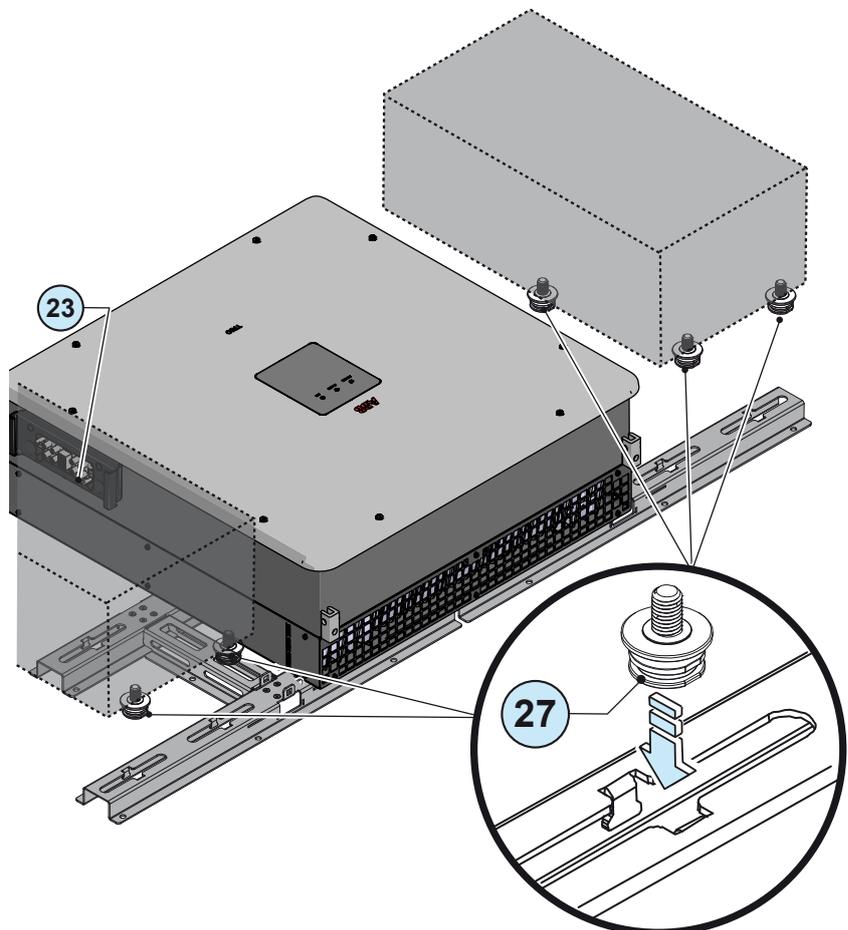


Risk of injury due to the heavy weight of the equipment.

16. Set the wiring boxes onto the edge of the bracket ①① one at a time the top three rear pins ②⑦ into the slots in the bracket.

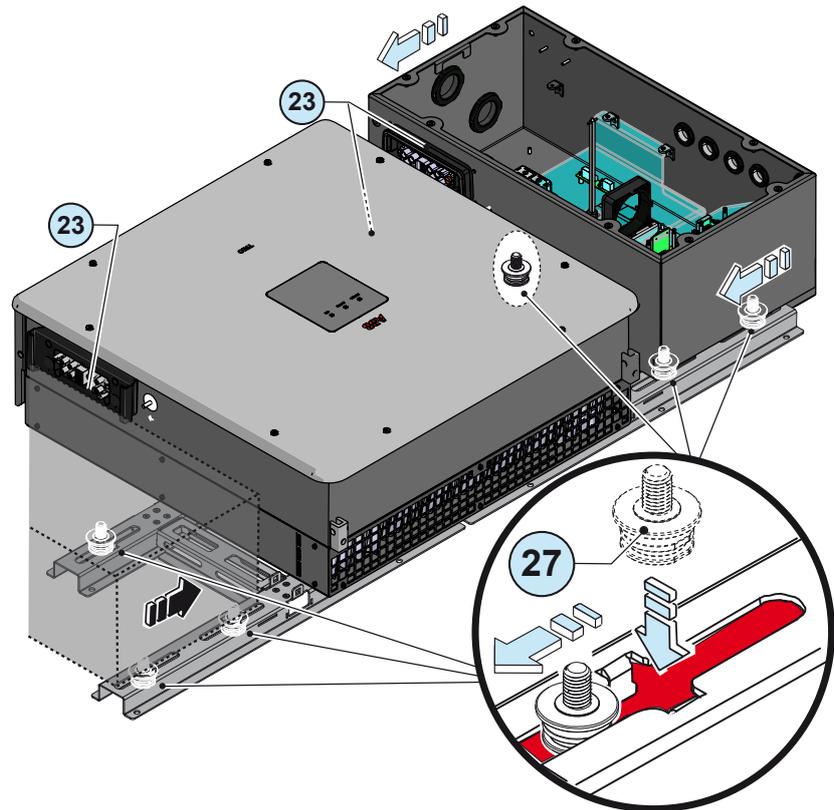
Confirm that the rear pins ②⑦ are all three inserted in the slots.

In this condition, the wiring boxes will be detached from the power module so not to interfere with the quick-fit connectors ②③



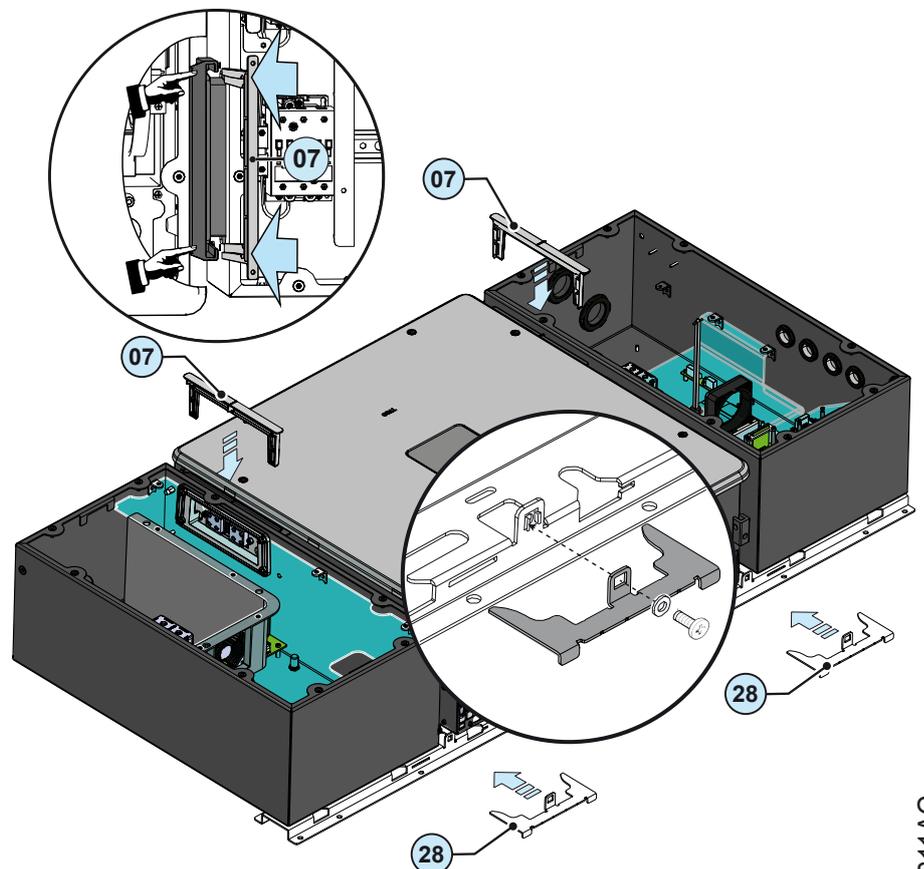
17. Attach the two wiring box ground cables (loose end of the cables) to the power module with the following hardware stackup: lock washer, ground cable, lock washer and hex nut (torque to 11N-m or 8ft-lb).

18. Slide each wiring box horizontally along the bracket **01**, into the power module. Confirm the quick disconnects **23** are completely seated.

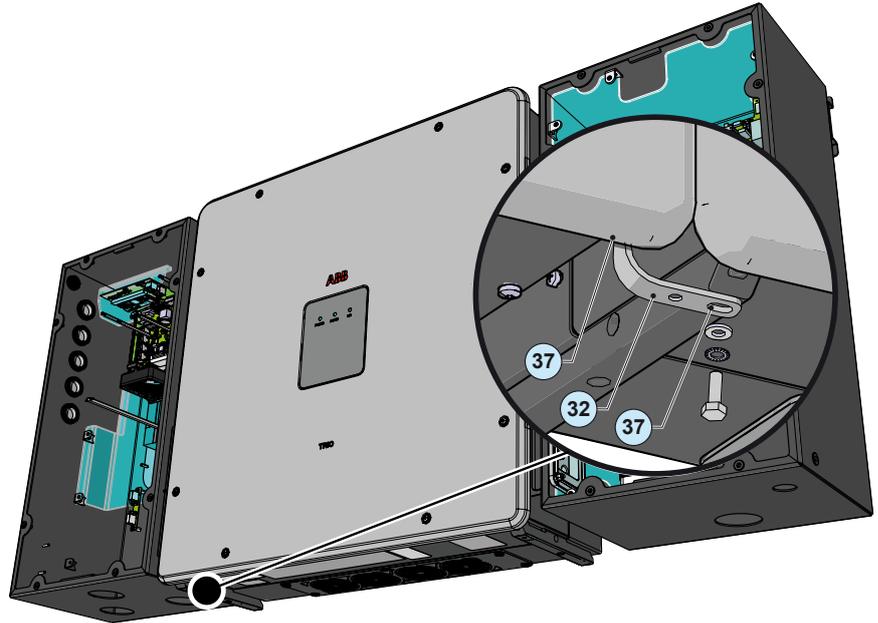


19. After sliding the wiring boxes inward, install the metal locking bracket **07** into the seats on the quick disconnects **23**. Through this step the wiring boxes will be attached to the power module.

20. Insert the stabilization forks **28** into the guides and tighten the screws on the cage nuts (which were previously mounted on the dedicated bracket slots).



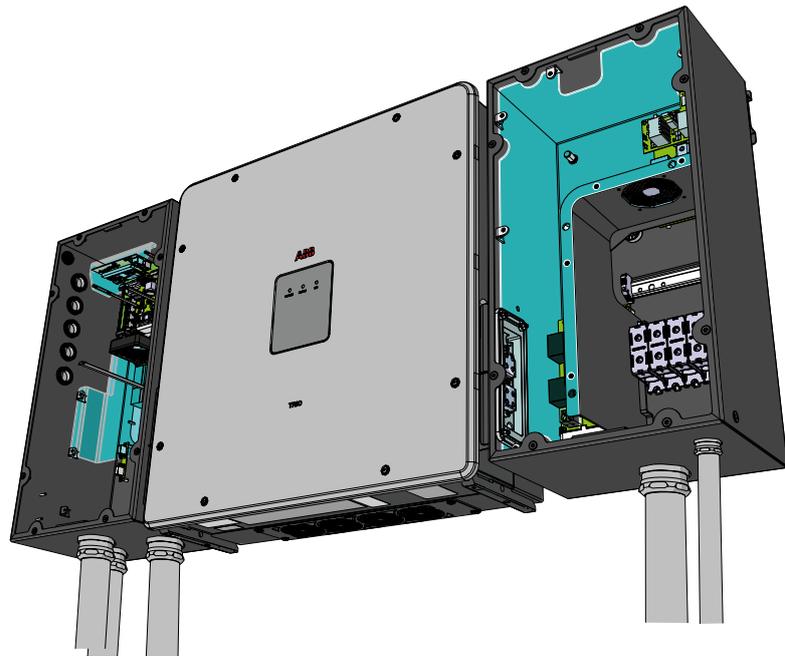
21. Attach the ground brackets ③② at the threaded inserts ③⑦ on the lower side of the power module with the M6 flat washer, M6 lock washer and the M6 hex screw, all of which are shipped with the inverter. Torque to 11N-m (8ft-lb).



22. Torque the two screws (previously installed on step 14 of this procedure) on the 2 ground brackets ③② located on the side of each wiring box. Torque to 11N-m (8ft-lb).



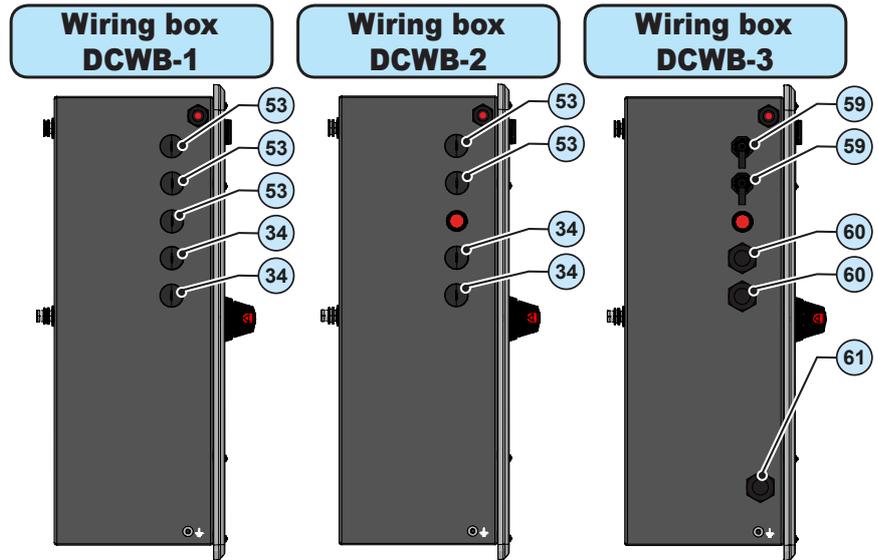
23. Remove the plug and install the conduit on the bottom side of the AC and DC (-1 and -2 models) wiring box. Use FMC (Flexible Metal Conduit) for the final two to three feet connecting to the inverter so that the inverter can be installed easily.



The input connection on DCWB-3 is made on the external quick-fit connectors and conduits are not present.

To connect low voltage conductors remove the plug and install the conduit on the left side of the DC wiring box. The conductors must be routed to the inverter in separate conduit from AC or DC power conductors. Based on the DC wiring box models there are different configuration of conduit openings/cable glands available for cable passing.

Also in this case use FMC (Flexible Metal Conduit) for the final two to three feet connecting to the inverter so that the DC wiring box can be installed easily.



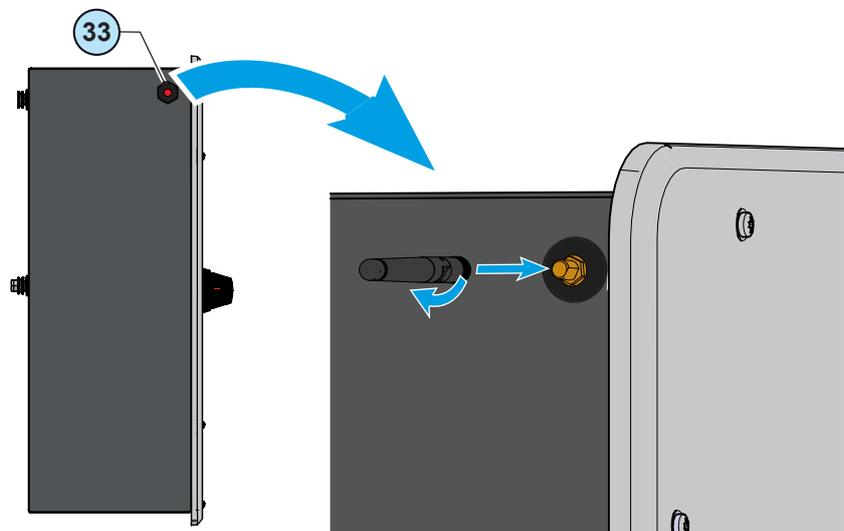
- ③④ Signal conduit opening for 3/4" (PG21 size)
- ⑤③ Signal conduit opening for 1/2" (PG13.5 size)
- ⑤⑨ external ethernet connector (RJ45)
- ⑥⑩ Signal cable gland (PG21 size)
- ⑥① EGC cable gland (PG21 size)

24. All conduits must be attached using liquid-tight fittings to maintain UL 50 Type 4X enclosure integrity.

25. Run the AC, DC and low voltage cables through the opening(s).

Only in the DCWB-3 the input connection is made on the external connectors.

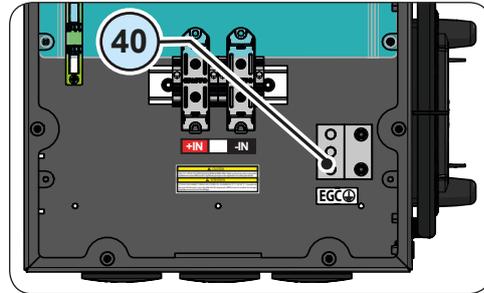
26. Remove the protective cover from the support of the wireless antenna located on the left side of the DC wiring box. Install the wireless antenna by screwing it into the specific connector.



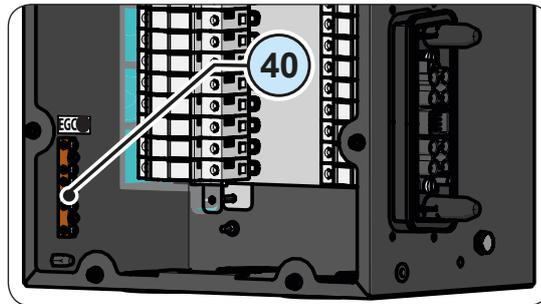
## Installing the ground cable(s)

Attach the DC side ground cable(s) to the equipment grounding conductor (EGC) terminal blocks (40).

**DCWB-1:** EGC terminal block accept 3 wires 4AWG to 0AWG, copper or aluminum (Torque to 14Nm / 10.3 ft-lb).

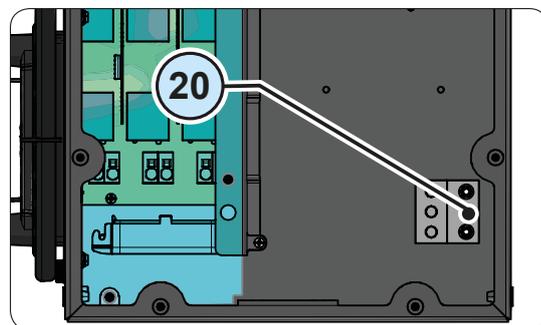


**DCWB-2 and-3 :** EGC busbar accept 6 copper wires 6AWG to 4AWG (Torque to 14Nm / 10.3 ft-lb).



Attach the AC side ground cable(s) to the protective earth (PE) connection point (20).

**ACWB:** Attach the system (site) ground cables on the terminal block (20) in the back of the AC wiring box. The terminal block accept 3 wires 4AWG to 0AWG, copper or aluminum (Torque to 14Nm / 10.3 ft-lb).



After connecting the ground wires, but before starting work on the DC or AC wiring, use a suitable ohmmeter to check the conductivity of the ground connections between:

1. one of the AC wiring box cover screw thread inserts, and and one of DC wiring box cover screw thread inserts
2. one of the AC wiring box cover screw thread inserts and a screw on the power module cover

## Grid output connection (AC side)

The medium voltage transformer, i.e. the grid (distribution system), must face the inverter as a **grounded WYE**, whose Neutral may or may not be brought to the inverter:

- Lines 1,2,3, Neutral + GND (“four-wire”) OR
- Lines 1, 2 3 + GND (“three-wire,” and in this case, the inverter creates its own “virtual” neutral)

**Delta connections to the grid are NOT permitted.**



*Caution! Connect the ground before the grid connections.*

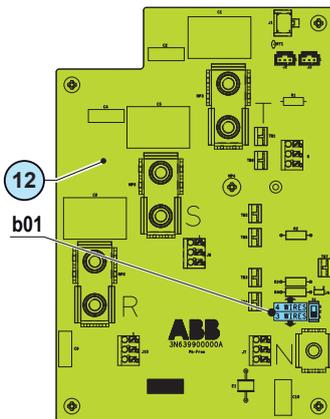
### Connection to the AC terminal block



*To prevent electrocution hazards, open and lock out /tag out the external AC disconnect switch before connecting the AC conductors, and any time the AC wiring box cover is to be removed. Proper PPE is required.*

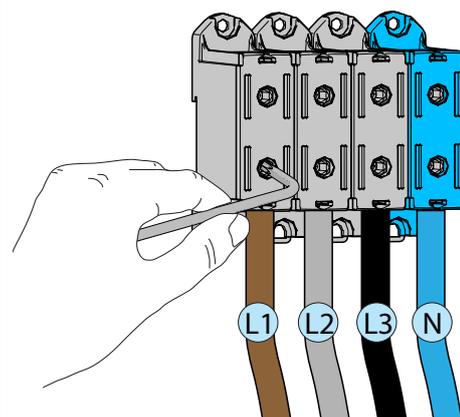
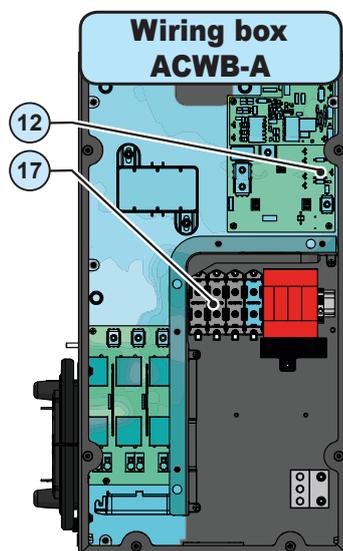
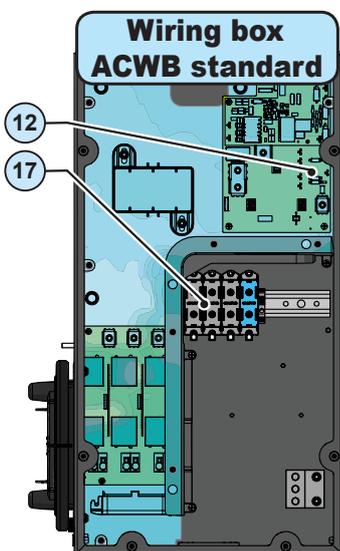


*Caution! Confirm the ground connection before starting the grid connections.*



#### Standard and - A models AC wiring box:

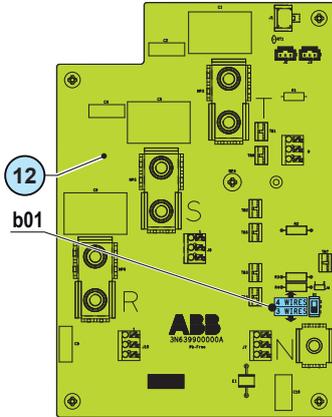
- Confirm the size of grid conductors 4AWG to 3/0AWG (copper or aluminum)
- Confirm the right setting of the switch on the AC filter board (in the ACWB) for the neutral connection to the grid:  
3WIRES → WYE connections with no neutral (L1+L2+L3+GND)  
4WIRES → WYE configurations with neutral (L1+L2+L3+N+GND)
- Connect the grid conductors (L1, L2, L3, Neutral) to the respective terminals on the AC output terminal block 17 in the AC wiring box. Observe the connection sequence of the phases L1, L2, L3 otherwise the inverter will enter in error state.
- Torque to 20Nm / 14.7 ft-lb
- Give each wire a pull test to confirm the connection is secure.



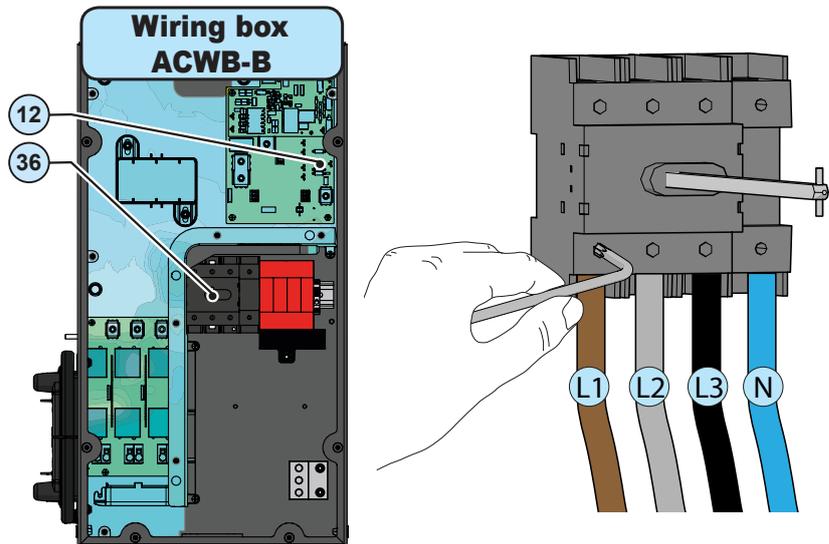
**-B model AC wiring box:**



The AC disconnect switch is designed for copper wire. If aluminum wire is to be used, terminate the aluminum wire with a bi-metallic terminal.



- Confirm the size of grid conductors 7AWG to 1/0AWG
- Confirm the right setting of the switch on the AC filter board (in the ACWB) for the neutral connection to the grid:  
 3WIRES → WYE connections with no neutral (L1+L2+L3+GND)  
 4WIRES → WYE configurations with neutral (L1+L2+L3+N+GND)
- Connect the grid conductors (L1, L2, L3, Neutral) to the respective terminals on the AC disconnect switch ③⑥ in the AC wiring box. Observe the connection sequence of the phases L1, L2, L3 otherwise the inverter will enter in error state.
- Torque to to 6 N·m (53in·lb)
- Give each wire a pull test to confirm the connection is secure.



# Operations preliminary to the connection of the PV generator

## Confirm the PV arrays have no ground leakage

Measure the voltage present between positive and negative terminal of each string with respect to ground.

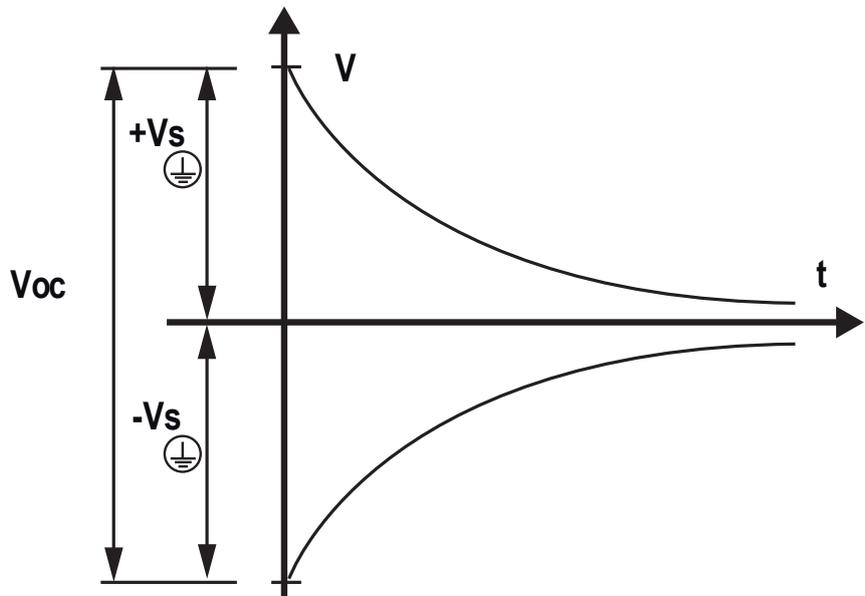
If voltage is measured between an input terminal and ground, there may be low insulation resistance in the PV array. Before installation, the low insulation resistance must be located, and the problem repaired.



*Do not connect the strings if leakage to ground has been detected, as the inverter will not connect to the grid.*

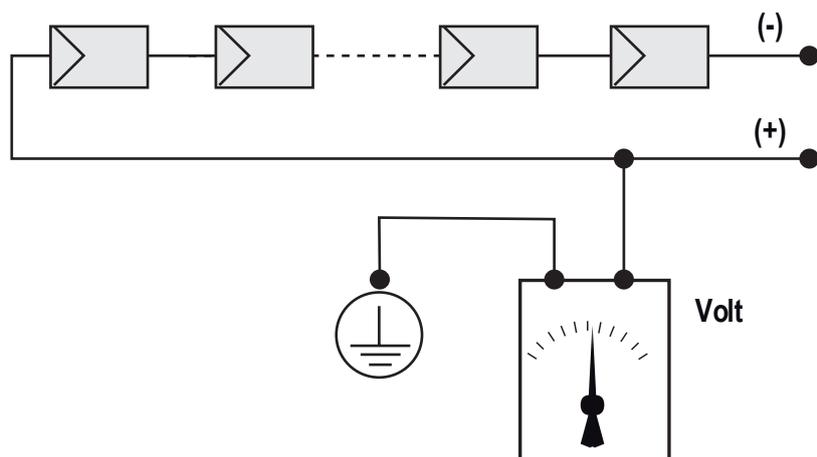
### Behavior of a system without leakage:

Due to stray capacitance inherent in the PV array, a voltmeter connected between an input terminal and ground will initially read about  $V_{oc}/2$ , then bleed off to  $\sim 0V$  if there is no ground leakage. This is shown in the graph below:



The internal resistance of the voltmeter tends to bleed off the voltage on any PV array capacitance.

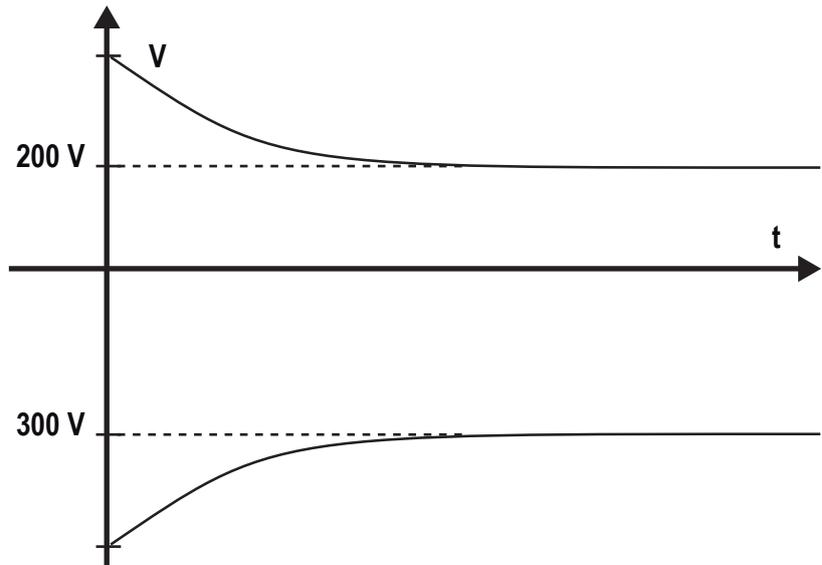
How to make the measurement:



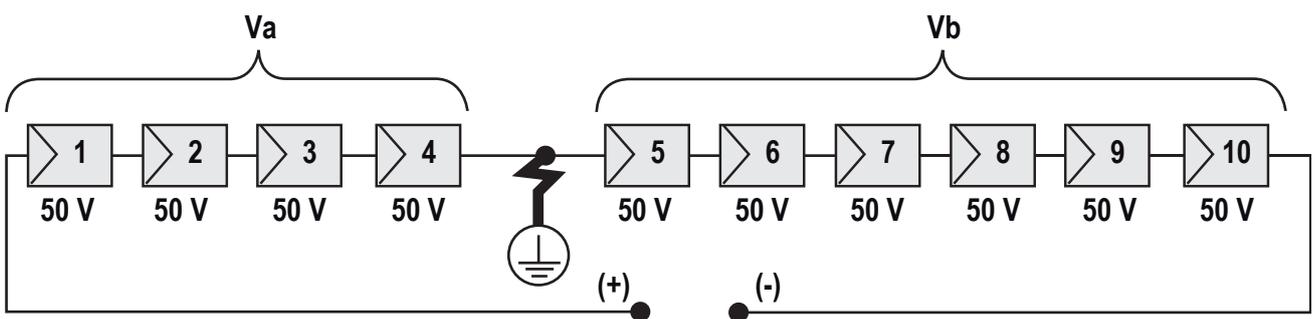
### Behavior of a system with leakage

If the voltage measured between one of the two terminals and ground does not discharge to 0V, but stabilizes on a non-zero value, there is ground leakage from the PV array.

Example: If the measurement is made between positive terminal and ground, and a voltage of 200V is measured....



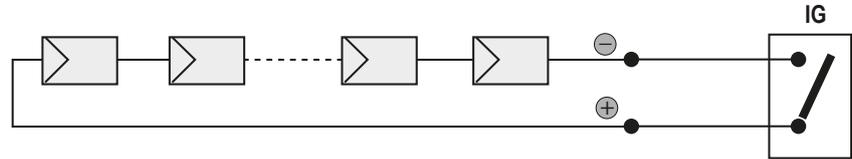
This means that if the system is made up of 10 modules in series and each one supplies 50V, the leakage is located between the 4th and 5th PV module.



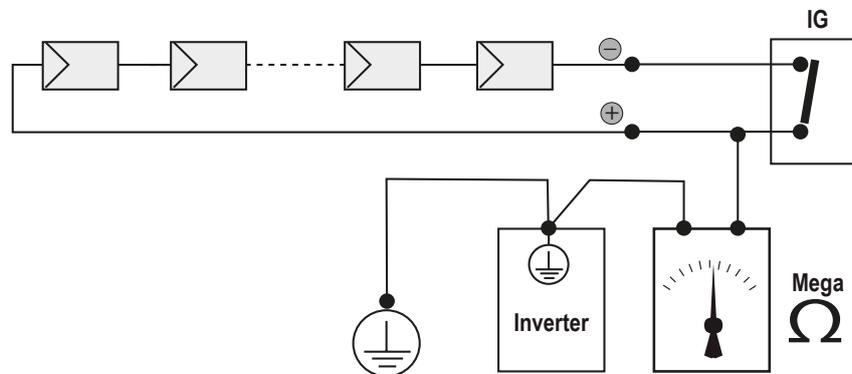
$V_a$  = voltage measured between + terminal and  $\oplus$  = 200V  
 $V_b$  = voltage measured between - terminal and  $\oplus$  = 300V  
 In all measurements with  $\oplus$ , the ground of the inverter is indicated.

## Measuring the insulation resistance of the PV array.

To measure the insulation resistance (from ground  $\oplus$ ) in the PV array, the two terminals of the PV array must be short circuited (using a suitably sized short).



Once the short circuit has been made, measure the insulation resistance (Riso) using a megohmmeter positioned between the two shorted terminals and ground (of the inverter).



If the measured insulation resistance (Riso) is less than 100 KOhm, the inverter may not connect to the grid because of low insulation resistance to ground in the PV array.

*The insulation resistance will be affected by the environmental conditions. The measurement must be made immediately after the anomaly is detected, especially if the PV array is damp after rain, dew or overnight humidity,*

## Confirm string voltage and correct polarity

In full sun, measure the positive (+) to negative (-) voltage for each string in the PV array. Confirm the polarity is correct.

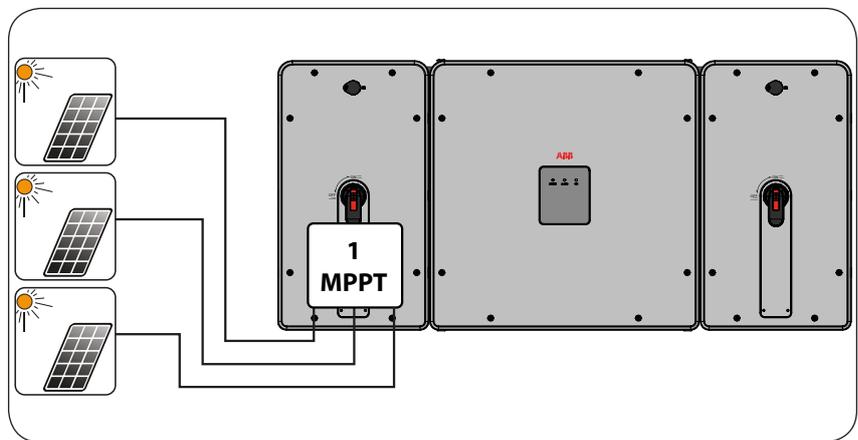
If the open circuit voltage (Voc) is anywhere near the inverter maximum input voltage rating, stop and confirm that during a full sun start up on the coldest possible day of the year, the PV string will not exceed 950Vdc. If it seems it might be approach 950Vdc, reduce the number of PV modules in the string(s) to avoid out-of-warranty damage to the inverter.

## Independent or parallel input channels configuration

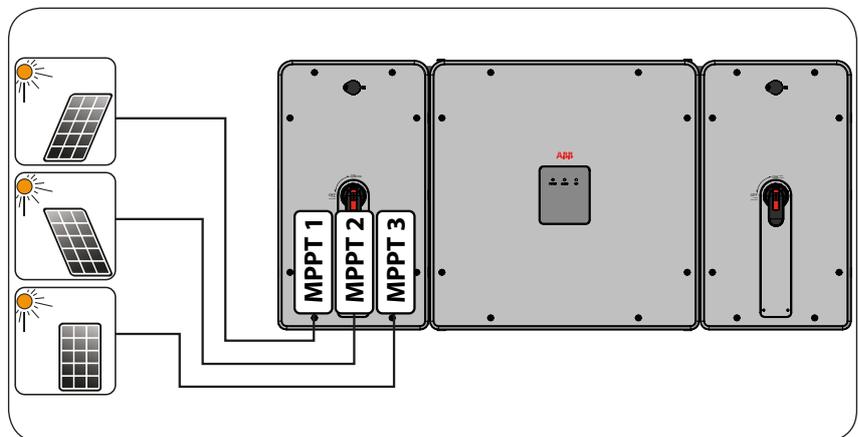
The inverter equipped with DC wiring box -2 and -3 versions have three input channels (thus benefiting from three trackers for MPPT maximum power point tracking) which work independently of one another, which can be paralleled by leveraging a single MPPT.

Strings of photovoltaic modules having the same type and number of panels in series must be connected to each single channel; they must also have the same installation conditions (in terms of orientation to the SOUTH and inclination from the horizontal plane).

When connecting the three input channels in parallel, you must comply with the above requirements in order to benefit from the ability to leverage the full power of the inverter output on a single channel.



The multi MPPT structure however allows management of three photovoltaic generators which are independent of each other (one for each input channel), and which may differ between themselves with regard to installation conditions, type and number of photovoltaic modules connected in series. A necessary condition for the three MPPT to be used independently is that the photovoltaic generator connected to each of the inputs has a lower power than the power limit of the single input channel and a maximum current lower than the current limit of the single input channel.



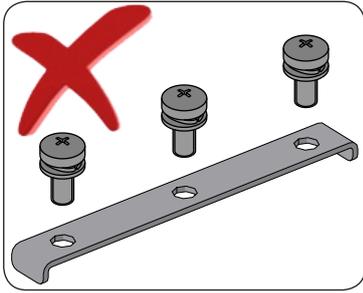
All input parameters that must be met for correct inverter operation are shown in the "technical data" table.

## Channel configuration examples

PV generator characteristics	MPPT configuration	Notes
<p>The photovoltaic generator consists of strings having a <b>different</b> number of modules in series from each other.</p> <p>The photovoltaic generator consists of strings that have <b>different</b> installation conditions from each other.</p>	<p><b>MPPT configuration has to be INDEPENDENT</b></p>	<p>A <b>NECESSARY</b> condition so that the three MPPTs can be used in independent mode is for the photovoltaic generator connected to each of the inputs to have a power <b>lower</b> than the power limit of the single input channel <b>AND</b> a maximum current <b>lower</b> than the current limit of the single input channel.</p>
<p>The photovoltaic generator consists of strings having the <b>same</b> number of modules in series as each other.</p> <p>The photovoltaic generator consists of strings that have the <b>same</b> installation conditions, that is to say, all the strings have the <b>same</b> inclination from the horizontal and the <b>same</b> orientation to the SOUTH.</p> <p>The photovoltaic generator connected to each of the inputs has a power <b>lower</b> than the power limit of the input channel <b>AND</b> a current <b>lower</b> than the current limit of the input channel.</p>	<p><b>Possibility of choosing between the configuration with MPPT as INDEPENDENT or PARALLEL</b></p>	<p>A <b>NECESSARY</b> condition so that the three MPPTs can be used in independent mode is for the photovoltaic generator connected to each of the inputs to have a power <b>lower</b> than the power limit of the input channel <b>AND</b> a maximum current <b>lower</b> than the current limit of the input channel.</p> <p>An <b>ADVISABLE</b> (*) condition so that the three MPPTs can be connected in parallel is for the photovoltaic generator connected to the three inputs to consist of strings made by the <b>same</b> number of modules in series and for all the modules to have the <b>same</b> installation conditions.</p>
<p>(*) <i>This condition is advisable from the point of view of the energy production of the system, not from the point of view of inverter operation.</i></p> <p>The photovoltaic generator consists of strings having the <b>same</b> number of modules in series as each other.</p> <p>The photovoltaic generator consists of strings that have the <b>same</b> installation conditions, that is to say, all the strings have the <b>same</b> inclination from the horizontal and the <b>same</b> orientation to the SOUTH.</p> <p>The photovoltaic generator connected to each of the inputs has a power <b>higher</b> than the power limit of the input channel <b>OR</b> a current <b>higher</b> than the current limit of the input channel.</p>	<p><b>MPPT configuration has to be PARALLEL</b></p>	<p>A <b>SUFFICIENT</b> (*) condition so that the three MPPTs must be used in parallel mode is for the photovoltaic generator connected to each of the inputs to have a power <b>higher</b> than the power limit of the single input channel <b>OR</b> a maximum current <b>higher</b> than the current limit of the single input channel.</p> <p>An <b>ADVISABLE</b> (**) condition so that the three MPPTs can be connected in parallel is for the photovoltaic generator connected to the three inputs to consist of strings made by the same number of modules in series and for all the modules to have the same installation conditions.</p>
<p>(*) <i>This condition is sufficient from the point of view of the energy production of the system, not from the point of view of inverter operation.</i></p> <p>(**) <i>This condition is advisable from the point of view of the energy production of the system, not from the point of view of inverter operation.</i></p>		

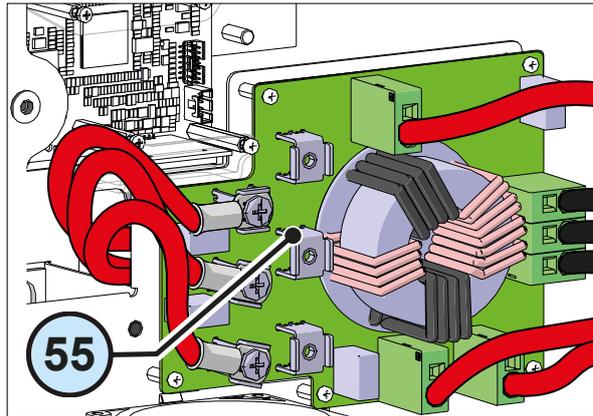


## Independent channel configuration (default configuration)



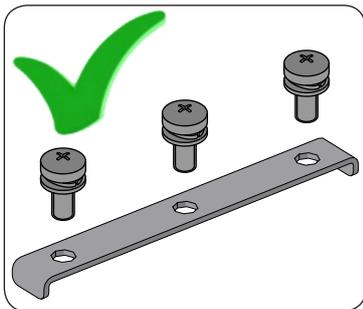
In the inverter equipped with DC wiring box -2 and -3 versions, the independent configuration of the input channels (MPPT) is set at the factory. This means that the parallel bar (supplied) must not be installed on the parallel MPPT connection points (55), and that the software setting “Independent channel mode” should be performed on the inverter; this setting can be done by different way:

1. During the commissioning wizard phase (STEP 4)
2. In the dedicated section of the internal webserver “**Setup section > Setup DC side > Input mode**”



*In the inverter equipped with DC wiring box -1 is available only one input channel and therefore not possible to set the inputs as independent*

## Parallel channel configuration

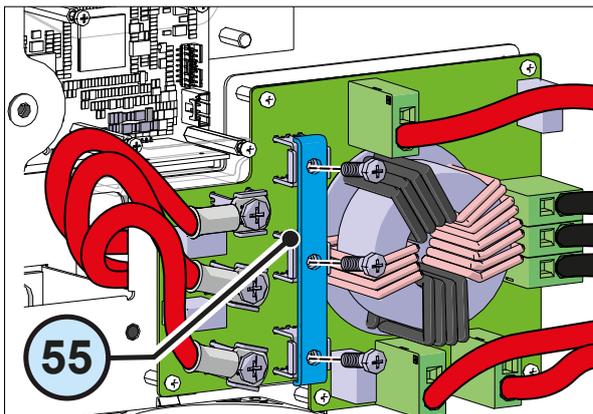


In the inverter equipped with DC wiring box -2 and -3 versions, the configuration of the input channels (MPPT) can be set in parallel. This means that the parallel bar (supplied) must be installed on the parallel MPPT connection points (55), and that the software setting “parallel channel mode” should be performed on the inverter; this setting can be done by different way:

1. During the commissioning wizard phase (STEP 4)
2. In the dedicated section of the internal webserver “**Setup section > Setup DC side > Input mode**”

To install the parallel bar follow the procedure below:

- Place the parallel bar (supplied) on the connection points
- Install the 3 screws with washers supplied (torque 4Nm / 3.0 ft-lb)



## DC input connection

After having carried out preliminary checks and therefore having verified that there are no problems in the photovoltaic system, and the channel configuration has been selected (parallel or independent) you may connect the inputs to the inverter.



According to the system configuration, check the correct setting of the channels to independent or in parallel mode. An incorrect setting of the input channels can lead to loss of energy production.



Comply with the maximum input current relating to the quick-fit connectors as indicated in the technical data.



Polarity inversion can cause serious damage. Check polarity before connecting each string!



When the photovoltaic panels are exposed to sunlight they provide continuous DC voltage to the inverter. To avoid risks of electrical shock, **all wiring operations must be carried out with the DC disconnect switch (internal or external to the inverter) OFF.**



The DC disconnect switch disconnects the DC current from the PV panels in the "OFF" position. The inverter will stop producing power, but **DOES NOT** disconnect the AC from the grid. To prevent electrocution hazards, all the connection operations must be carried out with the external AC disconnect switch (grid side) of the inverter open and locked out.

The transformerless design of the inverter requires that the PV array be floating with respect to ground, per NEC 690.35.

Per NEC 690.35, wires from the PV array must be listed by accredited NRTL, 1000V minimum rating, 90°C minimum temperature rating.

The connections can also be made with the wiring box <sup>02</sup> detached from the power module <sup>03</sup> that can be connected later for commissioning.

When working with the wiring box <sup>02</sup> detached, pay particular attention to:

- presence of a temporary ground connection
- coupling connector must always be protected in outdoor installations.

The DC side connections are different according to the wiring box used:

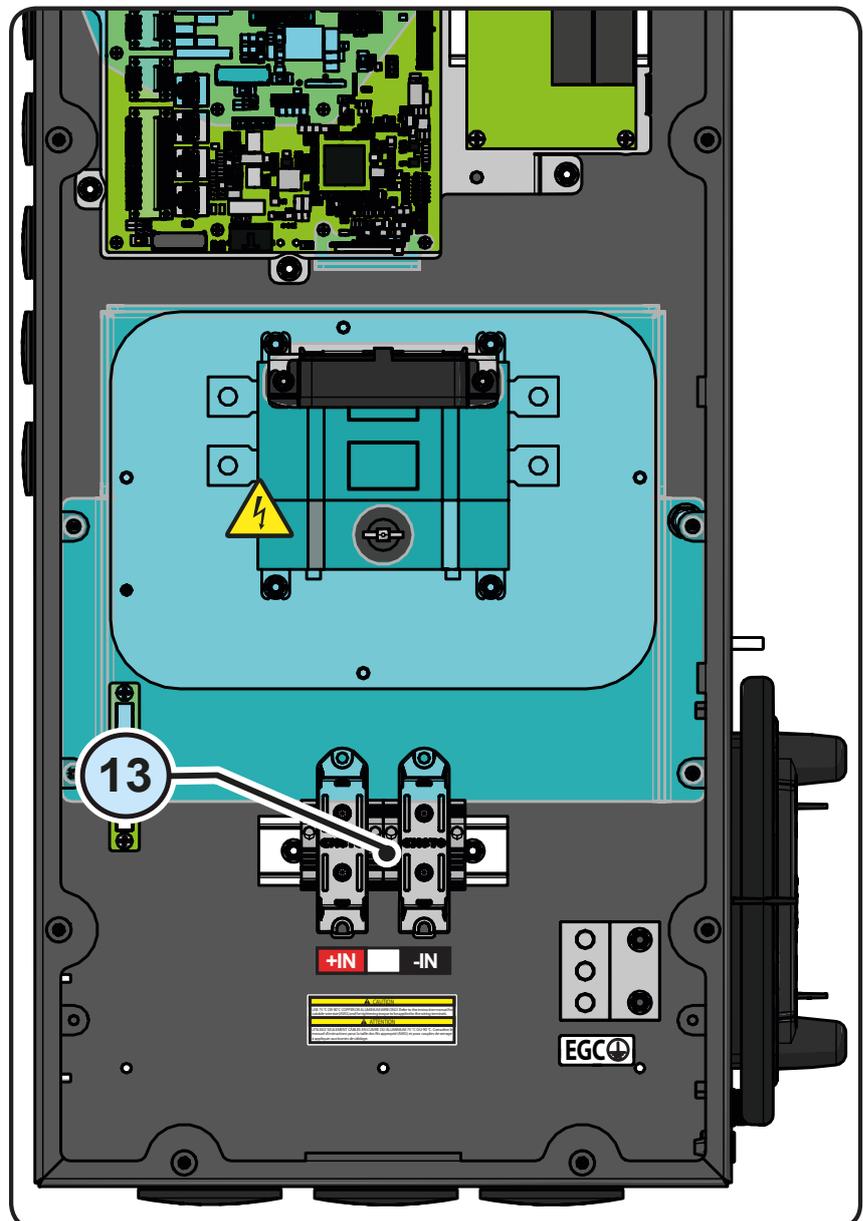
- **DCWB-1** - Conduits and terminal blocks
- **DCWB-2** - Conduits and fuse holders
- **DCWB-3** - Quick fit connectors (one for each pole of each string).

On the **DCWB-1** version, the connection in parallel of the strings ( array composition) must take place upstream of the input in the inverter and must be made by technicians during installation.

The **DCWB-2** and **DCWB-3** versions accept a direct single strings connection with connectors which are located on the outside of the wiring box <sup>02</sup>.

## DCWB-1 DC wiring box PV inputs

- Confirm that PV array equipment ground wire(s) is connected to the equipment ground terminal block (labelled “EGC”) in the DC wiring box.
- Confirm the DC cables are 4AWG - 3/0AWG, copper or aluminum.
- Connect PV array to the the DC input terminal block ⑬ (+ and -).
- Torque screws to 14 N-m (10.3 ft-lb).
- When finished, go back and confirm the polarity is correct for each string.
- Give each wire a pull test to confirm the connection is secure.



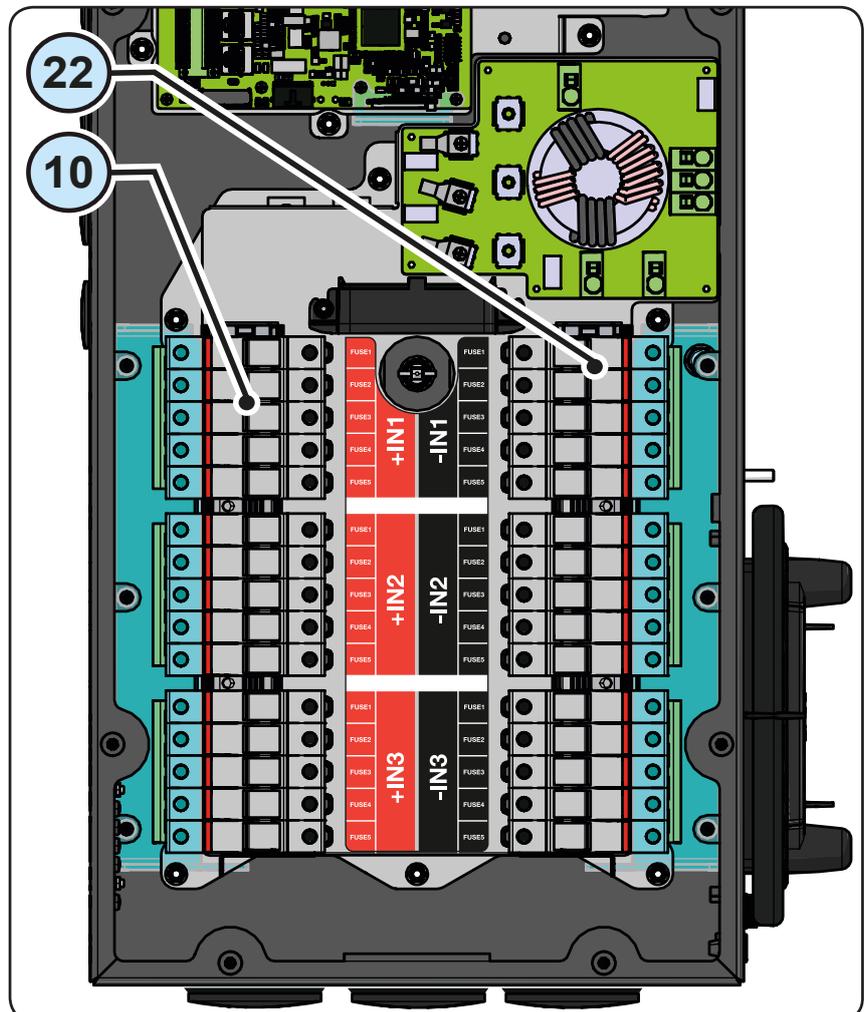
## DCWB-2 DC wiring box PV inputs

- Confirm that PV array equipment ground wire(s) is connected to the equipment ground busbar (labelled “EGC”) in the DC wiring box.



*DCWB-2 models have fuse holders for each individual string conductor pair. Fuses are sized for single-string currents only.*

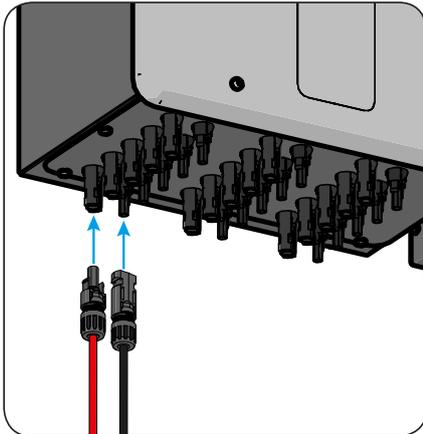
- Confirm that strings are not paralleled in the PV array.
- Confirm that the string fuse size is below of 20A
- Confirm the DC cables are 12AWG to 3AWG
- Connect each string to the fuse holders (+ and -) following site wiring diagrams. Fuse 1 (+) is the top left. Fuse 1 (-) is the top right.
- Torque screws to 3.4Nm (30 in-lb).
- When finished, go back and confirm the polarity is correct for each string.
- Give each wire a pull test to confirm the connection is secure.



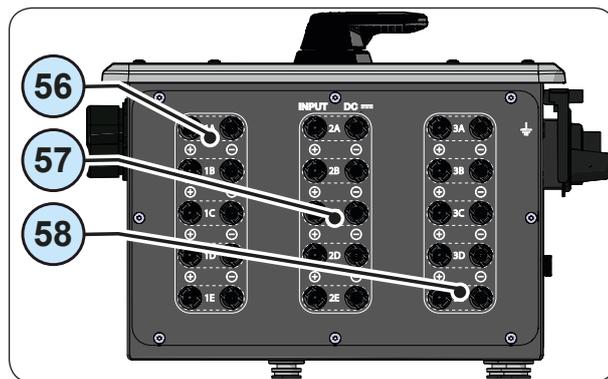
## DCWB-3 DC wiring box PV inputs

- Confirm that PV array equipment ground wire(s) is connected to the equipment ground busbar (labelled “EGC”) in the DC wiring box.

*DCWB-3 models have fuse holders for each individual string conductor pair. Fuses are sized for single-string currents only.*



- Confirm that strings are not paralleled in the PV array.
- Confirm that the string fuse size is below of 20A
- Install the quick fit connectors on the string cables following the instruction on the “Installation procedure for quick-fit connectors” paragraph.
- Connect each string to the quick fit connectors (usually Weidmüller PV-Stick, WM4, MultiContact MC4 or Amphenol H4) located on the bottom of the DCWB, following site wiring diagrams. The input connectors are divided into 3 groups (one group for each input channel) consisting of 5 pairs of quick fit connectors.



*Refer to the document “String inverter – Product Manual appendix” available at [www.abb.com/solarinverters](http://www.abb.com/solarinverters) to know the brand and the model of the quick fit connector. Depending on the model of the connector of the own inverter, it is necessary to use the same model and the respective counterpart (check the compliant counterpart on the website of the manufacturer or in ABB)*

- When finished, go back and confirm the polarity is correct for each string.
- Give each wire a pull test to confirm the connection is secure.



*Using corresponding parts that are not compliant with the quick fit connector models on the inverter could cause serious damage to the unit and void of the warranty.*

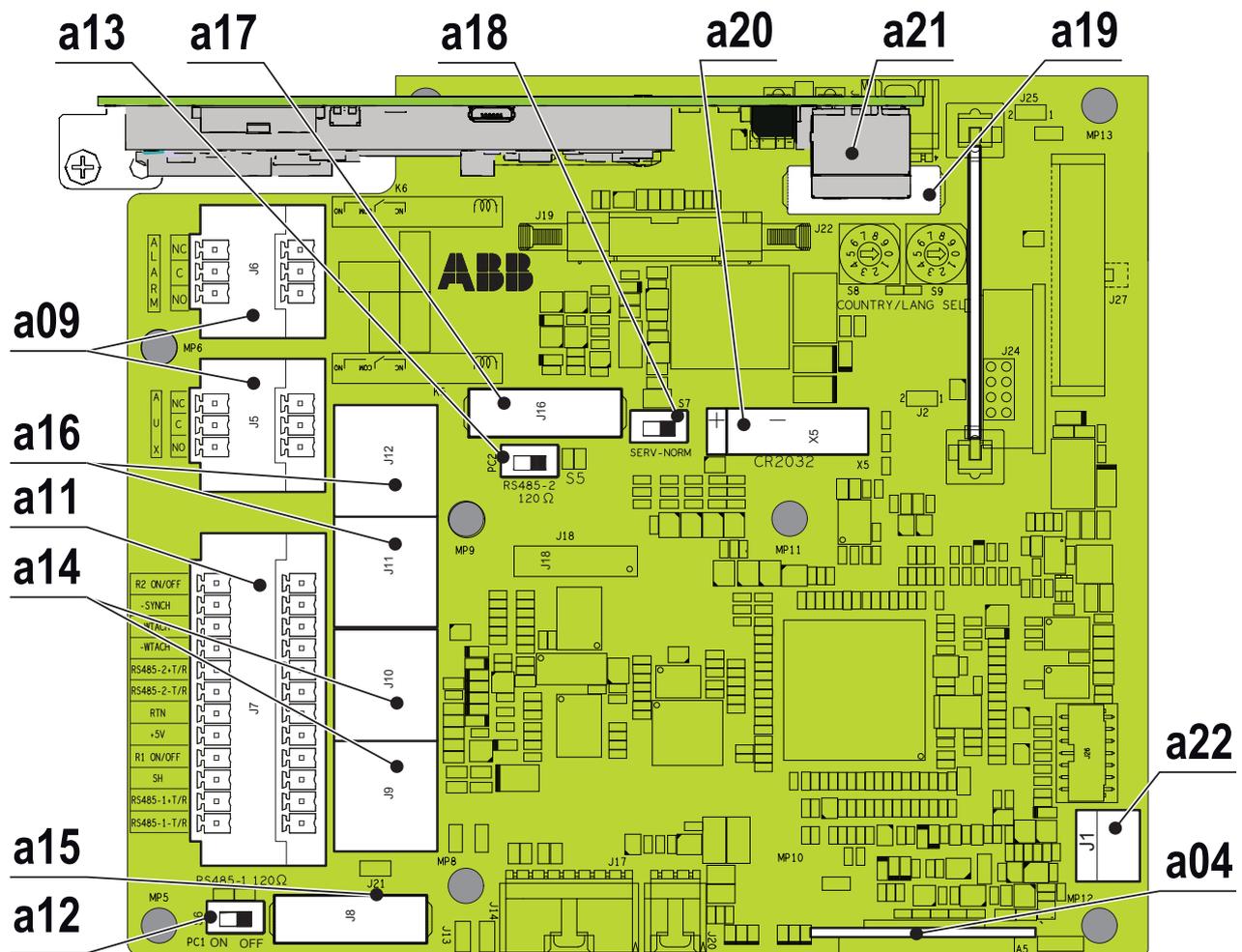


*If any string inputs are not required, you must ensure that covers are installed to the connectors, and install any which are missing. This is necessary both for the inverter seal, and to avoid damage to the free connector which may be used at a later time.*



*In these versions of the wiring box, it is MANDATORY to directly connect the individual strings coming into the inverter (do not make field switchboards for parallel strings). This is because the string fuses, situated on each input, are not rated to take strings in parallel (array). This operation can cause damage to the fuse and consequently malfunctioning of the inverter.*

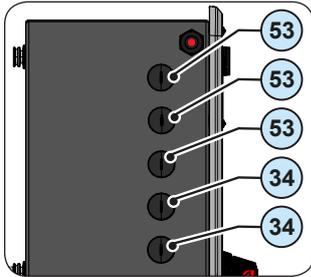
## Communication and control board



Code	Reference	Description of the communication and control board ⑨
A5	<b>a04</b>	SD card housing
J5 - J6	<b>a09</b>	Connection to the multifunction relay (ALARM and AUX)
J7	<b>a11</b>	Connection of the RS485 (PC) lines, of the remote ON/OFF and 5V auxiliary lines
S6	<b>a12</b>	RS485 line (1) termination resistance selector switch
S5	<b>a13</b>	RS485 line (2) termination resistance selector switch
J9 - J10	<b>a14</b>	RS485 (1) line connection on RJ45 connector
J8	<b>a15</b>	RS485 (1) communication card housing
J11 - J12	<b>a16</b>	RS485 (2) line connection on RJ45 connector
J16	<b>a17</b>	RS485 (2) communication card housing
S7	<b>a18</b>	Switch to set the inverter to normal or service mode
J22	<b>a19</b>	Inverter data memory card housing
X5	<b>a20</b>	Battery housing
	<b>a21</b>	Ethernet connectors
J1	<b>a22</b>	Grounding kit housing (optional kit)

## Connections to the communication and control board

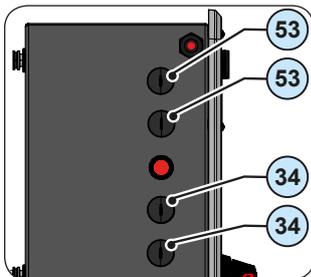
The communication and control signals are connected to the communication and control board inside the DC wiring box or directly to the connectors on the external of the inverter. In particular, on the left side of the DC wiring box, there are 3 different configuration based on the type of DC wiring box:



DCWB-1. This DC wiring box equipped with 5 holes on which plugs are installed. In particular there are:

- 2 holes of diameter 21mm (53).
- 1 hole of diameter 22.1mm (53).
- 2 holes of diameter 28.5mm (34).

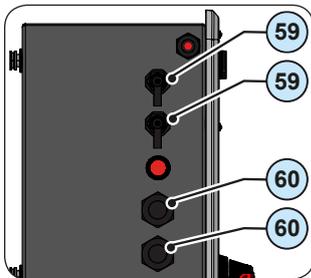
These holes can be used to install conduits or cable gland to pass the signals/ethernet cables inside the wiring box.



DCWB-2. This DC wiring box equipped with 4 holes on which plugs are installed. In particular there are:

- 2 holes of diameter 21mm (53).
- 2 holes of diameter 28.5mm (34).

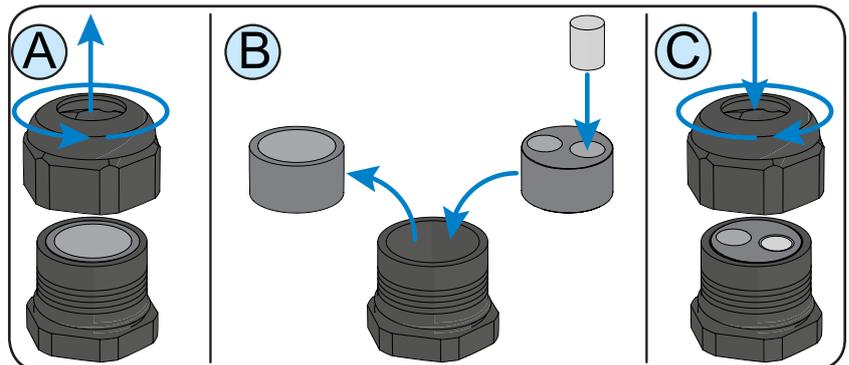
These holes can be used to install conduits or cable gland to pass the signals/ethernet cables inside the wiring box.



DCWB-3. This DC wiring box equipped with:

- 2 ethernet connector (59). The two connectors can be used for the daisy-chain connection (in / out) of inverters present on the system. The ethernet connection can be used to monitor, configure, and update the firmware remotely.
- 2 PG21 cable glands (60) that can be used to reach the terminals / connectors on the communication and control board. Each cable gland accepts a cable (from 13 mm to 18 mm diameter).

As an alternative to each cable gland, the two-hole gasket (supplied) can be installed, which accepts two cables with a diameter of 1.5 to 6mm; If a seal hole is not to be used, it is necessary to install a plug (supplied plastic cylinder) to ensure the inverter's sealing.

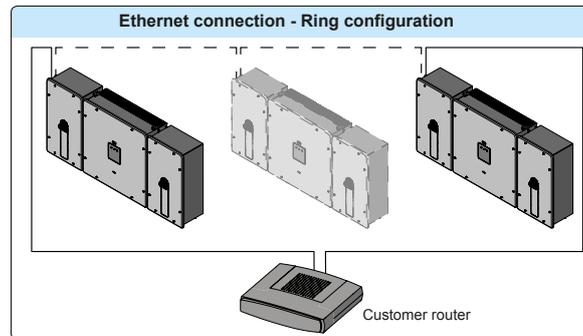


## Ethernet connection configuration



*In order to avoid ground loop (that could create communication issues) the shield of any Ethernet cable must be connected to the RJ45 plug in only one side, the other side of the shield should be leaved floating. This could be guaranteed by crimping the shield or the screen of the ethernet cable to the RJ45 connectors only at one end of each cables.*

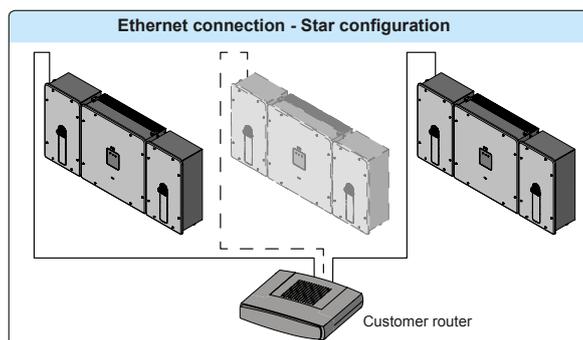
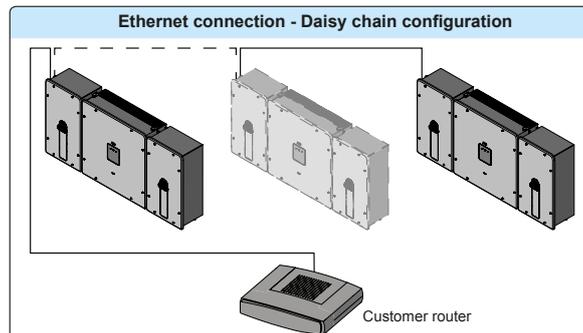
Three topologies of ethernet connection to the router are available:



*The ring configuration is the preferable way to connect the units in order to allow reaching inverters in case of single inverter fault.*



*In case inverters are connected to the networking switch with a ring topology is recommended to enable SPT protocol on the switch (Spanning Tree Protocol SPT (IEEE 802.1D) is enabled by default on inverters).*



On each configuration of connection the maximum length of the cable must be 100m maximum between inverter – inverter and inverter – switch.



*For further information on the Ethernet connection refer to the Local Area Network standard IEEE802.3*

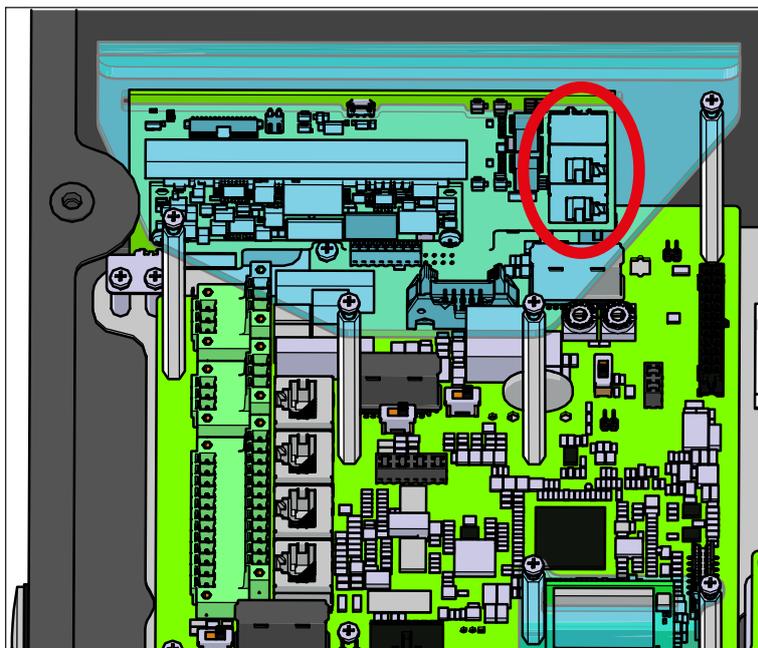
Please refer to Aurora Vision documents available on ABB website for further information how to get an Aurora Vision account for remotely monitoring and managing the installed solar assets.



*No initial setup is required to start data transmission to Aurora Vision. Internet connection is required to use all the Aurora Vision remote functionalities.*

## Ethernet connection on DCWB-1 and DCWB-2

The connection of the ethernet communication cable must be made on the connectors on the communication and control board inside the DC wiring box. If the inverters of the plant need to be connected in daisy chain use both connectors.



## Ethernet connection on DCWB-3

The connection of the ethernet communication cable must be made on the specific connectors ③④ on the left side of the DC wiring box. If the inverters of the plant need to be connected in daisy chain use both connectors. The ethernet cable must be installed on the dedicated counterpart supplied.

The cable should be compliant to the following specification:

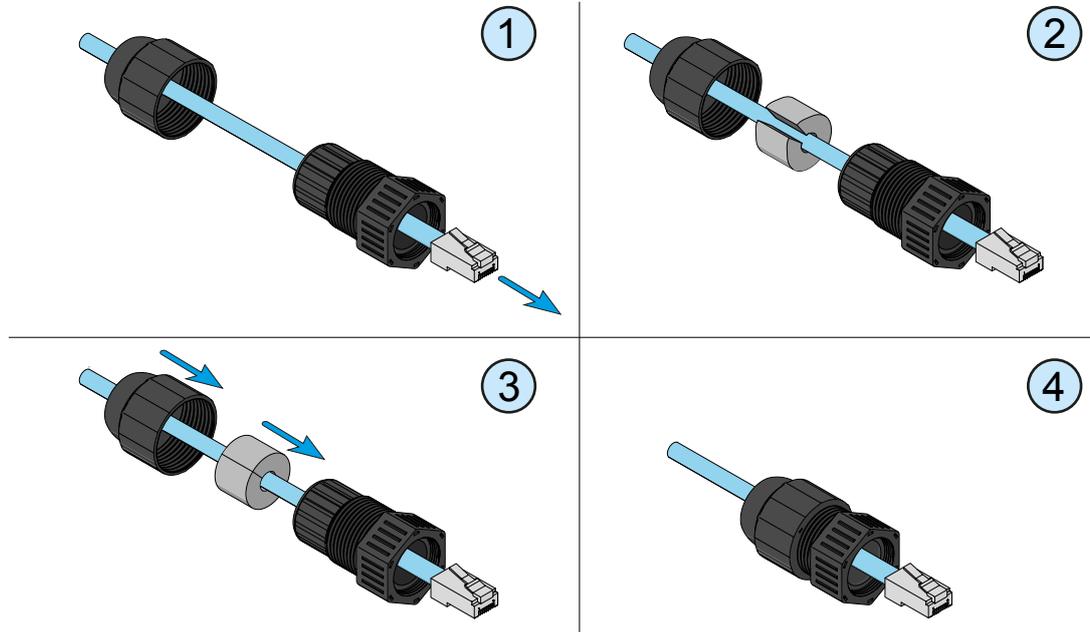
- Cross-section: min. 2 x 2 x 0.22 mm<sup>2</sup> or min. 2 x 2 x AWG 24
- Cable type: 100BaseTx, CAT5 (or higher) with shielding STP or FTP
- UV-resistant if used outdoors
- Type of plug: metallic shielded RJ45
- The maximum length that can reach these cables is 100 meters, and it is always advisable not to let them pass by the power cords to avoid interference with data transmission.
- Maximum inverters number connected over one single daisy chain is 50

Procedure to install the counterpart on the cable:

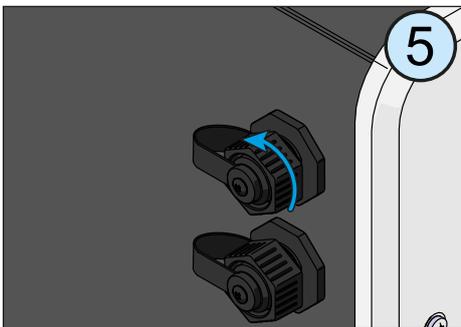
1. Unscrew the holding ring nut from the connector; remove the the gasket inside the connector body; feed the ethernet cable through the holding ring nut and the connector body
2. Install the gasket on the cable

3. Push the gasket inside the connector body until it fits snugly

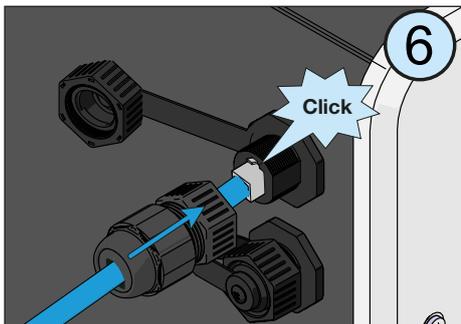
4. Extract the cable from the corresponding part just enough to enable the connection in the connector on the inverter.



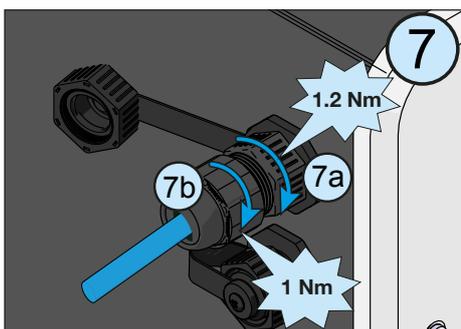
Proceed as follows to install the cable on the inverter:



5. Remove the cap from the ethernet connector installed on the inverter.



6. Connect the ethernet cable



7. Slide the counterpart on the cable until bringing it snug to the ethernet connector of the inverter.

7a. Turn the fastening ring nut (tightening torque of 1.2 Nm / 0.9 ft-lb) until blocking the two connectors and check the correctness of the installation.

7b. Turn the holding ring nut (tightening torque 1.0 Nm / 0.7 ft-lb)

## Serial Communication connection (RS485)

The connection of the inverters over the RS485 line is recommended for replacement of already installed old model of inverters or service purpose only.



*Automatic settings of network parameters, embedded logging capability, automatic logger free transferring of data to Aurora Vision Cloud and remote firmware update are not provided if the inverters are connected over the RS485 line.*

The inverter has two RS485 communication lines with the communication protocol which can be set in "Aurora" (proprietary communication protocol) or ModBus (public communication protocol). The default configuration of the protocol for both communication ports is "Aurora" which can be changed through the internal webserver..

Both RS485 lines can be used to:

- connecting the inverter to monitoring devices
- carry out configuration operations using the internal webserver..
- sending power management commands

The two lines only differ in terms of the firmware upgrading (locally or remotely through the ABB monitoring devices) which **must** be carried out by connecting to the RS485 (1) port

*When connecting the ABB monitoring devices, the RS485(1) line must be used*

Cables connecting the RS485 line may use two different types of connection:

- **Connection of the conductors using the terminal connectors a11 (+T/R, -T/R, RTN e SH)**

The SH connection must be used for connecting the shielding boot(s) of the cable(s).

- **Connection of conductors with RJ45 connectors a14 or a16**

The two RJ45 connectors (A) and (B) available for the RS485 communication, are equivalent to each other and can be used interchangeably for the arrival or for the output of the line in realising the daisy chain connection of the inverters.

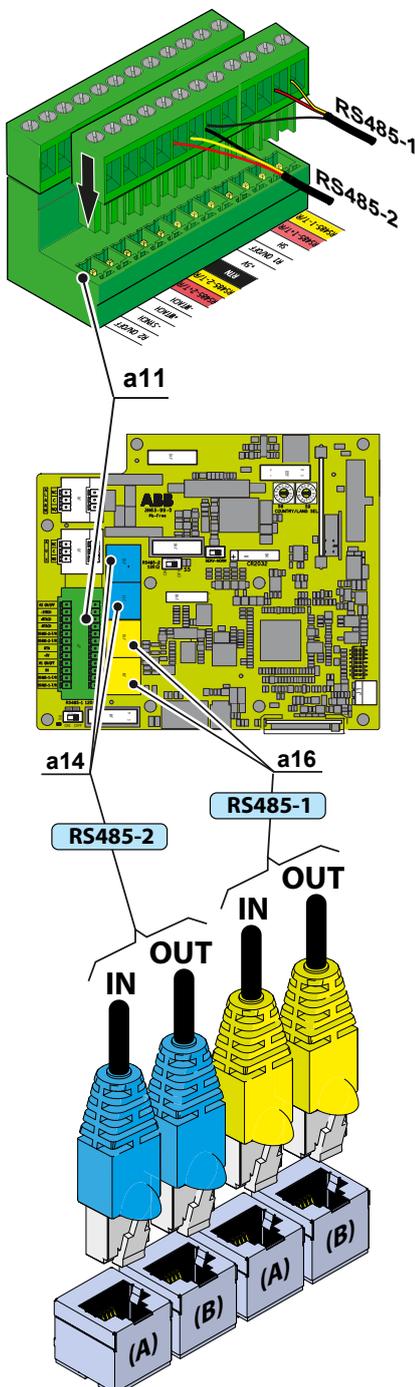
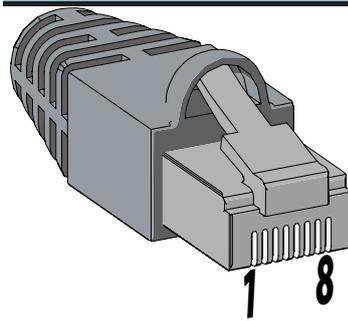


Table: crimping diagram for RJ45 connectors

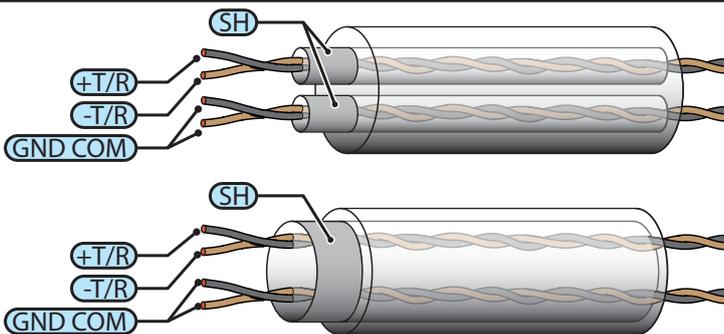
Pin No.	Function
3	+T/R
5	-T/R
7	RTN
1, 2, 4, 6, 8	not used



Use a connector with metal body to provide cable shield continuity!

For long distance connections, the connection on terminal connector is preferable using a shielded twisted pair cable with characteristic impedance of  $Z_0=120$  Ohm like the one shown on the following table:

Signal	Symbol
Positive data	+T/R
Negative data	-T/R
Reference	RTN
Screen	SH



Shield continuity must be provided along the communication line using the SH terminal and must be grounded at a single point.

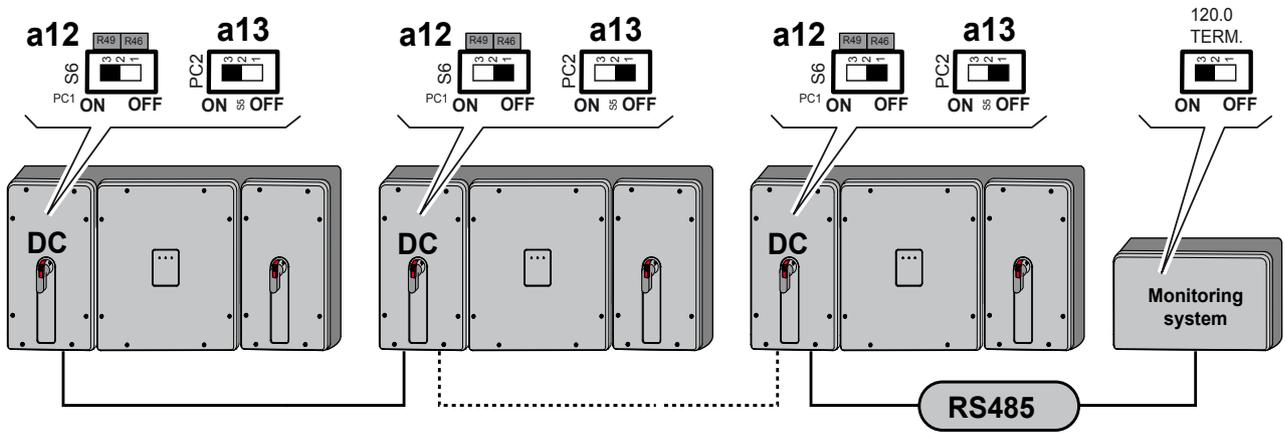
The RS485 line can be used to set up a line of communication (with the communication protocol which can be set in “Aurora” or “ModBus”) which, when connected to a monitoring device, enables the operation of the photovoltaic system to be kept under control. Depending on the device used monitoring can be local or remote.

Any ABB monitoring devices must be wired to the RS485(1) port



For information on installation, compatibility and use please refer to the specific documentation on the accessory components.

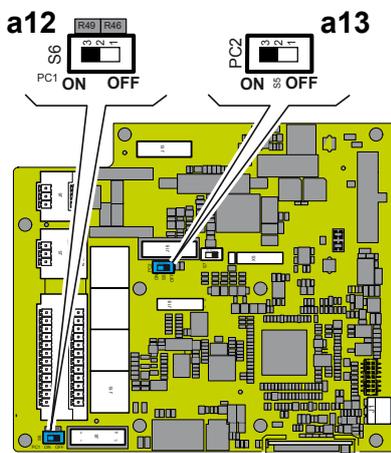
Connect all the units of the RS485 chain in accordance with the daisy-chain model observing the correspondence between the signals, and activate the termination resistance of the communication line in the final element of the chain by switching the **a12** or **a13** switch respectively on the basis of the RS 485 (1) and RS 485 (2) line in the ON position.



The communication line must also be terminated on the first element of the chain which normally corresponds to the monitoring device.



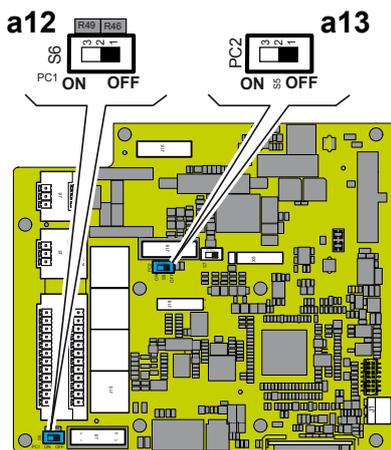
It is recommended not to exceed a length of 1000m for the communication line. The maximum number of inverters that can be connected to the same RS485 line is 62.



When connecting a single inverter to the monitoring system, activate the communication line resistance terminal by setting the switch **a12** or **a13** (to the ON position).

Set a different RS485 address on each inverter in the chain. **No inverter can have "Auto" as an address.** An address can be freely chosen between 2 and 63.

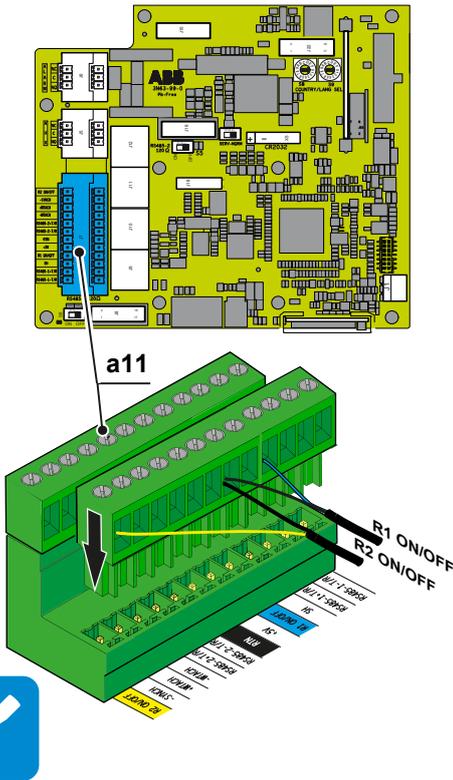
The setting of the address on the inverter is done through the internal webserver.



When an RS-485 connection is being used, if one or more inverters are added to the system at a later time, it is necessary to remember to reset to OFF the switch on the termination resistance being used (1) or (2) on the inverter which previously was the last in the system.

Each inverter is shipped with the RS485 address pre-set to two (2) and with the resistance terminal setting Switch **a12** or **a13** in the OFF position.

## Remote control connection



The connection and disconnection of the inverter to and from the grid can be controlled through an external control.

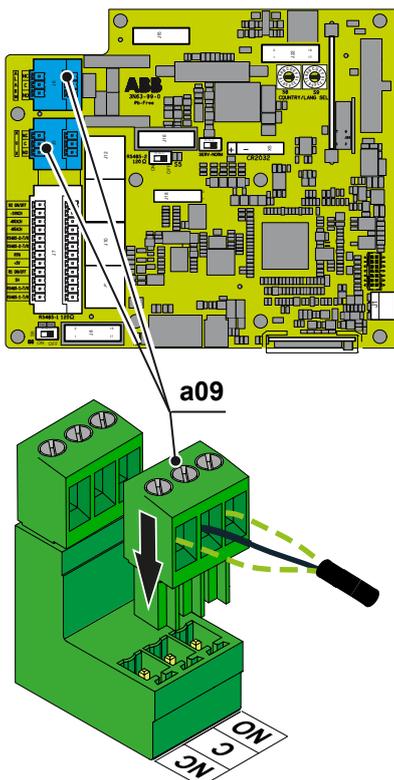
The function must be enabled in the relevant menu through the internal webserver. If the remote control function is disabled, the switching on of the inverter is dictated by the presence of the normal parameters which allow the inverter to connect to the grid.

If the remote control function is operating, besides being dictated by the presence of the normal parameters that allow the inverter to connect to the grid, the switching on of the inverter also depends on the state of the R1 ON/OFF and R2 ON/OFF terminals compared to the RTN terminal present on the a11 connector of the communication and control board ①9.

When one of the R1 ON/OFF or R2 ON/OFF signals is brought to the same potential as the RTN signal (i.e. by making a short circuit between the two terminals of the connector), this causes the inverter to disconnect from the grid.

The connections of these controls are made between the "R1 ON/OFF" and the "R1 ON/OFF" inputs compared to the common "RTN" signal. Since this is a digital input, there are no requirements to be observed as regards cable cross-section (it only needs to comply with the sizing requirement for passing cables through the cable glands and the terminal connector).

## Configurable Relay connection (ALARM and AUX)



The inverter is equipped with 2 multifunction relays with configurable activation. It can be connected with normally open contact (being connected between the NO terminal and the common contact C) and with normally closed contact (being connected between the NC terminal and the common contact C).

Different types of devices (light, sound, etc.) can be connected to the relay, provided they comply with the following requirements:

### Alternating current

Maximum Voltage: 240 V AC

Maximum Current: 1 A

### Direct current

Maximum Voltage: 30 V DC

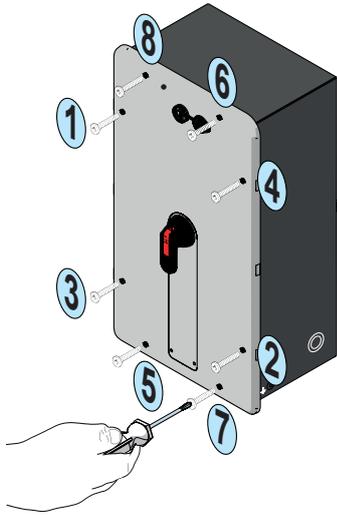
Maximum Current: 0.8 A

### Cable requirements

Conductor cross-section: from 26 to 15AWG

This contact can be used in different operating configurations that can be selected by accessing the internal webserver.

## Installing the wiring box covers



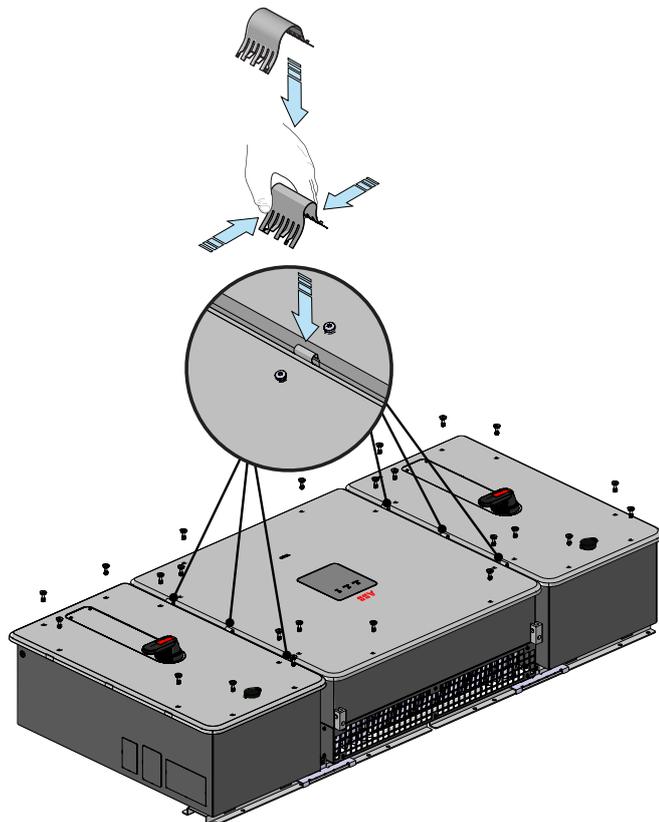
After installation, or any time the inverter is to be left in the field, all openings must be water tight, and the front covers 08 must be completely seated and closed.

- Confirm the disconnect switches on the cover are OFF
- Carefully place the cover over the wiring box. It's often easier to set the bottom of the cover in place first and rock the cover into place
- Confirm the disconnect switch lines up with its handle and the unpainted sections on the sides line up
- Let the cover fall into place
- Confirm the cover is seated and sealed
- Close the disconnect switch
- Reinstall the cover screws following the order shown in the figure; torque to 2.4 N-m (1.8 ft-lb)
- Close the key lock if appropriate

## Installing the conductive springs

Install the 6 conductive springs 29 which serve to reduce the radiated electrical noise:

- compress the spring
- insert the spring in an unpainted area between the wiring box and the conversion box covers
- release the spring



Confirm covers were securely sealed shut after installation.

## Instruments

# 6

One of the first rules for preventing damage to the equipment and to the operator is to have a thorough knowledge of the inverter instruments. ABB advise to carefully read this manual; in case of uncertainty on the information to request more detailed information.

*The ABB solar inverter help desk may be reached at 1-877-261-1374, 6am - 6pm (Arizona time) Monday-Friday. excluding major holidays.*



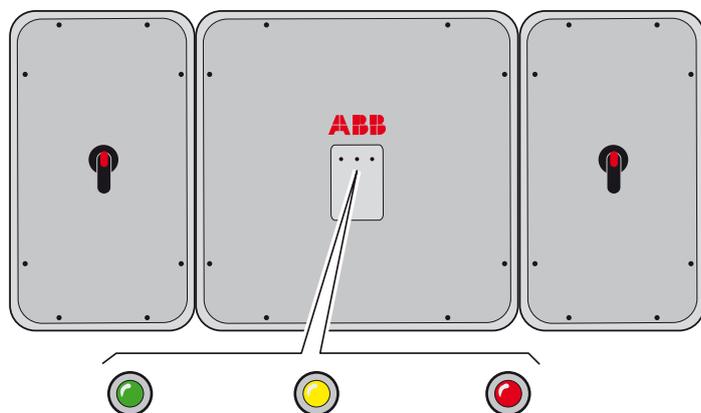
*Do not use the inverter or the PV plant if the operator:*

- is not trained or qualified to work on this PV plant;*
- does not understand how the system works;*
- is not sure what will happen when the buttons or switches are operated;*
- notices any operating anomalies;*
- has doubts based on his/her experience, the product manual and/or information from other operators.*

ABB cannot be held responsible for damage to the equipment or the operator resulting from lack of knowledge, insufficient qualifications or lack of training.

## Overview of front panel LED functions

There are 3 front panel LEDs which provide information about the inverter.



GREEN

A solid green LED indicates that the inverter is functioning correctly. When the unit is powered up, the green LED blinks while the grid is being checked. If a valid grid voltage is detected, the LED remains continuously lit, as long as there is sufficient sunlight to turn on the inverter. Otherwise, the green LED will continue to blink until the sunlight is sufficient for activation.

YELLOW

The yellow LED indicates that the inverter has detected an anomaly. Use the internal webserver to determine the nature of the warning.



RED

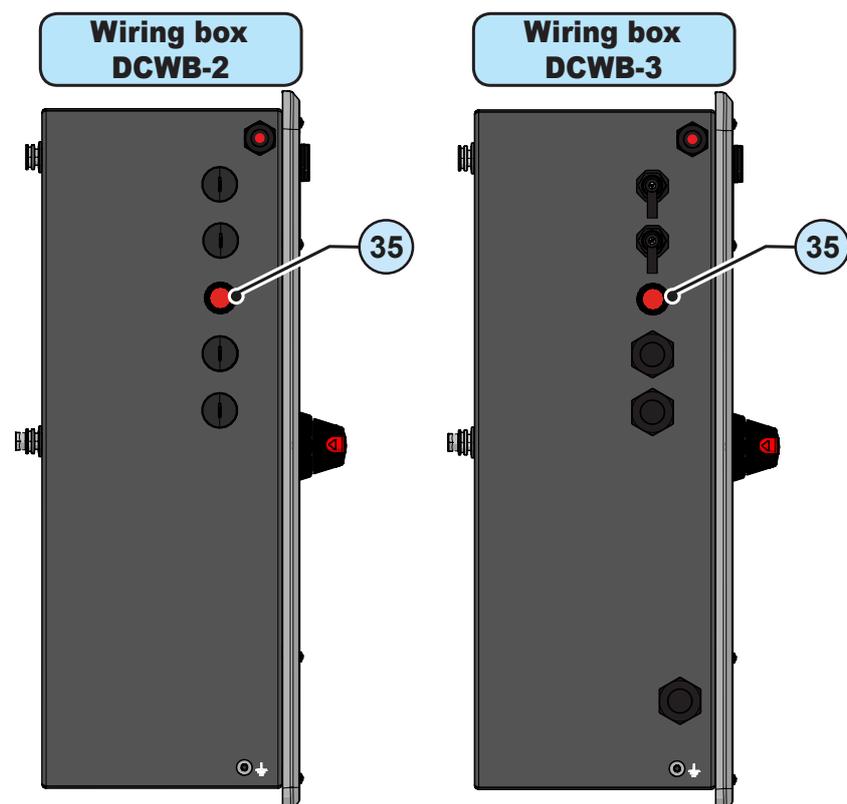
The red “GFI” (aka ground fault or ground insulation fault) LED indicates that the inverter has detected a ground fault in the DC side photovoltaic array. The inverter immediately disconnects from the grid.

*The LEDs, in various combinations, signal additional conditions other than these single-LED scenarios. See the various descriptions explained in “LED behavior” paragraph (chapter 7).*

## Arc fault reset button

The red “GFI” LED indicates that the inverter has detected an arc fault in the DC side photovoltaic array.

If an arc fault occurs (red “GFI” LED turned on) the inverter immediately disconnects from the grid. Is possible to reset the alarm pushing the button on the left side of DC wiring box.



- If the inverter reconnects normally to the grid, the fault was due to temporary or intermittent conditions.

If this malfunction occurs, have the PV plant inspected by a specialist. Arc faults are more likely in damp conditions, and signal an insulation breakdown.

- If the inverter does not reconnect to the grid, lock out/tag out both the AC and DC disconnects, then call for service to repair the fault in the photovoltaic array.

## User interface

### 1. Embedded Web User Interface

- Accessible via Wi-Fi by using any WLAN enabled standard device (PC, smartphone, tablet,...)
- Enables single inverter parameters settings (Aurora Manager Embedded)
- Updating of the inverter firmware.

### 2. Aurora Manager Lite

- Mainly for service purpose
- Local monitoring of the inverter.
- Advanced configuration of the inverter (INSTALLER access level)
- Updating of the inverter firmware.
- In order to use the software a connection must be established between the PC and the inverter (by means of an RS485 communication line) using a PVI-USB-RS485\_232 signal converter.

### 3. Mobile app and web portal Aurora Vision

- Remote monitoring of the inverter.



## Measurement tolerance

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

The tolerances are generally:

$\pm 5\%$  for real-time measurements with output power below 20%

$\pm 3\%$  for real-time measurements with output power above 20%

$\pm 4\%$  for all statistical data.

## Introduction and operation warnings

Before commissioning the inverter, it is necessary to have a thorough knowledge of the Instruments chapter 6 and the functions that is possible to enable in the commissioning phase.

When the inverter is commissioned it operates automatically without the aid of an operator; the operating state should be controlled through the equipment's instrumentation.



*The input voltage must not exceed the maximum values shown in the technical data, section 2 in order to avoid damaging the equipment.*

## Commissioning (Via internal Webserver) - Wireless connection



Do not place objects of any kind on the inverter during operation! Do not touch the heat sink while the inverter is operating! Some parts may be very hot and could cause burns.



Before proceeding with commissioning, make sure you have carried out all the checks and verifications indicated in the section on preliminary checks.

### Connection to the inverter - Wireless

Commissioning could be carried out via wireless connection to the inverter's internal webserver. Initial setup of the system must therefore be carried out via a tablet, notebook or smartphone with a wireless connection.

- Close the DC disconnect switch to supply the inverter with input voltage from the photovoltaic generator.

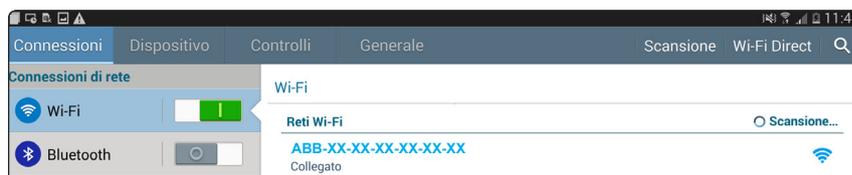


Make sure irradiation is stable and adequate for the inverter commissioning procedure to be completed.

- Once powered, the inverter will automatically create a wireless network (approx. 60 seconds after its switch-on) that will be visible as an Access Point from the user devices previously mentioned (tablet, smartphone, etc.).
- Enable the wireless connection on the device which is being used for the board setup (tablet, smartphone or PC) and connect it to the Access Point created by the inverter system: the name of the wireless network created by the system that the connection should be established with, will be: **ABB-XX-XX-XX-XX-XX-XX** where "X" is a hex digit of the wireless MAC address (MAC address can be found on the "Communication Identification Label" placed on the side of the inverter).



The screens shown below pertain to a tablet with the Android operating system. Screens on other devices or operating systems may differ.



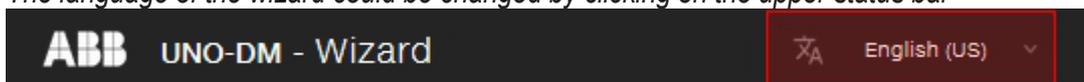
- When required type the "product key" (including the dashes. Example: 1234-1234-1234-1234) as the network password to access the inverter's access point. The product key is printed on the "wireless identification label" on the side of the inverter.

## Commissioning procedure - Wireless connected

- Open an internet browser (reccomended browser: Chrome versions from v.55, Firefox versions from v.50) and enter the pre-set IP address **192.168.117.1** to access the setup pages (web user interface). A guided setup procedure will open that will enable you to impose the necessary settings for correct commissioning of the inverter.



The language of the wizard could be changed by clicking on the upper status bar



The required information during the procedure is:

### STEP 1 - Administrator/User login credentials

#### Administrator account

Admin ⓘ

Username

Required

Password ⓘ

Password

Required

Confirm Password ⓘ

Re-enter Password

Required

#### User account

User ⓘ

Username

Required

No user password

- Set the **Administrator** account user and password (minimum 8 character for password):  
Administrator account can open and view the contents of photovoltaic site. Additionally, they can make changes to inverter settings.

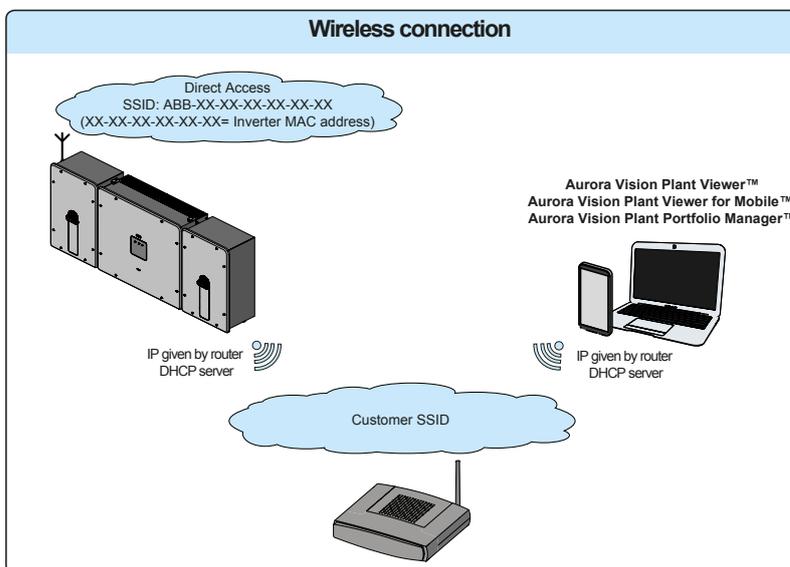
User and password are CASE SENSITIVE.

- Set the **User** account user and (optional) password (minimum 8 character for password):  
User account can only read data. It cannot make any changes.

User and password are CASE SENSITIVE.

**STEP 2 (Optional) - Wireless network connection.**

As described on chapter 2 the recommended way to get all the installed inverters to communicate to the internet and Aurora Vision Cloud is creating a cabled Ethernet daisy chain bus. Anyway, in case of a few inverters installation in suitable environment, it is also possible to connect each inverter of the plant to a Wi-Fi router without using any cable.



The access point is still available and the user can connect to the inverter.

In this scenario the Router gives IPs according to its own rules.

Inverter is reachable by IP.

Domain name can be used only if the Router permits multicast

In fact, during the installation wizard of the single inverter, the installer will be asked to connect the inverter to a Wi-Fi router. If the installer decided to do that be advised that the inverters will turn on a second Wi-Fi radio channel for enabling the communication with the Wi-Fi router. Otherwise this second radio channel will be kept turned off.

The availability of this second radio channel will allow the installer to be able to communicate wirelessly with the inverter by using the static IP address, in any operating condition, with the inverter connected to the switch/router by either Ethernet cable or Wi-Fi.

Whatever means is used to connect the inverter to the router (Ethernet cable or Wi-Fi) it will be always possible to access to the embedded web server also by connecting its own device to the same switch/router, and reaching the inverter (via second radio channel in case of Wi-Fi connection with the router) by using the assigned IP address or inverter's host name



*The IP address assigned to the inverter may vary or may be unknown. Please contact the IT administrator for getting the assigned IP address.*

*Differently from the assigned IP address, the «Host Name» of the inverter is unchangeable over time.*

*In order to use the «Host Name» as an alternative to the assigned IP address, for accessing to the inverters web server from the router the Domain Name System (DNS) service is needed to be available and activated.*

*The Host Name associated to each ABB inverters is structured as indicated below:*

**ABB-logger ID.LOCAL** where:

**logger ID** stands for the MAC address indicated on the "Communication identification lable" applied on the inverter.





### Wireless Network

Skip this step

IP Settings

DHCP

Available Network (SSID)

-- Please select --

Required

Password

Show password

CONNECT

The parameters relating to the customer wireless network (set on the router) that must be known and set during this step are:

- IP Settings: DHCP or Static.

If you select the DHCP function (default setup) the router will automatically assign a dynamic IP address to the inverter whenever it tries to connect to the user network.

With Static, the user can assign a fixed IP address to the system. The data which has to be entered in order for IP static address assigning to take place will appear. Complete the additional fields at the bottom of the screen (all the fields are mandatory with the exception of the secondary DNS server).

- Available networks (SSID):

Identify and select your own (customer) wireless network from all those shown in the SSID field (you can carry out a new search of the networks that can be detected with the Update button ).

Once the network has been selected, confirm.

- Password: Wireless network password.

Enter the password for the destination network (if necessary) and start the connection attempt (it will take a few seconds).

Click on "Connect" button to connect the inverter to the home wireless network.



### Wireless network connection:

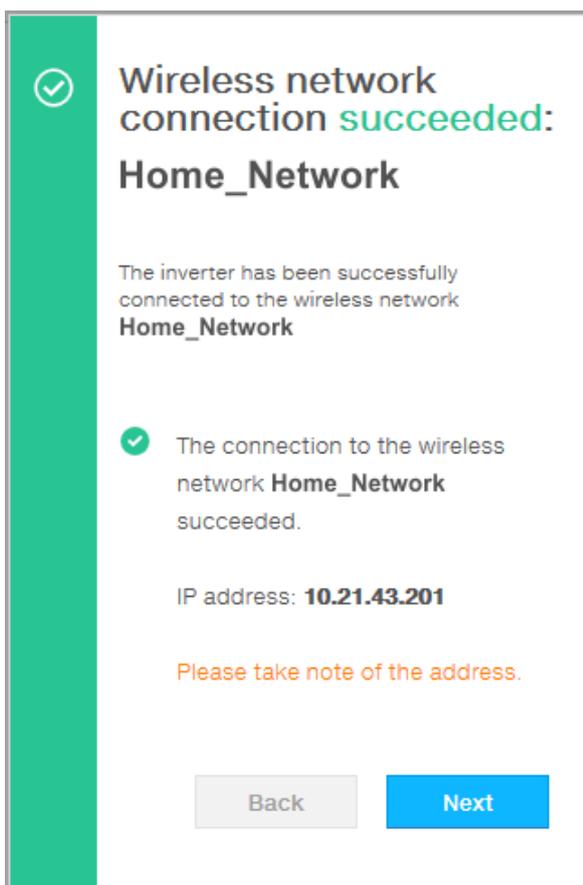
#### Home\_Network

The inverter is going to be connected to the wireless network **Home\_Network**

 On-going attempt to connect to the wireless network **Home\_Network**

Back Next

A message will ask for confirmation. Click "Next" to connect the inverter to the customer wireless network.



Once the inverter is connected to the customer wireless network, a new message will confirm that the connection is acquired.

The message provides the IP Address assigned by the home wireless network router to the inverter that can be used each time you want to access the internal webserver, with the inverter connected to the home wireless network.

**Take note of it.**

Click on “Next” button to proceed to the next stage of the configuration wizard.



*The IP address assigned may vary for reasons connected to the wireless home router setup (for example, a very brief DHCP lease time). If verification of the address is required, it is usually possible to obtain the client list (and the corresponding IP addresses) from the wireless router administration panel.*



If the inverter lost connection with the wireless network (and therefore, loses the internet connection), it will once again enable its own access point.



*The most common causes of losing connectivity might be: different wireless network password, faulty or unreachable router, replacement of router (different SSID) without the necessary setting updates.*

## STEP 3 - Date, Time and Time zone

### Date and Time

✔ Network Time Protocol server has been detected and it will be used to keep the system clock synchronized.

Date ●

Feb 22, 2017

SET by the NTP server

Time ●

3:28 PM

SET by the NTP server

Time Zone

Europe/Berlin GMT+01:00

BACK NEXT

Set the Date, Time and Time zone (The inverter will propose these fields when available).

### Date and Time

⊙ Network Time Protocol server has not been detected. Clock isn't synchronized. The displayed date and time come from the inverter or have been manually set up.

Please set the correct system date and time if needed.

Date and time will be automatically updated as soon as an NTP server is available.

Date

2/8/17

Time

11 : 56 AM

Time Zone

Europe/Berlin GMT+01:00

BACK NEXT

When it's not possible for the inverter to detect the time protocol, these fields have to be manually entered.

Click on "Next" button to proceed to the next stage of the configuration wizard.

## STEP 4 - Inverter country standard and Input configuration

### - **Country standard: selection of grid standard:**

Set the grid standard of the country in which the inverter is installed.



From the moment that the grid standard is set, you have 24 hours to make any changes to the value, after which the “Country Select > Set Std.” functionality is blocked, and the remaining time will have to be reset in order to have the 24 hours of operation available again in which to select a new grid standard (follow the procedure “Resetting the remaining time for grid standard variation” described in the relevant section).

### Country standard

Grid Standard

-- Please select --

Required

### Input mode

PV Input Channels Configuration

Independent

BACK

END

### - **Input mode:**

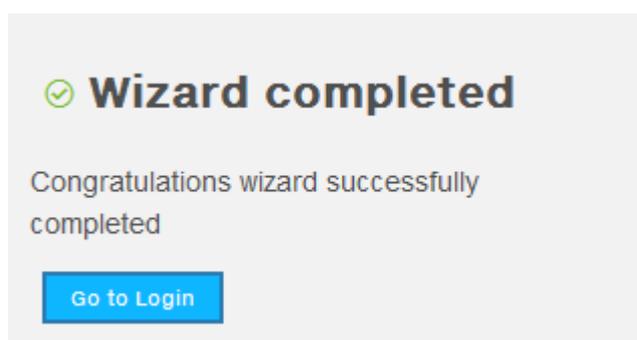
(See the relevant section of this manual to know how set the input mode)

1. **Independent**
2. **Parallel**

Confirm the settings by clicking “END” and the inverter will reboot.



A notification will confirm that the wizard is completed.



- After the wizard is completed, based on the input voltage value, the inverter changes the behavior of the “Power” and “Alarm” LEDs :

Input voltage	LED Status	Description
$V_{in} < V_{start}$	Power = Flashing Alarm = OFF	The input voltage is not sufficient to enable connection to the grid.
$V_{in} > V_{start}$	Power = Flashing Alarm = ON	The input voltage is sufficient to enable connection to the grid: the inverter waits for the grid voltage to be present to make the parallel connection.



*The inverter is powered SOLELY by the voltage generated by the photovoltaic generator: the presence of grid voltage alone is NOT SUFFICIENT for the inverter to switch on.*

- With the inverter in the “Missing Grid” status, close the AC switch downstream of the inverter thus applying the grid voltage to the inverter: the inverter checks the grid voltage, measures the isolation resistance of the photovoltaic field with respect to ground and performs other auto-diagnostic checks. During the preliminary checks on the parallel connection with the grid, the “Power” LED keeps flashing, the “Alarm” and “GFI” LEDs are off.
- If the arc-fault 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 error E053.
- During the pre-connection phase, the grid voltage, grid frequency, isolation resistance values are measured by the inverter. The inverter ONLY creates a parallel connection with the grid if the grid and isolation resistance parameters fall within the ranges foreseen by current regulations.
- If the outcome of the preliminary checks on the grid parallel is positive, the inverter connects to the grid and starts to export power to the grid. The “Power” LED remains fixed on while the “Alarm” and “GFI” LEDs are off.



*To address any problems that may occur during the initial stages of operation of the system and to ensure the inverter remains fully functional, you are advised to check for any firmware updates in the download area of the website [www.abb.com/solarinverters](http://www.abb.com/solarinverters) or at <https://registration.abbsolarinverters.com> (instructions for registering on the website and updating the firmware are given in this manual).*

- During normal operation the input current is continually measured and analyzed.

If a DC arc fault is detected during operation, the inverter is disconnects from AC grid and generates an E050 error code (readable through internal Webserver).

Press and hold the AFD reset button on the left side of the DC wiring box for 3 seconds. This will clear the E050 error and restart 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.

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

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

If the AFD trips frequently, it means arcs are occurring. Turn the inverter OFF and request service to do complete check of the system wiring, including all connections and junction boxes, to locate the problem.



## LED behavior

The LEDs on the front panel may behave in different ways depending on the inverter's operational status.

All possible LED activation combinations are shown in the following table. In particular, each LED could behave in one of the following ways:

● = LED on

⊗ = LED flashing slow (2 seconds on / 2 seconds off)

⊗ = LED flashing fast (0.2 seconds on / 0.2 seconds off)

○ = LED off

⊗ = Any one of the conditions described above

LED status	Operating state
green:  yellow:  red: 	<b>Firmware programming</b> The inverter firmware is being programmed
green: ○ yellow: ○ red: ○	<b>Night mode (inverter automatically switches off)</b> The inverter is in night time switch-off mode (input voltage less than 70% of the set start-up voltage).
green:  yellow: ○ red: ○	<b>Inverter initialization</b> This is a transitional state due to verification of the operating conditions. During this stage the inverter checks that the conditions for connecting to the grid are met.
green: ● yellow: ○ red: ○	<b>The inverter is connected and is feeding power into the grid</b> Normal operation. During this stage, the inverter automatically tracks and analyses the photovoltaic generator's maximum power point (MPP).
green:  yellow: ● red: ○	<b>Disconnection from the grid</b> Indicates lack of grid voltage. This condition does not allow the inverter to connect to the grid
green:  yellow: ● red: ○	<b>Warning indication: (W message codes) or Error: (E message codes)</b> - Indicates that the inverter control system has detected a warning (W) or error (E). It is possible to identify the type of problem generated with the internal Webserver (see "Event" section).
green: ○ yellow: ● red: ○	<b>Temperature protection trip</b> Indicates that the trip relating to internal temperatures (insufficient or excessive temperature) may have been activated
green: ○ yellow: ○ red: ●	<b>Anomaly in the insulation system of the photovoltaic generator</b> Indicates that a leakage to earth from the PV generator has been detected, causing the inverter to disconnect from the grid.
green: ○ yellow:  red: ●	<b>• Front cover open</b> The sensors located inside the wiring box are warning that one or both of the front covers is missing or not correctly installed. This condition prevents the commissioning of the equipment.

LED status	Operating state
green:  yellow:  red: 	<b>• Ventilation anomaly</b> Indicates an anomaly in the operation of the internal ventilation system that could limit output power at high ambient temperatures.
	<b>• Failed association of internal inverter components (after replacement)</b> Indicates that the installed wiring box (only in the event of a replacement) was already associated with another inverter and cannot be associated with the new inverter
	<b>• Overvoltage surge arresters triggered (where fitted)</b> Indicates that any class II overvoltage surge arresters installed on the AC or DC side have been triggered
	<b>• String protection fuses triggered (where fitted)</b> Indicates that one or more input string protection fuses that may be installed have been triggered
	<b>• Autotest not executed (only for Italian network standards)</b> On the inverter was not performed the Autotest
	<b>• Internal statistics memory anomaly</b> Indicates an operating anomaly in the internal memory on which the inverter statistics are stored
	<b>• Buffer battery discharged</b> The buffer battery is low and the inverter does not maintain the time setting
green:  yellow:  red: 	<b>• Initial configuration failure</b> The inverter is in locked state due to a failure in the initial configuration of the equipment, such as the standard network setting for the country of installation
	<b>• Self-test not carried out (for Italian grid standards only)</b> Self-test operation failure
	<b>• Incompatibility of the device firmware versions</b> The firmware versions of the various devices comprising the equipment are incompatible and are being updated (this is an automatic operation)
	<b>• Temperature sensor anomaly detected</b>
green:  yellow:  red: 	<b>Updating the firmware from an SD card</b> The equipment firmware is being updated from an SD card
* lighting of the LEDs in sequence	<b>Firmware programming failure</b> There has been a failure in programming the firmware, of one or more internal devices of the equipment, to the equipment from an SD card.
green:  yellow:  red: 	<b>Updating the firmware from an SD card completed</b> The equipment firmware has been successfully updated from an SD card
green:  yellow:  red: 	<b>Updating the firmware from an SD card has failed</b> The equipment firmware update from an SD card has failed
*blink 3 times	<b>Updating the firmware from an SD card has failed</b> The equipment firmware update from an SD card has failed
green:  yellow:  red: 	<b>Remote OFF activated</b> The Remote Off command has been activated. The unit will not connect to the network until the remote ON command has been activated



## Grid support functions

The inverter is equipped with advanced grid support functionality that is useful to support reactive loads and also assist in reliable operation of the utility grid in the presence of a large number of distributed energy generation sources.

The internal Webserver (see “Description of the internal Webserver” paragraph) can be used to adjust grid parameters.

A Wi-Fi connection to the inverter is required to modify settings using the internal Webserver.

### 1.Voltage ride-through

This inverter provides parameters to respond to underfrequency and overfrequency events. If frequency excursions occur, the inverter is designed to continue operating normally for a specified delay. Beyond this programmed delay, the inverter disconnects from the grid in the event of an abnormal voltage condition.

### 2.Frequency ride-through

This inverter provides parameters to respond to underfrequency and overfrequency events. If frequency excursions occur, the inverter is designed to continue operating normally for a specified delay. Beyond this programmed delay, the inverter disconnects from the grid in the event of an abnormal voltage condition.

### 3. Reactive power control

The inverter provides several modes of operation for reactive power control and are described below:

- Disable: This is the default setting. Under this setting, the inverter exports with a power factor of 1.0.
- Fixed power factor control (Cos $\phi$  set): In this mode, the operator can set the output power factor to a fixed value. When enabled, a new value will be set in the inverter.
- Q Fixed (Q Set): Sets the reactive power to a fixed value. When enabled, a new value will be set in the inverter.
- Power factor as function of output power (Watt/Cos $\phi$  Settings: Cos $\phi$ (P)): In this mode, the inverter reduces the power factor (cos-phi) as a function of the output power at a given operating point. The 4 points of the default curve, where you can set the % of Pmax values and related cos-phi, can be modified using the internal Webserver. When enabled, the curve will be set in the inverter.
- Dynamic Volt/VAR control (Volt/VAr Settings: Q(V)): Under this mode, the level of reactive power exported by the inverter is a function of the operating grid voltage, also known as a Volt/VAR curve. The 4 points of the default curve, where you can set the % of Vnom values and related % of Smax, can be modified using the internal Webserver. When enabled, the curve will be set in the inverter.



#### 4. Active Power Control

This inverter offers several modes for active power reduction.

- Active Power Curtailment: Sets a new value of active power as % of Pmax. When enabled, a new value will be set in the inverter.
- CEI Average VGrid Derating (only italian grid standard): Sets, after a specific threshold, an active power derating based on the average of Vac on 10 minutes as per CEI-021 italian grid standard.
- Volt/Watt settings: P(V). Under this mode, the level of active power exported by the inverter is a function of the operating grid voltage, also known as a Volt/Watt curve. The 4 points of the default curve, where you can set the % of Vnom values and related % of Pmax, can be modified using the internal Webserver. When enabled, the curve will be set in the inverter.
- Frequency/Watt function (Frequency Control: P(f)): In this mode, the inverter limits the active power as a function of the grid frequency.

#### 5. Ramp controls

The inverter is designed to control the rate at which output power is increased, either at startup, or after a temporary low power condition on the PV array (such as fast shading). The following ramp controls are provided on this inverter.

- Normal ramp: The normal ramp defines the maximum rate at which the inverter can increase the output power under normal operation. The normal ramp control limits the fluctuations in the output power in order to prevent instabilities on the utility grid.
- Soft start: The soft-start ramp defines the maximum rate at which the inverter can increase the output power when the inverter is first starting up. This startup may occur on a daily basis or when the inverter restarts after an abnormal grid event has ended.

This inverter has been factory programmed to automatically disconnect from the utility distribution system in compliance with UL 1741 and IEEE 1547-2003 specifications. Default voltage and frequency trip limit and trip time settings to comply with these standards are shown in table below. The internal Webserver can be used to adjust Voltage and Frequency Trip Limit and Trip Time Parameters according to Grid requirements of installation country.

Condition	Utility source		Max. time (sec) <sup>2</sup> at 60Hz before cessation of current
	Voltage (V)	Frequency (Hz)	
A	< 0.50 Vnom (Fixed)	Rated (60Hz)	0.16 (default)(Adj. Set Points 0.16 to 50s)
B	0.50 Vnom ≤ V < 0.88 Vnom (Adj.)	Rated (60Hz)	2 (Default)(Adj. Set Points 0.16 to 100 sec)
C	1.10 Vnom < V < 1.2 Vnom (Adj.)	Rated (60Hz)	1 (Default)(Adj. Set Points 0.16 to 100 sec)
D	1.2 Vnom ≤ V(Fixed)	Rated (60Hz)	0.16 (Adj. 0.001 to 0.16s)
E	Rated	f > 60.5Hz (Default) (Adj. 60.1 to 66.0 Hz)	0.16 (Default) (Adj. Set Points 0.16 to 1000 sec)
F	Rated	f < 59.3 Hz (Default) (Adj. 50.0 to 59.9 Hz)	0.16 (Default) (Adj. Set Points 0.16 to 1000 sec)
G	Rated	f << 57.0 Hz (Default) (Adj. 50.0 to 59.9 Hz)	0.16 (Default) (Adj. Set Points 0.16 to 1000 sec)
H	Rated	f >> 63.0 Hz (Default) (Adj. 60.1 to 66.0 Hz)	0.16 (Default) (Adj. Set Points 0.16 to 1000 sec)

Reconnection 300s (Default) (Adjustable 20s to 1000s)



## Description of the internal Webserver

The inverter is equipped with an advanced integrated webserver and user interface that allow a full access to all configuration and commissioning parameters from any electronic device (laptop, tablet or smartphone).

## Access to the internal Webserver

To access to the internal webserver is required to connect a device equipped with wireless connection (such as tablet, laptop or smartphone).

Depending on the connection method chosen during the inverter commissioning phase ("Station Mode" or "AP Mode") it's required to follow one of the two procedures described below:

### Connection to the inverter in "Station Mode"

- Enable the wireless connection on the device (tablet, smartphone or laptop) and connect it to the same wireless network to which the inverter is connected.
- Open an internet browser (recommended browser: Chrome versions from v.55, Firefox versions from v.50) and enter the links (corresponding to the IP Address assigned by the router to the inverter, or the "Host Name") provided during the commissioning phase to access the login page.

*In order to use the "Host Name" as an alternative to the dynamic IP address, the Wi-Fi router to which the board is connected (when operating in "Station Mode") must provide the Domain Name System (DNS) service (contact the network administrator for further information regarding the presence or absence of the DNS service in the Wi-Fi router or how to enable it). In this way, even if the IP address assigned to the inverter should change over time, (dynamic IP), it will always be possible to use the same "Host Name" which will remain unchanged over time.*

*The IP address assigned may vary for reasons connected to the wireless home router setup (for example, a very brief DHCP lease time). If verification of the address is required, it is usually possible to obtain the client list (and the corresponding IP addresses) from the wireless router administration panel.*

*If the "Host Name" was lost, it could be obtained writing this url:*

***<http://ABB-XX-XX-XX-XX-XX-XX.local>***

*replacing the "X" with the hex digits of the wireless MAC address of the inverter (it can be found on the "Wireless Identification Label" placed on the side of the inverter or applied during the commissioning phase to the quick installation guide on cover page).*

## Connection to the inverter in “AP Mode”

- Enable the wireless connection on the device which is being used for the board setup (tablet, smartphone or PC) and connect it to the Access Point created by the inverter system: the name of the wireless network created by the system that the connection should be established with, will be:

### **ABB-XX-XX-XX-XX-XX-XX**

where “X” is a hex digit of the wireless MAC address (MAC address can be found on the “Wireless Identification Label” placed on the side of the inverter or applied during the commissioning phase to the quick installation guide on cover page).

- When required type the “product key” (including the dashes. Example: 1234-1234-1234-1234) as the network password to access the inverter’s access point. The product key is printed on the “wireless identification label” on the side of the inverter.
- Open an internet browser (recommened browser: Chrome versions from v.55, Firefox versions from v.50) and enter the pre-set IP address **192.168.117.1** to access the login page.



## Login page

**Log In**

No user logged-in

Username

Password

**Log In**

[Forgot your password?](#)

After you have connected the device to the inverter and you access to the login page, login with the username and password created during the commissioning phase.



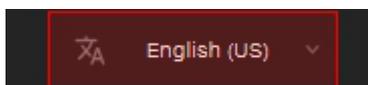
*User and password are CASE SENSITIVE.*



*If the Password is lost click on “Forgot your password?” to obtain the access to the webserver (and it will be possible to change the password) by entering the PRODUCT KEY (printed on the “Wireless identification label” and applied during the commissioning phase to the quick installation guide on cover page).*



*The language of the internal webserver could be changed in any moment by clicking on the right status bar:*



## Access to Admin Plus modality

By accessing to the **Admin Plus** sub-menu you can obtain the “Admin Plus” user privileges which allow you to change the grid standard of the inverter, after 24 hours while the inverter is operating, and the **Country Standard** sub-menu on **TOOLS** section is locked.

To access on the internal webserver with the “Admin Plus” user privileges it’s required to enter a security token that it can be obtained by registering on the website <https://registration.abbsolarinverters.com>. Refer to the dedicated section on this topic in the manual.

**Admin Plus**

Please insert the Token to enable the Admin Plus Mode

Token

Required

**Log In**

# Webserver menu structure



The following screenshots are related from a laptop visualization, may differ from smartphone or tablet visualization.

The Webserver is divided in six main sections, available on the left sidebar:



**MAIN:** Main section of webserver dedicated to viewing the summary informations related the status and the production informations of the inverter and photovoltaic plant.

**SETUP:** Section dedicated to AC and DC line parameters configurations.

**EVENTS:** Section dedicated to viewing Alarms and Warnings event log.

**USER:** Section dedicated to User management.

**NETWORK:** Section dedicated to inverter communication settings and configurations.

**TOOLS:** Section dedicated to main service tools configurations.

**INFORMATION:** Section dedicated for general informations about the embedded webserver.





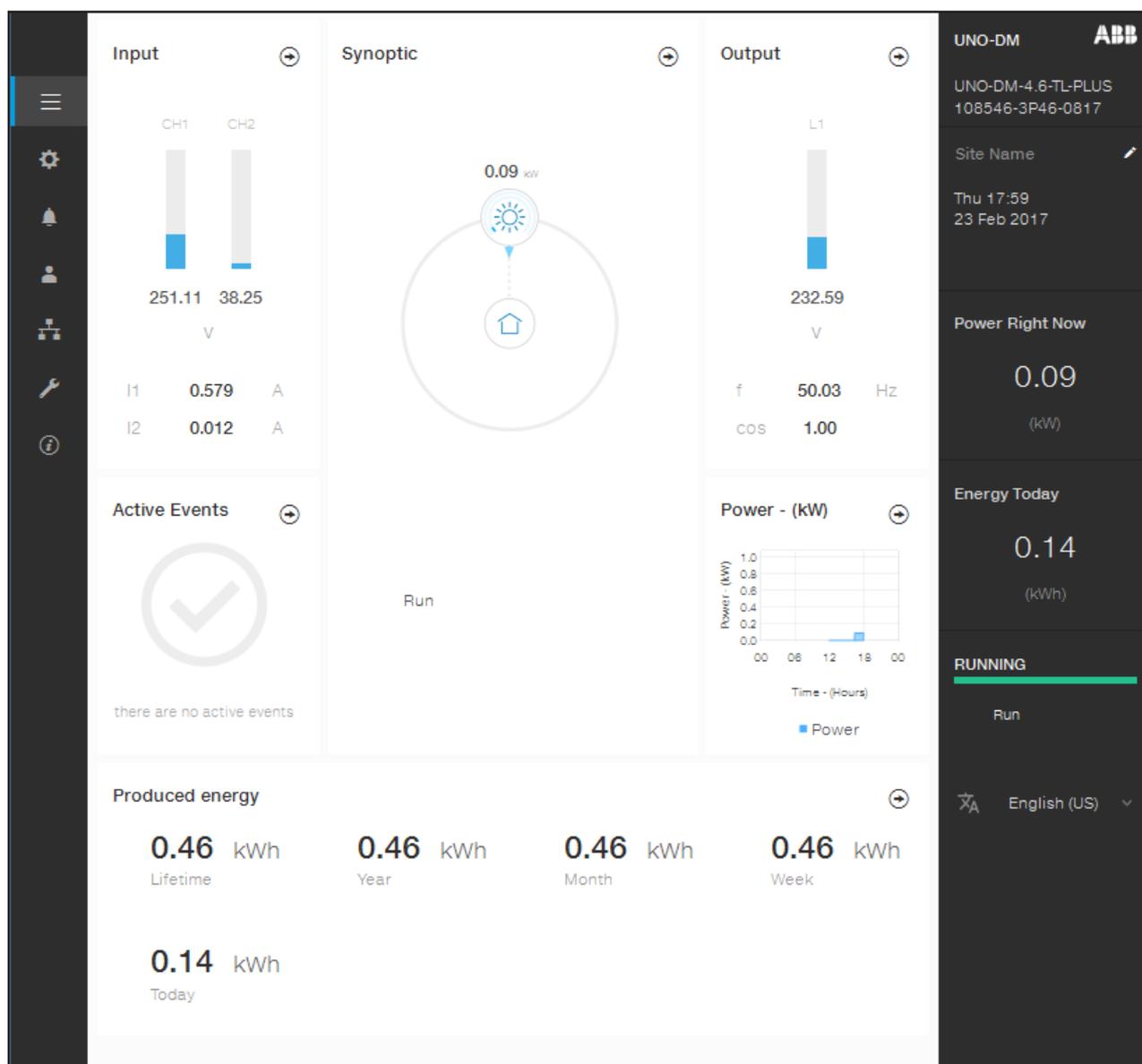
## MAIN section

In the **MAIN** section it's possible to access the following sub-menus:

- **Dashboard**
- **Status Summary**

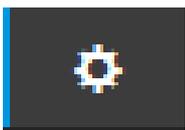
### Dashboard

In the **Dashboard** sub-menu you can view the main informations related the status and the production informations of the inverter and photovoltaic plant and alarm/warning active events.



### Status Summary

In the **Status Summary** sub-menu you can view the detailed informations related the status and the production informations of the system.



## SETUP section

In the **SETUP** section it's possible to access the following sub-menus:

- DC Settings
- AC Settings
- Frequency Control: P(f)
- Reactive Power Control
- Ramp Control
- Active Power Control
- Ground Fault Interface

### DC Settings

In the **Setup DC Side** sub-menu you can setup the parameter related to the Input DC side:

#### 1. VStart1

This parameter is used to set the Vstart activation voltage for the input channel 1 if they are configured independently (If parallel you will see only a single "Vstart" parameter for both channels). This voltage imposes a minimum input voltage on the inverter above which connection to the grid will be attempted.

#### 2. VStart2

This parameter is used to set the Vstart activation voltage for the input channel 2 if they are configured independently (If parallel you will see only a single "Vstart" parameter for both channels). This voltage imposes a minimum input voltage on the inverter above which connection to the grid will be attempted.

#### 3. VStart3

This parameter is used to set the Vstart activation voltage for the input channel 3 if they are configured independently (If parallel you will see only a single "Vstart" parameter for both channels). This voltage imposes a minimum input voltage on the inverter above which connection to the grid will be attempted.



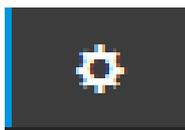
*We advise changing the activation voltage only if really necessary and to set it to the correct value: the string sizing tool available on the ABB website will indicate whether Vstart needs changing and what value to set it to.*

#### 4. Input Mode

This settings allows you to set the input configuration mode.  
In particular:

- **Independent:** Independent configuration of the input channels. This configuration is set by default.





- **Parallel:** Parallel configuration of the input channels (single input channel). Other hardware settings must be set on the inverter to set this mode. Refer to the paragraph “Parallel channel configuration”.

### 5. UV Protection Time

This section of the menu allows you to set the time for which the inverter stays connected to the grid after the input voltage has dropped below the Under Voltage limit (set at 70% of Vstart).

This value can be set from 1 to 3600 seconds (60 seconds is the default setting).

### 6. Multiple Max Scan Enable

This settings allows you to Enables/disables the scan for identifying the maximum power point of the system.

### 7. Multiple Max Scan Period

This settings allows you to set the time between scans. Remember that the shorter the scan interval the greater the loss of production, due to the fact that energy is transferred to the grid during the scan but not at the maximum power point. Each scan takes roughly 2 seconds..

## AC Settings

In the **Setup AC Side** sub-menu you can setup the parameter related to the Output AC side:

*Changing the above-mentioned parameters may prevent disconnection from the grid if the new values exceed those given in the standards of the country of installation. If these parameters are changed to values outside the standard range, an interface protection must be installed external to the inverter in accordance with the requirements of the country of installation.*

### 1. Grid Protections - VRT/FRT

By editing these settings it's possible to enable/disable and change the grid protection intervention thresholds parameters. The settable grid parameter are:

#### **Over voltage threshold (extended range)**

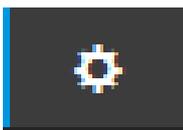
- Max U>> Grid Voltage Enable/Disable
- Max U>> Grid Voltage
- Max U>> Grid Voltage Trip Time

#### **Over voltage threshold (restricted range)**

- Max U> Grid Voltage Enable/Disable
- Max U> Grid Voltage
- Max U> Grid Voltage Trip Time

#### **Under voltage threshold (restricted range)**

- Max U< Grid Voltage Enable/Disable
- Max U< Grid Voltage-
- Max U< Grid Voltage Trip Time



#### **Under voltage threshold (extended range)**

- Max U<< Grid Voltage Enable/Disable
- Max U<< Grid Voltage-
- Max U<< Grid Voltage Trip Time

#### **Under voltage threshold (restricted range)**

- Max U<<< Grid Voltage Enable/Disable
- Max U<<< Grid Voltage-
- Max U<<< Grid Voltage Trip Time

#### **Over frequency threshold (extended range)**

- Max F>> Grid Frequency Enable/Disable
- Max F>> Grid Frequency
- Max F>> Grid Frequency Trip Time

#### **Over frequency threshold (restricted range)**

- Max F> Grid Frequency Enable/Disable
- Max F> Grid Frequency
- Max F> Grid Frequency Trip Time

#### **Under frequency threshold (restricted range)**

- Max F< Grid Frequency Enable/Disable
- Max F< Grid Frequency
- Max F< Grid Frequency Trip Time

#### **Under frequency threshold (extended range)**

- Max F<< Grid Frequency Enable/Disable
- Max F<< Grid Frequency
- Max F<< Grid Frequency Trip Time

#### **Low/high voltage fault ride trough**

- L/HVRT Momentary Cessation Enable
- HVRT Momentary Cessation Threshold
- LVRT Momentary Cessation Threshold
- L/HFRT Momentary Cessation Enable
- HFRT Momentary Cessation
- LFRT Momentary Cessation



## **2. Grid Connection**

By editing these settings it's possible to change the grid connection thresholds parameters to which the inverter have to connect to the grid.

#### **Grid voltage threshold for connection**

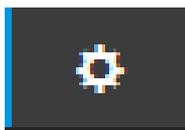
- Max VGrid for connection
- Min VGrid for connection

#### **Grid frequency threshold for connection**

- Max FGrid for connection
- Min FGrid for connection

#### **Time threshold for grid connection**

- Grid V/F Check Time Before Connection
- Grid V/F Check Time After Generic Fault



## Frequency Control: P(f)

In the **Frequency Control: P(f)** sub-menu you can setup the parameter related to the frequency control AC side:

- P max. - (read only)
- Frequency Control Enable/Disable
- High Frequency Control Enable/Disable
- Start Frequency Derating
- Stop Frequency Derating
- Intentional Delay
- Hysteresis Enable/Disable
- Restore Frequency Upper Limit
- Restore Frequency Lower Limit
- Restore Frequency Check Time
- Restore Ramp Enable/Disable
- Restore Ramp Mode
- Restore Ramp Slope
- Restore Ramp Slope (Minimum)



*Changing the above-mentioned parameters may prevent disconnection from the grid if the new values exceed those given in the standards of the country of installation. If these parameters are changed to values outside the standard range, an interface protection must be installed external to the inverter in accordance with the requirements of the country of installation.*



## Reactive Power Control

### 1. Reactive Power Control

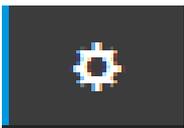
In this sub-menu is possible to set 4 points of a derating curve. In this mode, the inverter reduces the output power as a function of the output power at a given operating point:

- P max. - (read only)
- Point1: W1
- Point1: Cos $\phi$ 1
- Point2: W2
- Point2: Cos $\phi$ 2
- Point3: W3
- Point3: Cos $\phi$ 3
- Point4: W4
- Point4: Cos $\phi$ 4
- CEI Lock In
- CEI Lock Out
- Enable/Disable

### 2. Q Set

In this sub-menu is possible to adjust the reactive power set point:

- S max. - (read only)
- Q Set-point
- Enable/Disable



### 3. Volt/VAr Settings: Q(V)

In this sub-menu is possible to set 4 value of a derating curve. In this mode the level of reactive power exported by the inverter is a function of the operating grid voltage:

- VGrid Nominal - (read only)
- S max. - (read only)
- Intentional Delay
- Point1: V1
- Point1: Q1
- Point2: V2
- Point2: Q2
- Point3: V3
- Point3: Q3
- Point4: V4
- Point4: Q4
- CEI Lock In
- CEI Lock Out
- Enable/Disable

### 4. Cosφ Set

In this sub-menu is possible to set the output power factor to a fixed value:

- Cosφ Set-point
- Enable/Disable

## Ramp Control

The inverter is designed to control the rate at which output power is increased, either at startup, or after a temporary low power condition on the PV array (such as fast shading). The following ramp controls are provided on this inverter:



1. P max. - (read only)
2. Normal Ramp-up Enable/Disable
3. Soft Start Enable/Disable
4. Soft Start Ramp-up Rate
5. Normal Ramp-up Rate

## Ground Fault Interface

1. Minimum Riso - (read only)
2. Minimum time for Riso check

## Active Power Control

1. Active Power Curtailment
  - P max. - (read only)
  - P Set-point
  - Enable/Disable



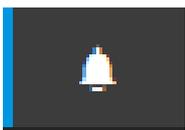
## 2. CEI Average VGrid Derating

- Protection Enable/Disable
- Derating Enable/Disable
- Derating Protection Threshold

## 3. Volt/Watt settings: P(V)

- VGrid Nominal - (read only)
- P max. - (read only)
- Regulation Curve Enable/Disable
- Point1: V1
- Point1: P1
- Point2: V2
- Point2: P2
- Point3: V3
- Point3: P3
- Point4: V4
- Point4: P4
- Time Constant Enable/Disable
- Time Constant





## EVENTS Section

In the **EVENTS** Section it's possible to view the Alarm and Warning events list that it can be custom filtered by type or by entering a matching word.

Clicking on any event to view his details.

**Alarm History**

[CLEAR FILTERS](#)    [REFRESH EVENTS](#)

All   Fault   Warnings   Info

1 of 1

Origin: inverter    23/02/2017 16:23:56 ⚠ <b>W004</b> WARNING (CLOSED) AC GRID OVERVOLTAGE
Origin: inverter    22/02/2017 19:01:11 ⚠ <b>W007</b> WARNING (CLOSED) AC GRID UNDERFREQUENCY
Origin: inverter    22/02/2017 18:32:05 ⚠ <b>W022</b> WARNING (CLOSED) REACT POWER MODE CHANGED
Origin: inverter    22/02/2017 17:10:05 ⚠ <b>W006</b> WARNING (CLOSED) AC GRID OVERFREQUENCY
Origin: inverter    22/02/2017 15:23:55 ⚠ <b>W006</b> WARNING (CLOSED) AC GRID OVERFREQUENCY

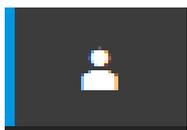
**Event Details**

---

Event Description

AC grid overvoltage - W004 - WARNING





## USER section

In the **USER** section it's possible to logout from webserver and return to the login page, or to access the following sub-menus:

- **Logout**
- **Edit Email and Password**
- **Admin Plus**
- **User Management**

### Logout

Allows to disconnect the wireless device to the internal web server session.

### Edit Email and Password

In the **Edit Email and Password** sub-menu you can change the e-mail and password related to the user which is used to login to the web-server:

### Admin Plus

By accessing to the **Admin Plus** sub-menu you can obtain the "Admin Plus" user privileges which allow you to change the grid standard of the inverter, after 24 hours while the inverter is operating, and the **Country Standard** sub-menu on **TOOLS** section is locked.

To access on the internal webserver with the "Admin Plus" user privileges it's required to enter a security token that it can be obtained by registering on the website <https://registration.abbsolarinverters.com>. Refer to the dedicated section on this topic in the manual.

### User Management

By accessing to the **User Management** sub-menu it's possible to edit all the users already created and create new users (both with admin or User privileges).



## NETWORK section

In the **NETWORK** section it's possible to access the following sub-menus:

- **RS485**
- **WLAN Status**
- **Modbus TCP**
- **Debug Settings**

### RS485

In the **RS485** sub-menu it's possible to adjust the settings relating to the RS485 communication serial line:

- RS485 Node Address: It allows you to set the address for serial communication of the individual inverters connected to the RS485 line. The UP and DOWN buttons scroll through the numerical scale. (The addresses that can be assigned are 2 to 63).
- RS485 Baud Rate: It allows you to set the Baud Rate (2400/4800/9600/19200/34800/57600/115200).
- RS485 Protocol Type: It allows you to set the type of protocol to be used for the RS485 line.
  - "Protocol Aurora Server": it's the proprietary ABB serial protocol usually used for back-compatibility or by service personnel.
  - "Modbus Sunspec Server": General purpose communication protocol to be selected to enable monitoring and control.
  - "Modbus Meter Interface": communication protocol to be selected for enable communication with the supported external meter.
  - RS485 Parity Mode: It allows you to set the Parity bit (No Parity, Even Parity, Odd Parity).

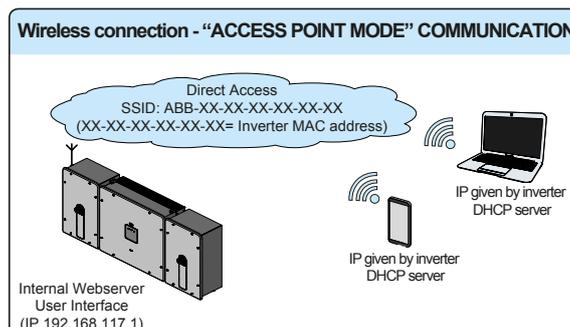




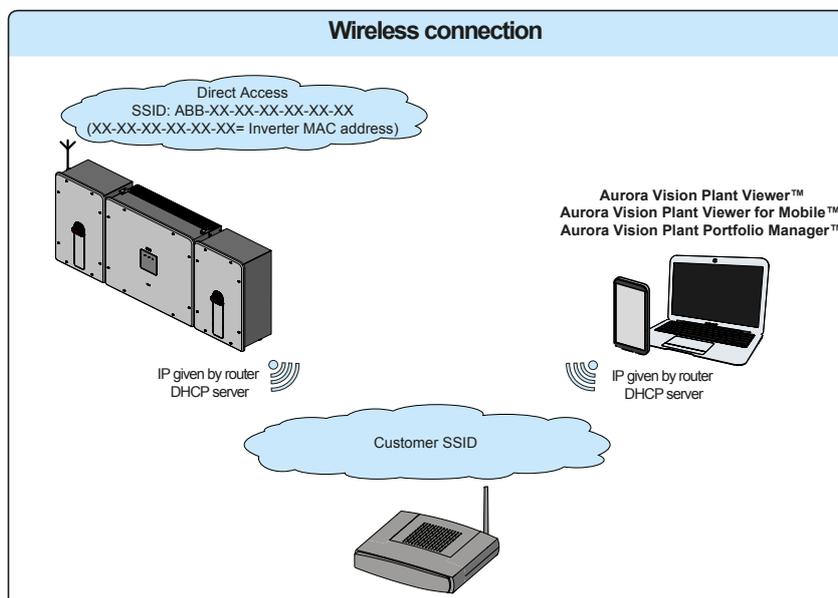
## WLAN

In the **WLAN** sub-menu it's possible to view the status of the two wireless channels of the inverter, and to disconnect the channel 2.

- Channel 1: "Access Point mode": Only local communication is enabled in this mode; In particular, the WLAN acts like an «access point» generating a wireless network to which the user can connect locally, configure the inverter / photovoltaic system, using the direct access to the embedded Webserver



- Channel 1 "Station Mode": In this operating mode is possible to connect the inverter to a WI-Fi router; in this condition remote monitoring is enabled accessing to Aurora Vision® CLOUD platform.





In case of channel 2 in “Station Mode”, it’s required to enter the wireless network parameters (set on the router) and follow the subsequent procedure:

## WLAN Status

### Wireless channel 1

Mode: Access Point  
 Status: **on**  
 SSID: ABB-b0-72-bf-9f-0d-39  
 IP: 192.168.117.1

### Wireless channel 2

You are connected through the channel 2 (Station)

Mode: Station  
 Status: **connected**  
 Connected to: ((Power-One\_Internal))  
 Signal level: Strong  
 IP: 10.21.43.188  
 Netmask: 255.255.252.0  
 DNS:  
 Gateway: it-r-valwificli

**i** Connect through the AP channel to change the connection status or the configuration of the station channel

DISCONNECT

### Edit channel 2 configuration

IP Settings

DHCP

Available Network (SSID)

((Power-One\_Internal))

Password

password

Show password

Back

Switch to AP

#### - IP Selection Mode: DHCP or Static:

If you select the DHCP function (default setup) the router will automatically assign a dynamic IP address to the inverter whenever it tries to connect to the user network.

With Static, the user can assign a fixed IP address to the system. The data which has to be entered in order for IP static address assigning to take place will appear. Complete the additional fields at the bottom of the screen (all the fields are mandatory with the exception of the secondary DNS server).

#### - SSID (name of wireless network):

Identify and select your own (home) wireless network from all those shown in the SSID field (you can carry out a new search of the networks that can be detected with the Update button ). Once the network has been selected, confirm.

#### - Password (wireless network password):

Enter the password for the destination network (if necessary) and start the connection attempt (it will take a few seconds).

Click on “Connect”



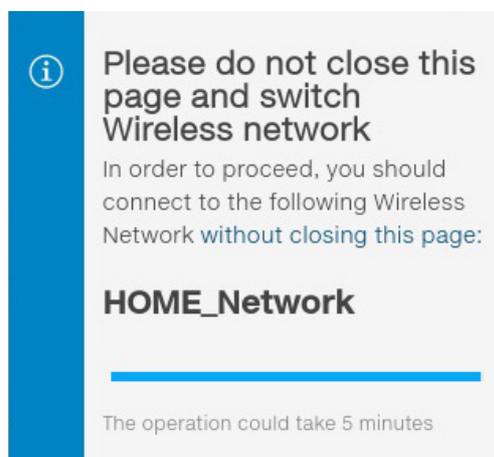
**Please do not close this page and waiting a moment**

 Config initializing

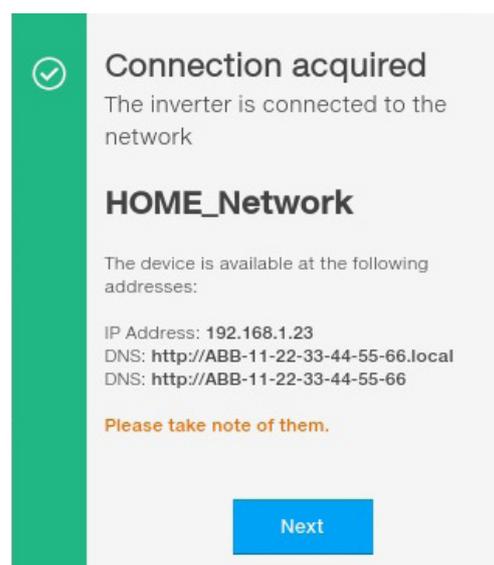
Please wait the network initialization before change to new network



Once the inverter is associated with a wireless network, the user must switch the tablet/smartphone/PC to the same wireless network which the inverter is connected.



Once the tablet/smartphone/PC device is switched to the local wireless network a new message will confirm that the connection is acquired.



Click the “Next” button” to complete the setup of “Station Mode”



*In order to use the “Host Name” as an alternative to the dynamic IP address, the Wi-Fi router to which the board is connected (when operating in “Station Mode”) must provide the Domain Name System (DNS) service (contact the network administrator for further information regarding the presence or absence of the DNS service in the Wi-Fi router or how to enable it). In this way, even if the IP address assigned to the inverter should change over time, (dynamic IP), it will always be possible to use the same “Host Name” which will remain unchanged over time.*



*The IP address assigned may vary for reasons connected to the wireless home router setup (for example, a very brief DHCP lease time). If verification of the address is required, it is usually possible to obtain the client list (and the corresponding IP addresses) from the wireless router administration panel.*



### Modbus TCP

In the **Modbus TCP** sub-menu it's possible to enable exchanging of data with third party monitoring and control systems over wireless channel in compliance with Sunspec register map, by setting "ON" the "Modbus TCP Server" parameter.

By changing "Modbus Power Control" parameter settings to "OFF" only reading register is enabled.

### Debug Settings

In the **Debug Settings** sub-menu it's possible to enable or disable the Debugging access (local or remote) for ABB Service purposes.





## TOOLS section

In the **TOOLS** section it's possible to access the following sub-menus:

- **Dynamic Feed-In Control**
- **Local I/O Manager**
- **Country Standard**
- **Firmware Update**
- **Date/Time**

### Dynamic Feed-In Control

This section of the menu allows you to set the energy management policy.

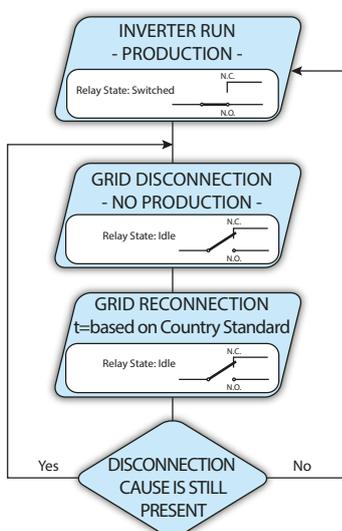
### Local I/O Manager

In the **Local I/O Manager** sub-menu it's possible to enable the management of power flows in order to optimize self-consumption or avoid feeding power to the grid.

This section of the menu allows you to set the activation status of a relay (available either as contact normally open – N.O. - and as a normally closed contact -N.C.) and to configure customised alarm conditions.

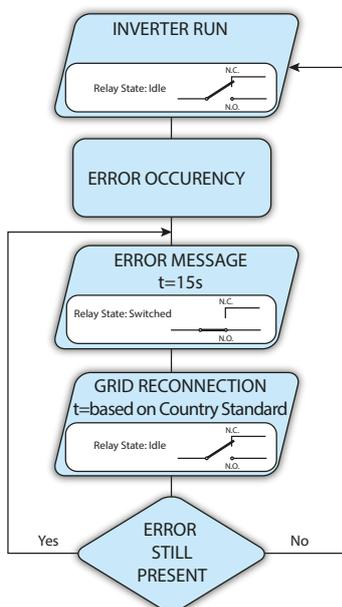
This contact can be used, for example, to: activate a siren or a visual alarm, control the disconnect device of an external transformer, or control an external device. A little description of the alarm type (e.g. "alarm lamp") is required.

Relay switching can be set in 9 different modes using the submenu **Set Alarm Type** (For the "Alarm Conf.", "Al. Conf. Latch", "Al. Conf. Ext.", "GoGo Rel(Auto)" and "GoGo Rel(Slave)" it is possible to configure customised alarm conditions through the submenu **Alarm Config** and **GoGo Config**):



#### • **Alarm-Contact (Production).**

The relay is activated (status: switched) whenever the inverter connects to the grid; as soon as the inverter is disconnected from the grid (for whatever reason that caused disconnection), the relay is in its resting position.



• **Alarm-Contact (alarm ALL - no-latch).** Alarm with reset at the end of the alarm signalling process:

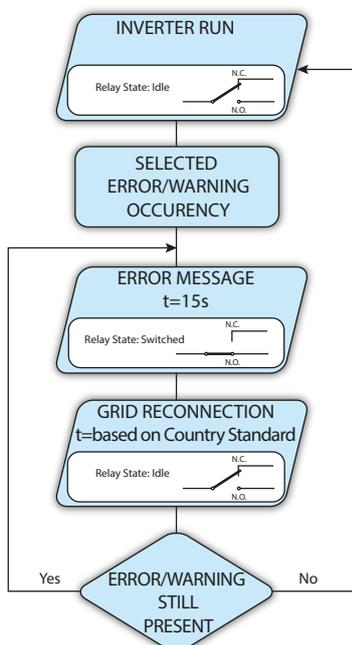
The relay is activated (status: switched) whenever an error (code Exxx) or warnings related to grid parameters out of range (Warning – codes W003, W004, W005, W006, W007) are present on the inverter. The alarm returns to its resting position when the alarm signal ends, i.e. before the inverter checks the grid parameters after the alarm state. This is because grid control state is not an alarm state but a state of normal operation.

**Alarms for which the relay is activated**

E001	E002	E003	E004	E005	E006
E007	E009	E010	E011	E012	E013
E014	E015	E016	E017	E018	E019
E020	E021	E022	E023	E024	E025
E026	E027	E028	E029	E030	E031
E032	E033	E034	E035	E036	E037
E046	E050	E053	E054	E055	E056
E057	E058	E077	E078	E081	E084
E089	W003	W004	W005	W006	W007



In the presence of W003, W004, W005, W006, W007 signalling, the alarm contact switches to then reset itself at the end of the alarm signal. This means that during the absence of grid voltage the alarm contact remains in its resting position.



• **Alarm-Contact (alarm configurable - no-latch).** Configurable alarm with reset at the end of the alarm signalling process.

The relay is activated (status: switched) whenever an error (code Exxx) or a warning (code Wxxx) is present from those selected from the list in the dedicated submenu **Alarm Config**. The contact returns to its resting position when the alarm signal ends, i.e. before the inverter checks the grid after the alarm state. This is because grid control state is not an alarm state but a state of normal operation.

**Selectable alarms for which the relay is activated**

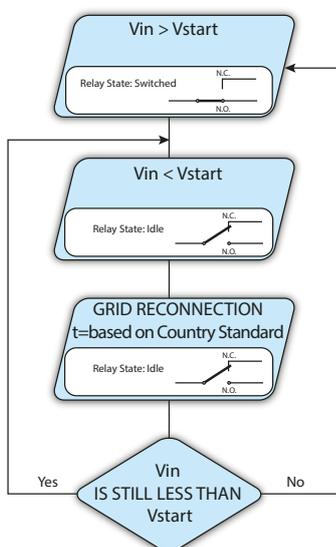
E001	E002	E003	E004	E005	E006
E007	E009	E010	E011	E012	E013
E014	E015	E016	E017	E018	E019
E020	E021	E022	E023	E024	E025
E026	E027	E028	E029	E030	E031
E032	E033	E034	E035	E036	E037
E046	E050	E053	E054	E055	E056
E057	E058	E077	E078	E081	E084
E089	W001	W002	W003	W004	W005
W006	W007	W009	W011	W015	W046
W047	W048	W051	W058	W059	

For the configurable relay operating mode “Alarm Conf.,” the following considerations are valid:  
If the alarm condition is persistent, the alarm contact cyclically switches from its resting state to its activated state.



In the presence of W002 signalling (Input UV – input voltage below the limit of operation), the alarm contact switches to then reset itself at the end of the alarm signal. This means that during the reduced input voltage the alarm contact remains in its resting position.

In the presence of W003, W004, W005, W006, W007 signalling, the alarm contact switches to then reset itself at the end of the alarm signal. This means that during the absence of grid voltage the alarm contact remains in its resting position.

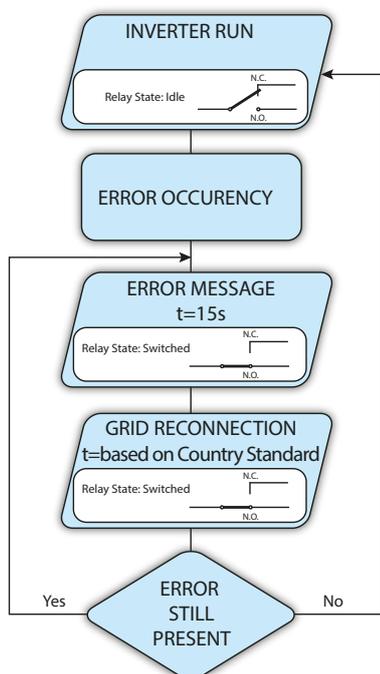


**• Alarm-Contact (crepuscular).**

The relay is activated (status: switched) as soon as the inverter input voltage exceeds the activation voltage set.

The relay switch to rest position when the input voltage drops below 70% of the activation voltage set.

This mode is useful for disconnecting any output transformers that could have unnecessary consumption during the night.



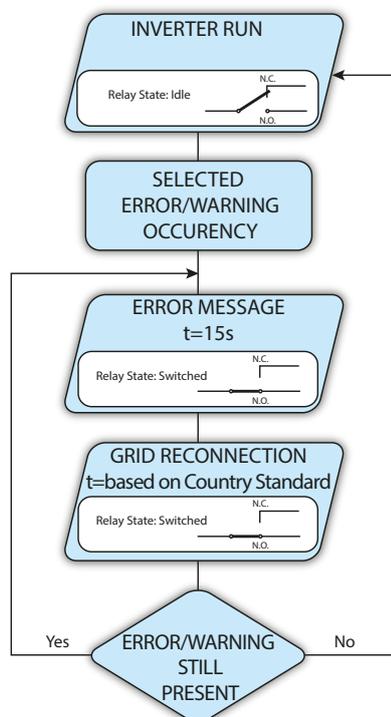
**• Alarm-Contact (alarm ALL - latch).**

The relay is activated (status: switched) whenever an error (code Exxx) or a warning (code Wxxx) is present (see the table below). When the inverter returns to the normal operating state and reconnects with the grid, the contact returns to its position of rest.

**Alarms for which the relay is activated**

E001	E002	E003	E004	E005	E006
E007	E009	E010	E011	E012	E013
E014	E015	E016	E017	E018	E019
E020	E021	E022	E023	E024	E025
E026	E027	E028	E029	E030	E031
E032	E033	E034	E035	E036	E037
E046	E050	E053	E054	E055	E056
E057	E058	E077	E078	E081	E084
E089	W003	W004	W005	W006	W007

If the alarm condition is persistent, the relay will remain activated (status:switched)



#### • Alarm-Contact (alarm configurable - latch).

The relay is activated (status: switched) whenever an error (code Exxx) or a warning (code Wxxx) is present from those selected from the list in the dedicated submenu **Alarm Config** (see the table below). When the inverter returns to the normal operating state and reconnects with the grid.

#### Selectable alarms for which the relay is activated

E001	E002	E003	E004	E005	E006
E007	E009	E010	E011	E012	E013
E014	E015	E016	E017	E018	E019
E020	E021	E022	E023	E024	E025
E026	E027	E028	E029	E030	E031
E032	E033	E034	E035	E036	E037
E046	E050	E053	E054	E055	E056
E057	E058	E077	E078	E081	E084
E089	W001	W002	W003	W004	W005
W006	W007	W009	W011	W015	W046
W047	W048	W051	W058	W059	

If the alarm condition is persistent, the relay will remain activated (status:switched)



#### • Alarm-Contact (alarm configurable - matrix).

In this mode, it is possible to configure the behaviour of the alarm relay according to an external error table which can be setup with the internal Webserver. In the table it is possible to select the alarms or warnings for which the alarm relay is activated (status: switched); for each individual alarm it is also possible to select the “Latch” or “No Latch” mode.



## Country Standard

By accessing to the **Country Standard** sub-menu you can modify the grid standard within 24 hours while the inverter is operating.



*After the grid standard was set you have 24 hours to make any changes to the grid standard value; 24 hours later the **Country Standard** sub-menu will be locked, and any subsequent changes can only be made accessing with **Adim Plus** privileges. Refer to the dedicated section on this topic in the manual to know how to unlock the **Country Standard** sub-menu.*

### Country standard

**i** You can change the parameter in the first 24 hours if you logged in as admin. After this time, you can reset the 24 hours only if you logged in as admin plus

Grid Standard

CEI 021 - internal protection ▼

RESET SAVE



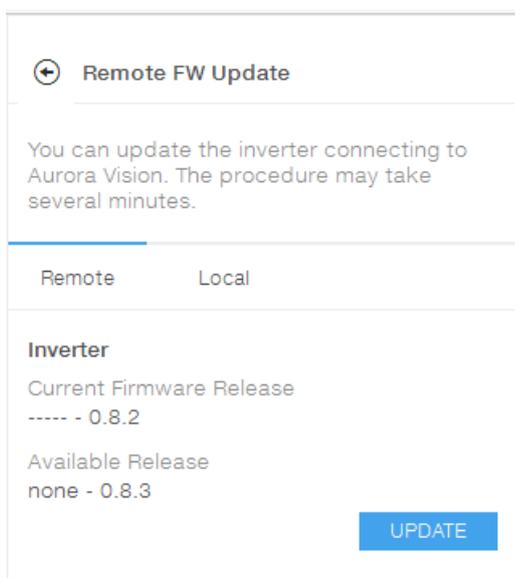


## Firmware Update

By accessing to the **Firmware Update** sub-menu you can upgrade the firmware of the inverter and his components selecting a Remote firmware Update or a Local firmware Update.

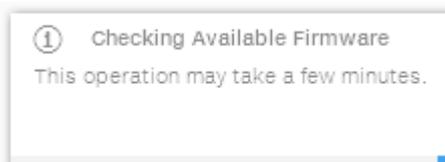


*Perform the update during good irradiation conditions (avoid the dawn and dusk hours). An interruption of updating process could damage the inverter!*

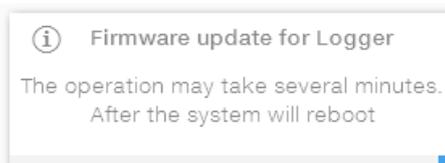


### • Remote firmware Update:

- In remote mode, the firmware will update automatically, searching the last available firmware on ABB servers, by clicking the “CHECK” button.



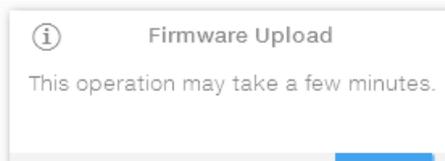
- After the finish of the checking process the available release will be notified on the bottom part of the section
- Click on “UPDATE” button to start with the updating process.



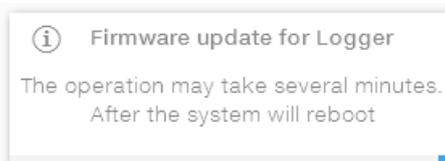
### • Local firmware Update:

By updating in local mode, the firmware have to be selected and uploaded from local folder of the used devices to access to the web server. The latest firmware version is available from the download area of the website [www.abb.com/solarinverters](http://www.abb.com/solarinverters) or from <https://registration.abbsolarinverters.com>

- Click on “FW SELECT” and select the firmware package previously downloaded.



- Click on “UPDATE” button to start with the updating process.





## Date and Time

In the **Date and Time** sub-menu it's possible to set the date, time and time zone.

The inverter will propose these fields when the time protocol is available).

When it's not possible for the inverter to detect the time protocol, these fields have to be manually entered.

### Date and Time

Network Time Protocol server has been detected and it will be used to keep the system clock synchronized.

Date

SET by the NTP server

Time

SET by the NTP server

Time Zone





## INFORMATION Section

In the **INFORMATION** Section it's possible to view the general informations about the embedded webserver.

it's possible to access the following sub-menus:

- **Privacy Policy**
- **Provider Information/Impressum**
- **Acknowledgments**
- **Relase Notes**



## Turning off the inverter



*Some parts may be very hot and could cause burns.*

- Turn OFF the DC and AC disconnects on the front of the inverter.
- Open the external DC and AC disconnects switches.
- Disconnect any power supplies that may be connected to the configurable relay.

## Working on the inverter



*Before attempting any work on the inverter, wait 30 minutes for stored energy to be discharged and for parts to cool.*

- Always lock out/tag out the external AC disconnect before working on the inverter
- Lock out/tag out external disconnects (external string combiners) to remove PV array power from the inverter
- The power compartment has no customer-serviceable parts, and its cover must never be removed. Doing so voids the warranty.
- Remove the wiring box covers covers  as needed.



### Introduction and maintenance warnings

Routine preventive maintenance is required to maintain warranty coverage. Maintenance must be entrusted to only those individuals with knowledge of how to perform these tasks and a thorough understanding of the PV plant.



*Turn off the inverter.*

*Open and lock out/tag out all external AC and DC disconnects before starting preventive maintenance.*



*For cleaning, DO NOT use rags made of filamentary material or use corrosive products that may corrode the equipment.*

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

*Always use personal protective equipment (PPE) provided by the employer and comply with local safety regulations.*

## Routine maintenance

Routine maintenance operations should not be considered obligatory, but rather as recommended in order to maintain the efficiency of the PV system.



*It is recommended that maintenance operations are only performed by qualified personnel or ABB personnel (under a servicing contract). The maintenance schedule may vary depending on the environmental conditions of the installation premises.*

**Table: routine maintenance**

<p><b>Annual visual inspections</b></p>		<ul style="list-style-type: none"> <li>• Check that the inverter is operating properly, without any alarm signals</li> <li>• Ensure all labels and safety symbols are visible</li> <li>• Check the integrity of the cables, connectors and cable glands outside the inverter</li> <li>• Check that the environmental conditions have not changed dramatically from those on installation.</li> <li>• Check there are no obstacles (animals, insects, leaves, vines or plants growing in heat sink, or anything which could reduce the heat exchanging capacity of the heat sink) at the top, at the bottom and between the fins.</li> </ul>
<p><b>Annual operations</b></p>		<ul style="list-style-type: none"> <li>• Check the tightening of the cable glands and the screw terminal blocks</li> <li>• Check the front cover is secured to the wiring boxes</li> <li>• If there is no monitoring system, check the record of alarms and errors using the indications provided in the manual in order to check recent notification of recent malfunctions.</li> <li>• For the models with AC+DC disconnect switch, it is recommended that once a year the disconnect switch is operated a number of times (at least 10) to keep the contacts clean and prevent oxidation. This operation must be carried out in periods with low input power or at night.</li> </ul>
<p><b>Annual cleaning</b></p>		<ul style="list-style-type: none"> <li>• Clean the equipment; verify, in particular, clean the lower array of the cooling fan assembly and the heat sink.</li> </ul>



# Troubleshooting



Operations on the inverter to identify and address any faults may only be performed by the installer or by qualified personnel.

## Internal Webserver and wireless communication troubleshooting

The following table gives a list of main and common errors or problems relating to the wireless communication between inverter and user devices.

Problem	Possible causes	Solution
The internal webserver cannot be accessed.	ADMIN or USER password forgotten.	Reset the passwords by clicking on "Forgot your password"; The passwords can be reset after having entered the "Product Key" code that can be found on the "Wireless Identification Label".
The inverter is able to identify a wireless network but is unable to connect to it.	The signal between the inverter and the wireless router to which the board wants to connect is too weak.	Modify the position of the wireless antenna, the inverter or the router.
		Make sure that the inverter has not been installed near obstacles which could affect the communication with the wireless router (for example: metal cages or walls, walls in reinforced concrete, electromagnetic fields).
		Move the router as close as possible to the inverter.
The Inverter has not identified the wireless network to which connection is required.	The wireless network to which the inverter is to be connected, could require the user to enter a username and password to allow navigation (for example, with a public wireless network or a hotel).	Unfortunately the inverter cannot be connected to these types of wireless networks. Connect the inverter to an alternative wireless network.
	The wireless network to which the Inverter is to be connected, is set so as not to be identified (hidden network).	The Inverter is not able to connect to a hidden network. Set the wireless network to which the inverter is to be connected (visible network), then identify and connect the Inverter to the wireless network as normal.
The wireless board does not communicate correctly with the inverter inside of which it is installed (inconsistency in the detected data read by the board), or when working in "Access Point Mode", it's not possible to access the internal webserver.	The signal between the inverter and the wireless router to which the board wants to connect is too weak.	Modify the position of the wireless antenna, the inverter or the router.
		Make sure that the inverter has not been installed near obstacles which could affect the communication with the wireless router (for example: metal cages or walls, walls in reinforced concrete, electromagnetic fields).
		Move the router as close as possible to the inverter.
Alternating difficulties in the local connection to the internal webserver.	The wireless board of the inverter could be damaged.	Request a service intervention to check that the inverter wireless board is working correctly.
	Wrong Inverter Date/Time settings.	Check if Date/Time has correctly set on the inverter; correct it if necessary.
Alternating difficulties in the local connection to the internal webserver.	The inverter might not be correctly powered (for example, if the inverter is switched off at night, the internal webserver cannot be accessed).	Access to the internal webserver only when the inverter is correctly powered.
	The wireless connection signal between the device in use and the router or the Inverter, may not have sufficient power or it may be disturbed by obstacles which affect the communication.	Make sure that the signal between the wireless devices which interact with the inverter are sufficiently high and that any obstacles such as metal cages or walls, walls in reinforced concrete or strong electromagnetic fields do not affect communication.



Problem	Possible causes	Solution
Although the Inverter has been configured correctly in "Station Mode" and works correctly on the local network, no data has been transmitted to the Aurora Vision®.	The MAC address used to register the inverter on the Aurora Vision® platform is not the same as the actual address associated with the inverter.	Make sure that the MAC address registered on the Aurora Vision® platform is actually the one associated with the inverter. If it is not, modify the registered MAC address.
	The wireless network to which the Inverter is connected, could be protected by a Firewall which prevents the remote exchange of data with the Aurora Vision® platform.	Contact the network administrator in order to have the Firewall configured so that the remote exchange of data between the Inverter and the Aurora Vision® platform is allowed.
It is not possible to access the Internal webserver using the IP address when the inverter is operating in "Station Mode – DHCP".	An incorrect dynamic IP address is being used to access the Internal Webserver or the IP address could have been modified by the wireless router to which the inverter is connected.	Access the Internal Webserver using via "AP Mode" (refer to dedicated section to know how to connect via "AP Mode") and read the current IP Address in "NETWORK > WLAN" section.
		Access the Internal Webserver using the "HostName" that could be obtained writing this url <a href="http://ABB-XX-XX-XX-XX-XX-XX.local">http://ABB-XX-XX-XX-XX-XX-XX.local</a> replacing the "X" with the hex digits of the wireless MAC address of the inverter (it can be found on the "Wireless Identification Label" placed on the side of the inverter or applied during the commissioning phase to the quick installation guide on cover page). The DNS or multicast service must be enabled on router. <b>Note: This connection method doesn't work on Android devices.</b>
	The IP Address used to access the Internal Webserver was lost.	Access the inverter display menu <b>WLAN Logger&gt;Info&gt;View IP</b> to obtain the IP Address assigned by the router to the inverter. If possible, access the pages of the wireless router web server to which the inverter is connected and read the new dynamic IP address assigned to the Inverter.
	The wireless router doesn't allow the connection to local IP address. Typically this happen on company networks.	Contact the network administrator to allow the wireless router to connect to local IP address.
Using an Android devices, a notification advise that internet connection is missing when trying to connect to the Access Point wireless network created by the inverter and ask for connection confirmation.	The device doesn't allow the connection to local IP address. Typically this happen with company devices.	Contact the system administrator to allow the device to connect to local IP address.
	Known behavior of Android devices. Android OS always check if internet connection are available and ask for confirmation if it's not present.	Confirm the connection request in the notification of Android devices by clicking "Yes".
It is not possible to view the Pdf Autotest report using an Ios devices.	Popup opening is not allowed on Ios browser.	Allow the popup opening in the browser settings of the Ios devices (A notification will advise you for enable popup when trying to view the pdf autotest report).



## Alarm Messages of the Inverter

In order to understand and resolve warning (Wxxx) or error (Exxx) signals that appear in the Alarm section of the internal webserver or on the inverter's display, follow the table given in the following paragraph.

The equipment can notify errors/warnings in the Alarm section of the internal webserver or on the display (where present) only if the input voltage is greater than the Vdcm in voltage (POWER Led flashing or lit; see chapter on operation)

The following table gives the complete list of errors/warnings relating to string inverters. Some error/warning codes may not be used depending on the inverter model installed.

- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- No code - Ground F -  Red LED	<b>Ground fault of photovoltaic generator:</b> The alarm is generated when a leakage current to ground is detected in the DC section of the system.	<ul style="list-style-type: none"> <li>• Measure the isolation resistance using a megohmmeter positioned in the photovoltaic array (positive terminal short-circuited at the negative pole) compared to ground. The measurement is strongly influenced by the environmental conditions, so must be made under the same conditions in which the error occurred.</li> <li>- If the value measured is lower than 1 megaohm, a check must be carried out by a technician/installer on the photovoltaic generator to identify and eliminate the problem.</li> <li>- If the value measured is higher than 1 megaohm and the error signal persists, contact customer assistance.</li> </ul>
- No code - NEW SYSTEM PART REFUSED! -  Flashing yellow LED	<b>Lack of linkage of the new system part:</b> The components inside the inverter (e.g. display, fuse board, communication and control board, etc.) are not inter-linked. This occurs following the replacement of one of the components inside the inverter.	<ul style="list-style-type: none"> <li>• Link the components inside the inverter by accessing the "Settings &gt; Service &gt; Accept boards" (refer to the procedure given in this manual).</li> <li>- If the signal persists also following the linking of the components, contact customer assistance.</li> </ul>
- No code - SET COUNTRY or NO NATION -  No LED	<b>SET COUNTRY or NO NATION:</b> Indicates that in the installation phase the grid standard was not set on the inverter.	<ul style="list-style-type: none"> <li>• Set the grid standard of the country of installation following the instructions given in this manual for the inverter.</li> <li>- If the signal persists also after the grid standard has been set, contact customer assistance.</li> </ul>
- No code - Missing Grid -  Yellow LED	<b>Missing Grid:</b> The inverter does not detect grid voltage (AC side).	<ul style="list-style-type: none"> <li>• Check the grid voltage on the inverter's AC terminal block.</li> <li>- Should it be absent, check any protection work on the line and the presence of grid voltage on the supply point.</li> </ul>
- No code - Memory fault -  Flashing yellow LED	<b>Memory fault:</b> The inverter has detected a communication problem with the memory board on which the inverter saves the daily value of energy produced.	<ul style="list-style-type: none"> <li>• Remove the memory board and check the welding of all the connector's terminals. Subsequently reinsert the memory board and check that it is correctly inserted into the dedicated slot</li> <li>- If the signal persists also following the above checks, contact customer assistance.</li> </ul>
- No code - Waiting Sun -  Flashing green LED	<b>Waiting Sun:</b> The inverter goes into the "Waiting Sun" stage when, following a W001 and/or W002 warning, the voltage from the photovoltaic generator is less than the activation voltage (Vstart).	<ul style="list-style-type: none"> <li>• Check the input voltage on the inverter.</li> <li>- If it does not exceed Vstart, check for the presence of sufficient irradiation and the correct composition of the system.</li> <li>- If it exceeds Vstart, contact customer assistance</li> </ul>
- W001 - Sun Low -  Yellow LED	<b>Insufficient irradiation (Low input voltage on switching on the inverter):</b> Incorrect configuration of the PV generator or an "on the limit" configuration for the inverter's minimum input voltage.	<ul style="list-style-type: none"> <li>• Check the input voltage on the inverter.</li> <li>- If it does not exceed Vstart, check for the presence of sufficient irradiation and the correct composition of the system.</li> <li>- If it exceeds Vstart, contact customer assistance</li> </ul>
- W002 - Input UV -  Yellow LED	<b>Insufficient irradiation (Low input voltage on switching off):</b> Incorrect configuration of the photovoltaic generator or an "on the limit" configuration for the inverter's minimum input voltage.	<ul style="list-style-type: none"> <li>• Check the input voltage on the inverter.</li> <li>- If it does not exceed Vstart, check for the presence of sufficient irradiation and the correct composition of the system.</li> <li>- If it exceeds Vstart, contact customer assistance</li> </ul>



- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- W003 - Grid Fail -  Yellow LED	<b>Parameters of grid voltage outside range:</b> This error signal occurs when during the inverter's normal operation the grid parameters exceed the limits set by the operator: - Grid voltage absent (after the signal the inverter goes to "Missing Grid") - Unstable grid voltage (values too low or too high) - Unstable grid frequency	<ul style="list-style-type: none"> <li>• Check the grid voltage on the inverter.</li> <li>- Should it be absent, check for absence of grid voltage on the supply point.</li> <li>- If, on the other hand, the voltage tends to rise (when the inverter is connected) there is high line or grid impedance.</li> <li>• Check the grid voltage also on the supply.</li> <li>- If it is high, it means that there is high grid impedance. In this case, ask the operator to adjust the grid voltage. If the operator authorises a change to the inverter's parameters, agree the new limits with customer assistance</li> <li>- If the voltage at the point of supply is much lower than that measured on the inverter, it is necessary to adjust the line (inverter-contactor).</li> <li>- If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance</li> </ul>
- W004 - Grid OV -  Yellow LED	<b>Grid overvoltage:</b> This error signal occurs when during the inverter's normal operation the grid voltage exceeds the maximum limit set by the operator.	<ul style="list-style-type: none"> <li>• Check the grid voltage on the inverter.</li> <li>If the voltage tends to rise (when the inverter is connected), there is a problem of high line or grid impedance.</li> <li>• Check the grid voltage also on the supply.</li> <li>- If it is high, it means that there is high grid impedance. In this case, ask the operator to adjust the grid voltage. If the operator authorises a change to the inverter's parameters, agree the new limits with customer assistance</li> <li>- If the voltage at the point of supply is much lower than that measured on the inverter, it is necessary to adjust the line (inverter-contactor).</li> <li>- If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance</li> </ul>
- W005 - Grid UV -  Yellow LED	<b>Grid undervoltage:</b> This error signal occurs when during the inverter's normal operation the grid voltage exceeds the minimum limit set by the operator.	<ul style="list-style-type: none"> <li>• Check the grid voltage on the inverter.</li> <li>• Check the grid voltage also on the supply.</li> <li>- If it is high, it means that there is high grid impedance. In this case, ask the operator to adjust the grid voltage. If the operator authorises a change to the inverter's parameters, agree the new limits with customer assistance</li> <li>- If the voltage at the point of supply is much lower than that measured on the inverter, it is necessary to adjust the line (inverter-contactor).</li> <li>- If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance</li> </ul>
 - W006 - Grid OF -  Yellow LED	<b>Grid over-frequency:</b> This error signal occurs when during the inverter's normal operation the grid frequency exceeds the maximum limit set by the operator.	<ul style="list-style-type: none"> <li>• Check the grid frequency in the inverter.</li> <li>• Check the grid frequency also on the supply:</li> <li>- If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance</li> </ul>
- W007 - Grid UF -  Yellow LED	<b>Grid under-frequency:</b> This error signal occurs when during the inverter's normal operation the grid frequency exceeds the minimum limit set by the operator.	<ul style="list-style-type: none"> <li>• Check the grid frequency in the inverter.</li> <li>• Check the grid frequency also on the supply:</li> <li>- If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance</li> </ul>
- W010 - Fan Fail -  Flashing yellow LED	<b>Fan Fail:</b> This error occurs when there is a malfunction in the fan/fans inside the inverter.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the alarm repeats persistently, contact customer assistance.</li> </ul>
- W011 - Bulk UV -  Yellow LED	<b>Low "Bulk" voltage (DC-DC circuit):</b> The alarm (which is a warning and not an error) is generated when the voltage at the heads of the bulk capacitors does not reach the threshold for the operation of the inverter (internal unchangeable threshold).	<ul style="list-style-type: none"> <li>• Raise the value of the activation voltage (Vstart) so as to have sufficient power from the PV generator at the time of the inverter's grid connection.</li> <li>• Check the input voltage on the inverter.</li> <li>- If it does not exceed Vstart, check for the presence of sufficient irradiation and the correct composition of the system.</li> <li>- If it exceeds Vstart, contact customer assistance.</li> </ul>

- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- W012 - Batt. Low -  Flashing yellow LED	<b>Battery Low:</b> The inverter has detected a backup battery voltage that is too low.	<ul style="list-style-type: none"> <li>• Check that the date/time are set correctly and, if they are not, set them.</li> <li>• Subsequently arrange to completely switch off the inverter (on both AC and DC) and wait a few minutes.</li> <li>• Finally, restart the inverter and check whether the date/time are now correctly set or whether they have reset to 01/01/2000. In this case replace the battery with the inverter completely switched off (isolate AC and DC side) being careful to maintain the polarity</li> </ul>
- W013 - Clock Fail -  Flashing yellow LED	<b>Clock Fail:</b> The alarm occurs when there is a difference of more than 1 minute in the time shown the internal webserver compared to the internal time of the microprocessors and indicates a malfunction of the clock circuit.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the alarm repeats persistently, contact customer assistance.</li> </ul>
- W015 - Island Detect. -  Yellow LED	<b>Disconnection due to Anti-Islanding:</b> The inverter has been improperly connected to an island grid.	<ul style="list-style-type: none"> <li>• Check that the grid to which the inverter is connected is not an island grid.</li> <li>- If the grid to which the inverter is connected is an island grid, switch the inverter off and then on again: if the problem persists, contact customer assistance.</li> </ul>
- W017* - String Err. -  Flashing yellow LED * (only for models with monitored string fuses)	<b>Error recorded in measuring string currents:</b> Damaged string protection fuse(s)	<ul style="list-style-type: none"> <li>• Check with a multimeter the state of the fuses (positioned on the fuse boards).</li> <li>- If one or more fuses is open, arrange to replace them and check that the input current on the string(s) does not exceed the rating of the fuses (should parallel strings have been made outside the inverter).</li> <li>- If there are no damaged string fuses and the inverter continues to show the alarm message check whether the settings to be made via the internal webserver are correct (presence or absence of one or more input strings).</li> </ul>
- W018 * - SPD DC Err -  Flashing yellow LED * (only for models with monitored SPD)	<b>Intervention of overvoltage surge arresters on DC side:</b> Overvoltage surge arresters situated on the DC side are damaged.	<ul style="list-style-type: none"> <li>• Observe the inspection window on each surge arrester (DC side). If it is red, the surge arrester is damaged and the cartridge must be replaced.</li> <li>- If the alarm status persists, even if all the surge arresters have a green inspection window, contact customer assistance.</li> </ul>
- W019 * - SPD AC Err -  Flashing yellow LED * (only for models with monitored SPD)	<b>Intervention of overvoltage surge arresters on AC side:</b> Overvoltage surge arresters situated on the AC side are damaged.	<ul style="list-style-type: none"> <li>• Observe the inspection window on each surge arrester (AC side). If it is red, the surge arrester is damaged and the cartridge must be replaced.</li> <li>- If the alarm status persists, even if all the surge arresters have a green inspection window, contact customer assistance.</li> </ul>
W021 - P-reductionStart -  No LED	<b>Activation of reduction in power:</b> Indicates that one of the power limitations described in the paragraph "Power limitation messages" has been triggered.	<ul style="list-style-type: none"> <li>• Check which power limitation code is active and, on the basis of that, carry out the necessary checks that might relate to various factors including:               <ul style="list-style-type: none"> <li>- settings by the user</li> <li>- high grid frequency</li> <li>- high grid voltage</li> <li>- anti-islanding</li> <li>- low grid voltage</li> <li>- high internal temperature</li> <li>- high input voltage</li> </ul> </li> </ul>
- W022 - Reactive power mode changed -  No LED	<b>Variation in means of managing reactive power:</b> Variation in the means of managing reactive power; this change can be made through the internal webserver.	The variation in the means of managing reactive power is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter
- W023 - date/time changed -  No LED	<b>Variation in the inverter's date and time:</b> Variation of the inverter's date and time; this change can be made through the internal webserver.	<ul style="list-style-type: none"> <li>• The variation in the inverter's date and time is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter</li> </ul>
- W024 - Energy data reset -  No LED	<b>Zeroing of the statistical energy data memorised in the EEPROM:</b> Reset of the energy data saved in the inverter; this operation can be handled through the internal webserver.	The zeroing of the partial energy values memorised by the inverter is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter <ul style="list-style-type: none"> <li>• The warning may also occur when the Memory Card on which the production statistics are saved is replaced</li> </ul>



- Error code - Error message - Warning	Name of Alarm and Cause	Solution
<b>W025</b> - P-reductionEnd - ⊗ No LED	<b>Deactivation of reduction in power:</b> Indicates that the inverter has come out of one of the power limitation states described in the paragraph "Power limitation messages".	This type of warning does not need any check
- <b>W026</b> - AFDD user reset - ⊗ No LED	<b>Reset of the Arc Fault error:</b> Manual reset of the Arc Fault error; this operation can be made through the internal webserver.	<ul style="list-style-type: none"> <li>The reset of the Arc Fault error is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter</li> </ul>
- <b>W027</b> - Latch-Manual reset - ⊗ No LED	<b>Resetting of the Latch alarm conditions:</b> Manual reset of the Latch alarm conditions; this operation can be made through the internal webserver.	<ul style="list-style-type: none"> <li>The reset of the Latch alarm conditions is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter</li> </ul>
- <b>W030</b> - Energy Meter ERROR * - ⊗ No LED	<b>METER device communication problem:</b> Error detected on the RS485 serial communication line between the inverter and the energy meter (METER).	<ul style="list-style-type: none"> <li>Check the serial communication line connections between the inverter and the METER. Particularly check the signal correspondence, the correct installation of the conductors and that there are no breaks in the cables.</li> <li>Faulty communication card (Comm. card)</li> <li>Error inside the inverter and cannot be checked externally.</li> <li>If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- <b>W045</b> - Sys disconnected - ● Yellow LED	<b>Disconnection of system from grid:</b> Warning of disconnection of system from electrical grid (no DC input voltage) because of dead battery pack or no demand from domestic loads	<ul style="list-style-type: none"> <li>Check that, when the warning occurs, the battery pack is dead and/or there have been no energy demands from domestic loads for more than 10 minutes.</li> </ul>
- <b>W046</b> - Grid conn. fault - ● Yellow LED	<b>Connection to the grid unsuccessful</b> The alarm is logged when a Missing grid or Input UV error occurs or due to the manual disconnection of the inverter during the grid connection sequence.	<ul style="list-style-type: none"> <li>Once the error occurs, the inverter tries to return to normal operation.</li> <li>If the problem persists after a number of attempts to connect the inverter, switch the inverter off and then on again.</li> <li>If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- <b>W047</b> - Update Incomplete - ● Yellow LED	<b>FW update method unsuccessful</b> The alarm occurs when a firmware update has not been completed.	<ul style="list-style-type: none"> <li>Complete any pending firmware updates.</li> <li>If the problem persists once the firmware updates have been completed, switch the inverter off and on again.</li> <li>If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- <b>W048</b> - Periodic GridOff - ● Yellow LED	<b>Automatic disconnection from the grid due to time limit:</b> If the inverter exceeds the set grid connection time limit set by the grid standard, it will automatically have to carry out a disconnection and reconnection to the grid to carry out the Riso test.	<ul style="list-style-type: none"> <li>The presence of this alarm is not an error as the automatic disconnection is prescribed by safety regulations.</li> <li>If the inverter disconnects in a shorter time than expected, contact customer assistance.</li> </ul>
 - <b>W049</b> - Global-Settings Event - ⊗ No LED	<b>Variation of the grid standard</b> Variation of the inverter's grid standard; this change can be made through the internal webserver.	<ul style="list-style-type: none"> <li>The variation in the inverter's grid standard is done directly by the customer/installer and is not an error. The information is only saved on the historic record of the events memorised by the inverter</li> </ul>
- <b>W058</b> - System Frozen - ● Yellow LED	<b>Converter in locked state:</b> The converter lock state is connected to an installation phase in which the starts-up and grid connection conditions are not yet present.	<ul style="list-style-type: none"> <li>Complete the commissioning phase of the inverter.</li> <li>If the problem persists (once the commissioning phase has been completed and the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- <b>E001</b> - Input OC - ● Yellow LED	<b>Input over-current (photovoltaic generator):</b> The alarm occurs when the inverter's input current exceeds the inverter's threshold for maximum input current.	<ul style="list-style-type: none"> <li>Check whether the composition of the PV generator enables input current which exceeds the maximum threshold allowed by the inverter and that the configuration of the inputs (independent or in parallel) is carried out correctly.</li> <li>If both checks are positive, contact customer assistance.</li> </ul>
- <b>E002</b> - Input OV - ● Yellow LED	<b>Input overvoltage (photovoltaic generator):</b> The alarm is generated when the input voltage (from the PV generator) exceeds the inverter's threshold of maximum input voltage. The alarm is triggered before reaching the absolute threshold beyond which the inverter will be damaged. When the inverter's input voltage exceeds the Over Voltage threshold, the inverter will not start up due to the generation of the alarm.	<ul style="list-style-type: none"> <li>It is necessary to measure the input voltage inside the inverter with a voltmeter.</li> <li>If it is higher than the maximum voltage of the operating range, the alarm is genuine and it is necessary to check the configuration of the PV generator. If the voltage has also exceeded the maximum input threshold the inverter could be damaged.</li> <li>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 assistance.</li> </ul>

- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- E003 - No Parameters - Yellow LED	<b>DSP initialisation error:</b> The main microcontroller is unable to correctly initialize the two DSPs (booster stage and inverter stage). The error is caused by communication problems on the inverter's internal bus.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E004 - Bulk OV - Yellow LED	<b>"Bulk" over-voltage (DC-DC circuit):</b> Error inside the inverter. The alarm is raised when the voltage at the heads of the bulk capacitors exceeds the Over Voltage threshold (internal unchangeable threshold).	<ul style="list-style-type: none"> <li>• The alarm may be triggered by causes external to the inverter:               <ul style="list-style-type: none"> <li>- An excessive input voltage can be recorded as a condition for bulk over voltage. In this case it is advisable to check the inverter's input voltage and should this value be close to the input OV threshold, review the configuration of the photovoltaic generator.</li> <li>- Excessive grid voltage could cause the bulk voltage to rise in uncontrolled fashion with a consequent protection intervention and hence generation of the alarm. In these cases the alarm is transitory and the inverter automatically restarts</li> <li>- The alarm may be triggered by causes inside the inverter and in this case it is necessary to contact customer assistance.</li> </ul> </li> </ul>
- E005 - Comm.Error - Yellow LED	<b>Communication error inside the inverter:</b> The alarm occurs when there are communication problems between the control devices inside the inverter.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E006 - Output OC - Yellow LED	<b>Output overcurrent:</b> The alarm occurs when the inverter's output current exceeds the inverter's threshold for maximum output current.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E007 - IGBT Sat - Yellow LED	<b>Saturation recorded on the IGBT components:</b> 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. <ul style="list-style-type: none"> <li>- Should the error occur sporadically, it may be caused by a brusque transition of the grid voltage or of the input voltage, but is not due to a malfunction by the inverter.</li> <li>- If the error is connected to an internal fault, it will continue to appear and so it is necessary to contact customer assistance.</li> </ul>
- E009 - Internal error - Yellow LED	<b>Error inside the inverter:</b> Error inside the inverter	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E010 - Bulk Low - Yellow LED	<b>Low "Bulk" voltage (DC-DC circuit):</b> The alarm can be caused by causes external to the inverter: a reduced input voltage on the inverter (just above the activation voltage) but which is not accompanied by a sufficient availability of power from the photovoltaic generator (typical condition of the stages with limited irradiation)	<ul style="list-style-type: none"> <li>- If the error signal occurs sporadically, it may be due to causes external to the inverter (limited irradiation and so limited power availability from the PV generator).</li> <li>- If the problem occurs systematically even in conditions of high irradiation and with input voltage which is significantly higher than the activation voltage, contact customer assistance.</li> </ul>
- E011 - Ramp Fail - Yellow LED	<b>Long wait for "Booster" regime to start:</b> Error internal to inverter relating to start up time for DC-DC circuit regime (Booster)	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E012 - DcDc Fail - Yellow LED	<b>Error in the "Booster" circuit (DC-DC side) recorded by the "Inverter" circuit (DC-AC side):</b> Error inside the inverter regarding the operation of the DC-DC circuit part (Booster).	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E013 - Wrong Mode - Yellow LED	<b>Incorrect configuration of inputs (set in parallel rather than independent):</b> The alarm is generated solely when the inverter is configured with parallel inputs. In this particular configuration the inverter checks the input voltage of each of the two channels and if the two voltages differ by more than 20Vdc, the alarm is raised .	<ul style="list-style-type: none"> <li>• Check that the setting of the "IN MODE" switch is specifically set to "PAR" and that the bridges between the two input channels have been included.</li> <li>- If the configuration of the inverter is correct, check that the input strings have the usual number of standard panels of the usual brand and with the same inclination/orientation.</li> <li>- If both the configuration of the inverter and the characteristics of the PV generator conform with the specifications, contact customer assistance.</li> </ul>



- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- E014 - Over Temp. - ● Yellow LED	<b>Excessive temperature inside the inverter:</b> External temperature over 60°C. This parameter also depends on the power which the inverter must supply since the measurement of temperatures is done internally and is influenced by the heat dissipated by the components of the inverter itself	<ul style="list-style-type: none"> <li>• 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.</li> <li>- If the problem persists (once the ambient temperature has returned to within the range), contact customer assistance. You must remember to wait for the time necessary to allow the inverter to cool down.</li> </ul>
- E015 - Bulk Cap Fail - ● Yellow LED	<b>Breakdown recorded on the “Bulk” capacitor:</b> Error inside the inverter regarding a problem in the bulk capacitors.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E016 - Inverter Fail - ● Yellow LED	<b>Error in the “Inverter” circuit (DC-AC side) recorded by the “Booster” circuit (DC-DC side):</b> The alarm is generated when a problem is detected in the inverter circuit part (DC/AC).	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E017 - Start Timeout - ● Yellow LED	<b>Long wait for “Inverter” regime to start up:</b> Error internal to inverter relating to start-up time for the DC-AC circuit regime (Inverter) The alarm can be caused by causes external to the inverter: a reduced input voltage on the inverter (just above the activation voltage) but which is not accompanied by a sufficient availability of power from the photovoltaic generator (typical condition of the stages with limited irradiation)	<ul style="list-style-type: none"> <li>- If the error signal occurs sporadically, it may be due to causes external to the inverter (limited irradiation and so limited power availability from the PV generator).</li> <li>- If the problem occurs systematically even in conditions of high irradiation and with input voltage which is significantly higher than the activation voltage, contact customer assistance.</li> </ul>
- E018 - Ground Fault - ● Red LED	<b>High leakage current measured on the DC side (photovoltaic generator):</b> The alarm is generated when, during normal operation of the inverter, a leakage current to ground is detected in the DC section of the system. It is also possible that the inverter generates the alarm E018 message also due to AC leakage currents connected to the capacitive nature of the photovoltaic generator compared to ground.	<ul style="list-style-type: none"> <li>• Measure the isolation resistance using a megohmmeter positioned in the photovoltaic array (positive terminal short-circuited at the negative pole) compared to ground. The measurement is strongly influenced by the environmental conditions, so must be made under the same conditions in which the error occurred.</li> <li>- If the value measured is lower than 1 megaohm, a check must be carried out by a technician/installer on the photovoltaic generator to identify and eliminate the problem.</li> <li>- If the value measured is higher than 1 megaohm and the error signal persists, contact customer assistance.</li> </ul>
 - E019 - ILeak sense.fail - ● Yellow LED	<b>Failure of test on sensor to measure the leakage current (DC side):</b> Before connecting to the grid the inverter runs a self-test regarding the sensor for the leakage current. The test is carried out by “forcing”, in the sensor of the leakage current, a current with a known value: the microprocessor compares the value read with the known value. The error is generated if the comparison between the read value and the known value during the test does not fall within the allowed tolerance.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally. By its nature, the alarm only occurs prior to connection to the grid</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E020 - Self Test Error 1 - ● Yellow LED	<b>Failure of the test on the relay of the “Booster” (DC-DC circuit):</b> Before connecting to the grid, the inverter carries out some internal tests. One of these tests concerns the correct operation of the booster relay. The test is carried out by “forcing” the switching of the relay and checking its operation. The error is generated if a problem is found in actioning the relay.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally. By its nature, the alarm only occurs prior to connection to the grid</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E021 - Self Test Error 2 - ● Yellow LED	<b>Failure of the test on the inverter’s relay (DC-AC circuit):</b> Before connecting to the grid, the inverter carries out some internal tests. One of these tests concerns the correct operation of the inverter relay. The test is carried out by “forcing” the switching of the relay and checking its operation. The error is generated if a problem is found in actioning the relay.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally. By its nature, the alarm only occurs prior to connection to the grid</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E022 - Self Test Error 4 - ● Yellow LED	<b>Timeout of the tests undertaken on the relays inside the inverter:</b> Execution time for the self-test carried out on the relay of the DC_AC (inverter) circuit too high. It may indicate a problem connected to the aforementioned relays	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>

- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- E023 - DC in error - Yellow LED	<b>Feeding of direct current to grid outside of range:</b> 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. In any case, the inverter does not stop because of the E023 error, but tries to connect to the grid again. The sporadic repetition of the error is a sign of serious grid distortions or sharp irradiation changes, while systematic repetition of the error signal will indicate a breakdown on the inverter	Once the error appears, the inverter attempts to resume normal operation. - Should the error occur sporadically, it may be caused by a brusque transition of the grid voltage or of the input voltage, but is not due to a malfunction by the inverter. - If the error is connected to an internal fault, it will continue to appear and so it is necessary to contact customer assistance.
- E024 - Internal error - Yellow LED	<b>Error inside the inverter:</b> Error inside the inverter	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E025 - Riso Low - Red LED	<b>Low value of isolation resistance:</b> Before connecting to the grid the inverter measures the isolation resistance of the PV generator compared to ground. Should the measurement of the isolation resistance be below 1Mohm, 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) of the panels not correctly sealed, so as to permit infiltration by water and/or humidity; - Problems in connections between panels (not perfectly fit); - Poor quality of cable joints; - Presence in the DC section of unsuitable or damaged overvoltage surge arresters outside the inverter (reduced ignition voltage compared to the characteristics of the strings of the PV generator); - Presence of humidity inside any junction box	• Measure the isolation resistance using a megohmmeter positioned in the photovoltaic array (positive terminal short-circuited at the negative pole) compared to ground. The measurement is strongly influenced by the environmental conditions, so must be made under the same conditions in which the error occurred. - If the value measured is lower than 1 megaohm, a check must be carried out by a technician/installer on the photovoltaic generator to identify and eliminate the problem. - If the value measured is higher than 1 megaohm and the error signal persists, contact customer assistance.
- E026 - Vref Error - Yellow LED	<b>Internal reference voltage outside of range:</b> Wrong measurement of reference voltage inside inverter	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E027 - Error Meas V - Yellow LED	<b>Grid voltage outside of range:</b> Error in the internal measurement of grid voltage (set by law) to have a redundant measurement (2 measurements on the same parameter made by two different circuits)	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E028 - Error Meas F - Yellow LED	<b>Grid frequency outside of range:</b> 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).	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E029 - Mid Bulk OV - Yellow LED	<b>Internal overvoltage on the measurement of the "Mid bulk":</b> Error inside the inverter (only triphase models)	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E030 - Error Meas Ileak - Yellow LED	<b>High leakage current (DC side):</b> - Error on the internal measurement (performed when the inverter is connected to the grid) of the DC side (PV generator) leakage current with respect to ground (required by regulations) to have a measurement redundancy (2 measurements of the same parameter carried out by two independent circuits)	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E031 - Error Read V - Yellow LED	<b>Output relay damaged:</b> Measurement of internal voltage on heads of the output relay outside of range. There is too great a difference in voltage between the input and output of the grid connection relay.	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.
- E032 - Error Read I - Yellow LED	<b>Imbalanced output currents:</b> Measurement of the unbalance in the output voltage (made across the three phases) outside of range (only in three-phase models)	• Error inside the inverter and cannot be checked externally. - If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.



- Error code - Error message - Warning	Name of Alarm and Cause	Solution
- E033 - UTH -  Yellow LED	<b>Low ambient temperature:</b> Temperature outside the inverter below -25°C	<ul style="list-style-type: none"> <li>• Wait for the temperatures to which the inverter is exposed to return to the operating range.</li> <li>- If the problem persists, contact customer assistance. You must remember to wait for the time necessary to allow the inverter to warm up.</li> </ul>
- E034 - Interlock fail -  Yellow LED	<b>"IGBT" circuitry not ready:</b> Error inside the inverter	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
- E035* - Remote Off -  Yellow LED	<b>Inverter awaiting "remote ON" command:</b> 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).	<ul style="list-style-type: none"> <li>• Switch the inverter back on 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.</li> <li>- If the problem persists (once the Remote ON/OFF function has been reactivated), contact customer assistance.</li> </ul>
- E036 - Vout Avg error -  Yellow LED	<b>Average of the measurements of grid voltage outside of range:</b> The average value of the grid voltage (sampled every 10 minutes) does not fall within the permitted ranges. The grid voltage in the point connected to the inverter is too high. This may be caused by a grid impedance that is too high. In the final stage of the timeout, the inverter limits the power to check whether the grid voltage has stabilised into regular parameters. If this does not happen, the inverter disconnects from the grid	<ul style="list-style-type: none"> <li>• Check the grid voltage in the connection point to the inverter.</li> <li>- If the grid voltage differs from the range due to the conditions of the distribution grid, ask the operator to adjust the grid voltage. If the operator authorises a change to the inverter's parameters, agree the new limits with customer assistance.</li> </ul>
- E037 - Riso Low -  Red LED	<b>Low value of the isolation resistance (only with the "Amorphous" mode activated):</b> 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 generator exceeds 30V for more than 30 minutes or 120V for more than one second.	<ul style="list-style-type: none"> <li>• Check for the presence and correct contact between the two terminals of the grounding resistance installed inside the inverter</li> <li>• Measure the isolation resistance using a megohmmeter positioned in the photovoltaic array (positive terminal short-circuited at the negative pole) compared to ground. The measurement is strongly influenced by the environmental conditions, so must be made under the same conditions in which the error occurred.</li> <li>- If the value measured is lower than 1 megaohm, a check must be carried out by a technician/installer on the photovoltaic generator to identify and eliminate the problem.</li> <li>- If the value measured is higher than 1 megaohm and the error signal persists, contact customer assistance.</li> </ul>
 E046 - String self test fail -  No LED	<b>Error during the automatic check of the string voltages (only in models with the "fuse-control" board):</b> In some inverter models it is possible to carry out the check test of the polarity of the strings connected to the input (e.g.:TRIO-20.0/27.6kW). This error signal occurs when, during the test stage, an inverted string is recorded	<ul style="list-style-type: none"> <li>• Section the inverter and check the polarity of the string(s) which the inverter has recorded as inverted.</li> <li>- Once all the strings have been correctly connected, activate the system once again; the inverter will once again check the correct polarity of the string inputs at the end of which it will carry out the checks for the grid connection.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E049 - AC FF Error -  Yellow LED	<b>Error in the "AC feed-forward" circuit:</b> Error inside the inverter	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E050 - AFDD Activated -  Yellow LED	<b>Arc Fault protection activated:</b> Possible photovoltaic arc detected on the DC side.	<ul style="list-style-type: none"> <li>• If it is the first time this problem has occurred, press the ESC button for 5 seconds and wait for the unit to restart.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E051 - Safety mem. Fault -  Yellow LED	<b>Error inside the inverter.</b>	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E053 - AFDD Fault -  Yellow LED	<b>Arc Fault board autotest failed:</b> Problem detected during the AFDD board autotest phase.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E054 - AFDD comm. Fault -  Yellow LED	<b>Arc Fault board communication error:</b> Error on the RS485 serial communication detected between the inverter and the AFDD board.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
E055 - AFDD wrong conf. -  Yellow LED	<b>Arc Fault board parameter reading error:</b> Error in the parameter reading by the system.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>

- Error code - Error message - Warning	Name of Alarm and Cause	Solution
<b>E056</b> - Over Temp. (from external box) -  Yellow LED	<b>Excessive temperature measured inside the inverter's wiring box:</b> High internal temperature. This error relates to the temperature measured on external boxes (e.g.:TRIO-20.0/27.6kW).	<ul style="list-style-type: none"> <li>• 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.</li> <li>- If the problem persists (once the ambient temperature has returned to within the range), contact customer assistance. Remember to wait the time needed to allow the inverter to cool down</li> </ul>
<b>E057</b> - Vbulk reading error -  Yellow LED	<b>Input voltage (Vin) higher than booster voltage (Vbulk):</b> The error occurs if the input voltage exceeds the Bulk voltage (voltage on the DC-DC circuit inside the inverter)	<ul style="list-style-type: none"> <li>• It is necessary to measure the input voltage inside the inverter with a voltmeter.</li> <li>- If it is higher than the maximum voltage of the operating range, the alarm is genuine and it is necessary to check the configuration of the PV generator. If the voltage has also exceeded the maximum input threshold the inverter could be damaged.</li> <li>- 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 assistance.</li> </ul>
<b>E058</b> - Pin vs Pout check error -  Yellow LED	<b>Error in the check of Pin vs Pout:</b> 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.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
<b>E074</b> - Internal error -  Yellow LED	<b>Communication error inside the inverter:</b> The alarm occurs when there are communication problems between the control devices inside the inverter.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
<b>E077</b> - Internal Error -  Yellow LED	<b>Error in the system configuration:</b> Error inside the inverter	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
<b>E078</b> - Riso Test fail -  Yellow LED	<b>Riso test error:</b> Problem detected during the Riso test phase.	<ul style="list-style-type: none"> <li>• Error inside the inverter and cannot be checked externally.</li> <li>- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance.</li> </ul>
<b>E079</b> - Wrong Sequence -  Yellow LED	<b>Incorrect Phases connection</b> (Only triphase models) The phases have not been connected correctly to the AC output	<ul style="list-style-type: none"> <li>• Invert two of the phases of the network wiring to the AC terminal block of the inverter.</li> </ul>
<b>E081</b> - Internal Error -  Red LED	<b>Inverter fault / Incomplete inverter closing:</b> Fault inside the inverter or incomplete inverter closing (front cover missing or not tightened, cable glands missing or incorrectly tightened, environmental protection IP65 not guaranteed)	<ul style="list-style-type: none"> <li>• If the problem has occurred during the installation phase or during the inverter maintenance phase (therefore the cover has been removed or the cable glands have been acted upon), carry out the following operations:              - Disconnect the AC grid and DC input from the inverter and check for the front cover and all the cable glands, also checking their correct tightening to ensure environmental protection IP65; reconnect the AC grid and the DC input and attempt to switch the inverter on; if the problem persists, contact customer assistance :              - If the front cover and all cable glands are present, disconnect the AC grid and DC input from the inverter and wait 15 minutes at a safe distance, then open the inverter cover and if no smoke/smell of burning is present, check the integrity of the components or the presence of moisture or other abnormal conditions; reconnect the AC grid and DC input and attempt to switch on the inverter; if the problem persists contact customer assistance.</li> <li>• If the problem has occurred after installation or after an inverter maintenance phase (therefore the cover has NOT been removed or the cable glands have NOT been acted upon), disconnect the AC grid and the DC input from the inverter and contact customer assistance.</li> </ul>
<b>E084</b> - BackFeed OC -  Yellow LED	<b>Return current to photovoltaic field:</b> The error occurs if the input voltage is particularly low (typically in the evening in conditions of low irradiation) and indicates a return current from the inverter to the photovoltaic panels).	If the error occurs in the evening or in conditions of low irradiation, it must not be considered a problem but a protection intervention for the photovoltaic field. - If the error occurs with good irradiation conditions, switch the inverter off and back on again; if the error persists, contact customer assistance.



## Power limitation messages

The equipment can signal possible output power limitations which may occur on the basis of:

- settings made by the user
- settings required by the grid standard of the country of installation
- protective devices inside the inverter

The signals and the messages can only be verified using the internal Webserver.

*The following table gives the complete list of power limitation messages relating to string inverters.*

*Some messages may not be used depending on the inverter model installed.*

- Limitation code	Name of Derating and Cause	Solution
- LIMxxx% CODE:00	<p><b>Power limitation:</b> The message indicates that the user has set an output power limitation for the inverter. LIM xxx% = Power reduction percentage Examples: LIM 100% = no power limitation LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• Check the limitation value in “Settings &gt; Power Reduction”.</li> </ul>
- LIMxxx% CODE:01	<p><b>Power limitation for over-frequency:</b> The message indicates that the user has set a power limitation due to over frequency in order to reduce the maximum output power of the inverter when the grid frequency exceeds certain limits. LIM xxx% = Power reduction percentage Examples: LIM 100% = no power limitation LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• Check the limitation value set in “Settings &gt; Service Power &gt; OF Derating”</li> </ul>
- LIMxxx% CODE:02	<p><b>Power limitation for over-voltage:</b> The message indicates that the user has set a power limitation due to overvoltage (parameter U &gt;(10 min)) in order to reduce the maximum output power of the inverter when the reading of the average grid voltage exceeds certain limits. The sampling of readings is done every 10 minutes (U&gt;(10min)). LIM xxx% = Power reduction percentage Examples: LIM 100% = no power limitation LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• Check the limitation value in “Settings &gt; Service Power &gt; U&gt;(10min) Der.”</li> </ul>
- LIMxxx% CODE:03	<p><b>Anti-islanding power limitation:</b> The message indicates that a power limitation is active since an "islanding" condition has been recorded. LIM xxx% = Power reduction percentage Examples: LIM 100% = no power limitation LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• If the inverter remains connected to the grid and the limitation is active, contact customer assistance</li> </ul>
- LIMxxx% CODE:04	<p><b>Power limitation due to low grid voltage:</b> The message indicates that an output power limitation may occur since a low grid voltage (AC) condition has been recorded. LIM xxx% = Power reduction percentage Examples: LIM 100% = no power limitation LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• Check that the grid voltage is lower than the minimal voltage. Should this condition persist, contact the grid operator to resolve the problem.</li> </ul>



- Limitation code	Name of Derating and Cause	Solution
- LIMxxx% CODE:05	<p><b>Power limitation due to excess temperature:</b>            The message indicates that a power limitation is active since an excess temperature condition has been recorded inside the inverter (This parameter depends also on the power which the inverter must provide since the measurement of temperatures is taken internally and is influenced by the heat dissipated by the components of the inverter itself).            LIM xxx% = Power reduction percentage            Examples:            LIM 100% = no power limitation            LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>- If the problem (once the ambient temperature has returned within the range) persists, contact customer assistance.</li> </ul>
- LIMxxx% CODE:06	<p><b>Power limitation for input over-voltage:</b>            The message indicates that a power limitation is active since an input overvoltage (AC) has been recorded.            LIM xxx% = Power reduction percentage            Examples:            LIM 100% = no power limitation            LIM 50% = limitation to 50% of the output nominal power</p>	<ul style="list-style-type: none"> <li>• It is necessary to measure the input voltage inside the inverter with a voltmeter.</li> <li>- If it is higher than the maximum voltage of the operating range, the alarm is genuine and it is necessary to check the configuration of the PV generator. If the voltage has also exceeded the maximum input threshold the inverter could be damaged.</li> <li>- 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 assistance.</li> </ul>



## Procedure for removing the power module and wiring box

The DC and AC wiring boxes and the power module may be removed separately to take one out of service.

*Never open the wiring boxes if there is rain, snow or relative humidity >95%. Always carefully seal all unused openings.*

*Even though the device is equipped with an anti-condensation valve, air with extremely high levels of humidity can lead to the creation of condensation inside the inverter.*

*As the inverter is almost completely insulated from the outside, condensation can also form after maintenance in cold, damp weather conditions.*

Refer to the chapter

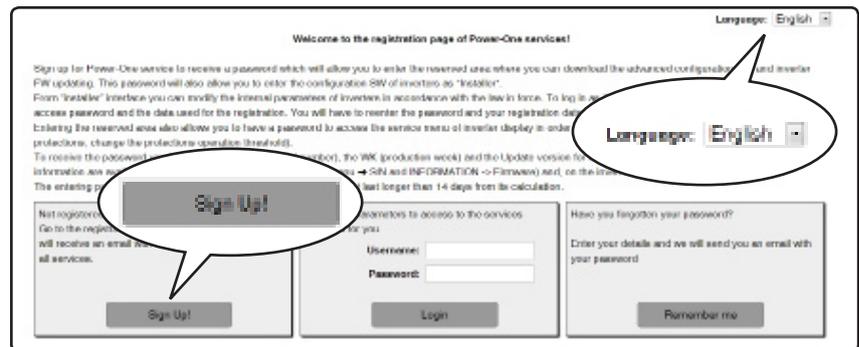
- "Turning off the inverter" (chapter 7), before removing one of the two wiring boxes or the inverter itself.
- Follow the instructions for the mounting procedure (vertical or horizontal) in reverse order (paragraph "Vertical mount" or "Horizontal mount", chapter 5).
- After or during removal, reinstall the quick disconnect covers ④ on the quick disconnect connectors ② on the power module ③.
- If needed, arrange temporary ground connections if needed to ensure that all parts of the inverter which are not removed remain grounded.



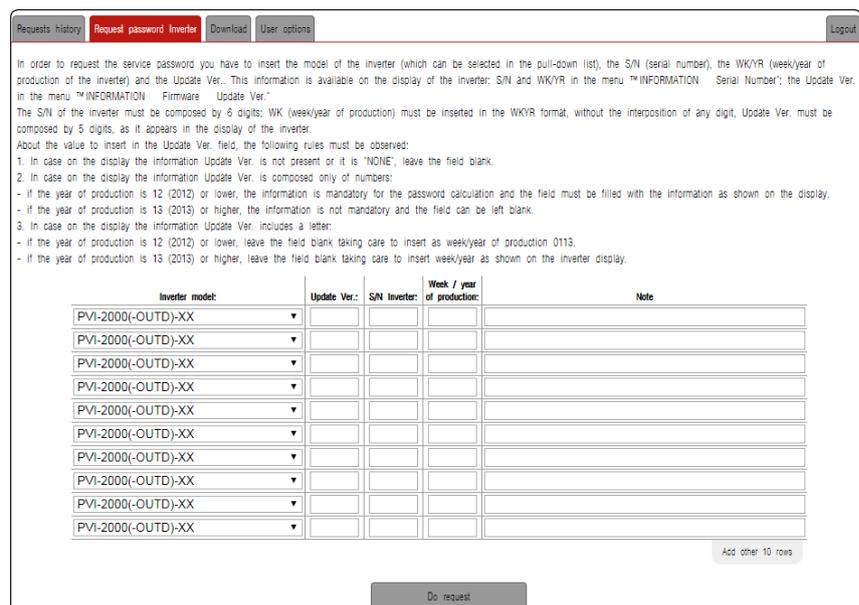
# Obtaining the Admin Plus credentials - Registering at the “Registration” site

In order to obtain the Admin Plus token for advanced configuration of the inverter using the internal Webserver, do the following:

- Go online and access <https://registration.abbsolarinverters.com>
- Set the desired language and click on the correct icon to start registration



- Insert the personal data requested.
- An email will be sent to the email address provided, with a link for completing the registration.
- Once registration is done, another email will be sent with the password for accessing <https://registration.abbsolarinverters.com> website.
- Click on “Request password inverter”



- Choose Inverter model and insert the information on the field S/N and Week of production. These information are available on the identification label on the inverter

Inverter model:	Update Ver.:	S/N Inverter:	Week / year of production:
PVI-2000(-OUTD)-XX ▼			

- Click on "Do request" button and take note of the 6 digit token. An e-mail containing the token will be automatically sent to the e-mail address used during the registration to the site.

The Admin Plus token must be inserted in the dedicated "User" section of the internal Webserver.



## Replacing DC string fuses (DC wiring box -2 models)

The string fuses in the DC wiring box -2 models may need to be replaced in the following circumstances:

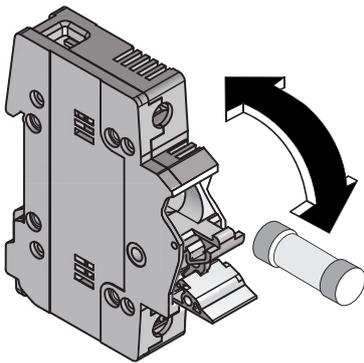
1. Adjustment of the fuse value based on of the type of PV panels used
2. Damaged fuse

Procedure for replacing string fuses:

- Turn off the inverter following the instruction on the “Turning off the inverter” (chapter 7)



*NOTE that by opening only the inverter's DC disconnect switch, the DC input voltage is still present on the input strings and fuse holder.*



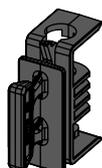
- Open the fuse holder by pulling up on the “ABB” tab
- Remove the fuse
- Set the new fuse in the fuse holder
- Close the fuse holder by pushing downwards on the tab until it clicks back into place



## Replacing DC string fuses (DC wiring box -3 models)

The string protection fuses (where present) in the inverter may need to be replaced in the following circumstances:

1. Adjustment of the fuse value on the basis of the type of PV panels used
2. Damaged fuse



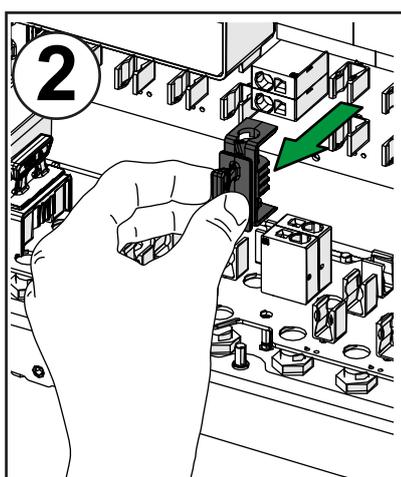
Fuses are replaced using the specific fuse box which allows them to be removed easily and correctly positioned when being inserted.

Procedure for replacing string fuses:

1. Disconnect the strings by disconnecting the DC and AC disconnect switches fitted on the inverter followed by the quick fit input connectors.



**By only disconnecting the AC disconnect switch and the DC disconnect switch, the DC input voltage is still present on the fuse board. Use adequate PPE (personal protective equipment).**

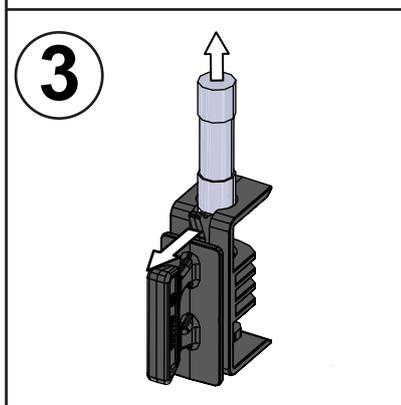


2. Remove the fuse to be replaced acting on the fuse box grip

3. Lift the fuse retaining clip and remove the fuse from the fuse box

4. Introduce the new fuse into the fuse box

5. Fit the fuse box into the wiring box



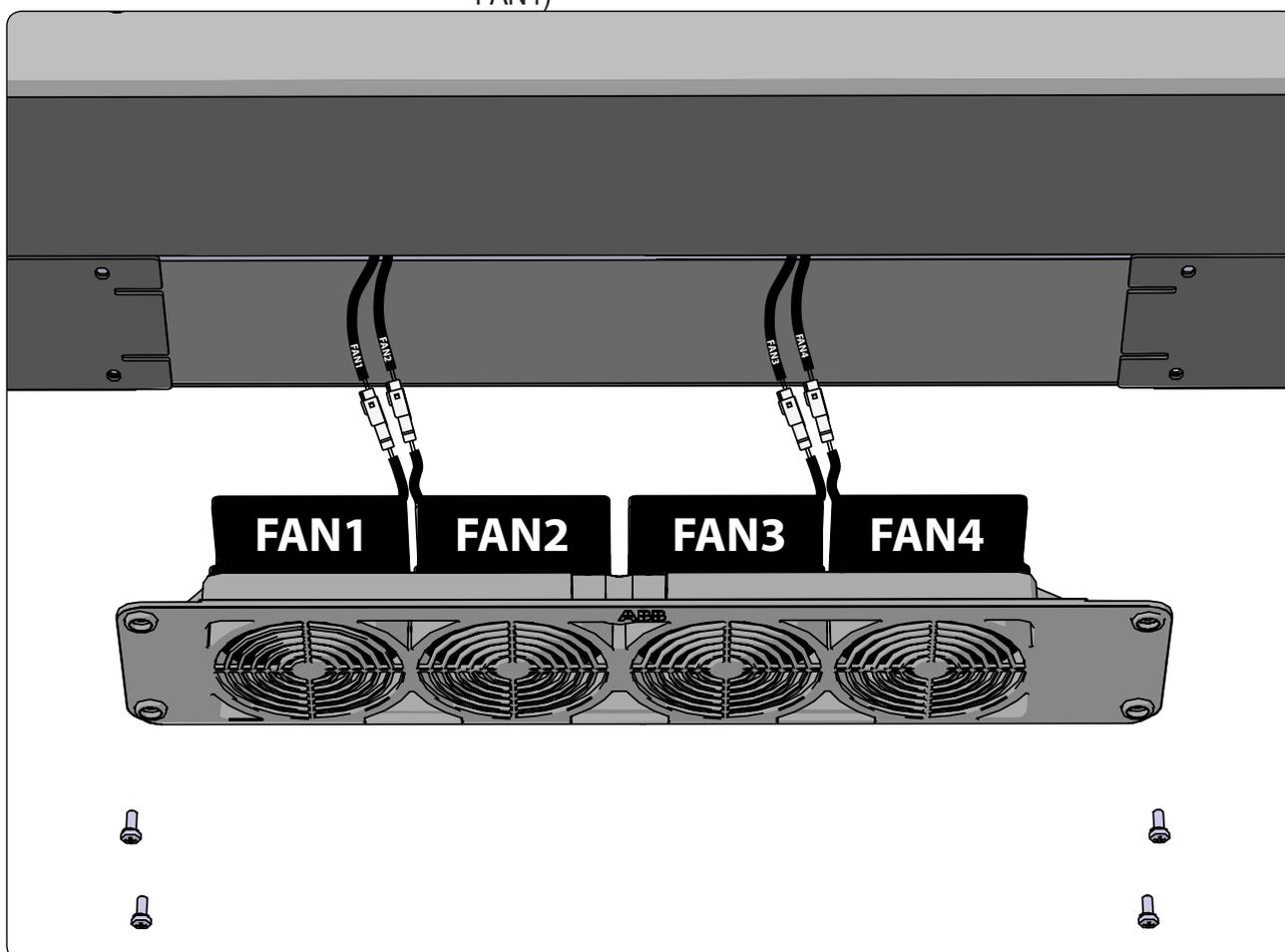
**Once the fuse box has been fitted, check that it is in contact with the fuse board.**

## Replacing cooling section

Procedure for replacing cooling section:



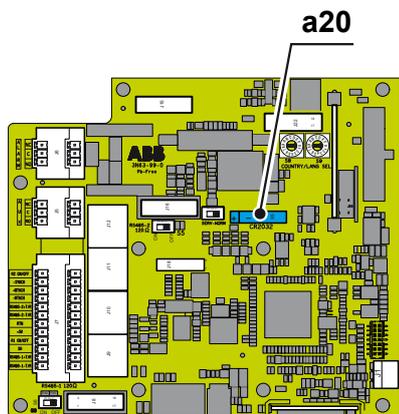
1. Perform the “inverter switch-off” procedure before operate on the inverter
2. Remove the 4 screws of the cooling section.
3. Pull out the cooling section
4. Disconnect the 4 fan connectors
5. Take the new cooling section and connect the 4 fan connectors. During this phase pay attention to connect the fan to the correspondent cable; on each fan cable coming from the power module and on each fan are applied labels that indicates the fans number (from FAN1 to FAN4)



6. Place the new cooling section on the lower side of the power module

7. Screw the 4 fastening screws

## Replacement of the buffer battery



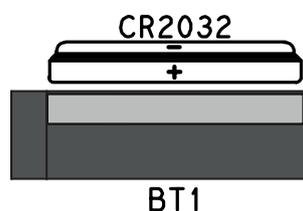
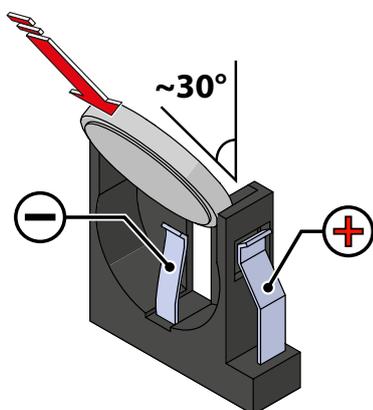
The backup battery, reference designator X5 (a20), is in the DC wiring box 02 and may need to be replaced in case of

1. an LED error signal
2. Reset of the date and time settings

The battery is type **CR2032**. It is on the control and communication board 09 in the DC wiring box.

To replace the backup battery:

- Turn off and lock out/tag out the inverter, both AC and DC sides.
- Remove the DC wiring box's 02 front cover 08, taking care to save the screws.
- Remove the plastic cover above the control and communication board. Save the cover and screws.
- Remove the CR2032 battery X5 (a20), noting its polarity
- Install the new battery, taking care to handle it with insulating gloves in order not to compromise the charge. Note the polarity is shown on the silkscreen on the control and communication board



- Reinstall the plastic cover above the communication and control board
- Reinstall the DC wiring box cover and remove the lock out/tag out.
- Resume inverter operation.

## Storage and dismantling

### Storage of an uninstalled inverter for long periods

If the inverter is to be stored for a long period of time before installation, check that it is correctly packed.

The equipment must be stored in well-ventilated, indoor areas, in a non-corrosive environment that doesn't damage the inverter's components.

Have the inverter inspected before installation -- interior components, covers and gaskets.

### Storage of an installed inverter for long periods of non-use

If an inverter in the field is to be left unused, confirm all external openings and connectors have water tight seals or cap. Securely close all locks. If it's in a humid environment, install dessicant in the interior since the inverter is not seeing heat cycles each day.

Restarting after a long period of non-use requires a thorough inspection of the inverter's interior, exterior and wiring to the PV field and grid (and removal of any dessicant). In some cases, oxidation and dust that has settled inside the equipment must be removed.

## Disposal

ABB CANNOT be held responsible for disposal of the equipment (cables, batteries, etc.). The customer must dispose of these items, some of which be harmful to the environment, in accordance with the local regulations



Dispose of the various types of materials at facilities that are suitable for the purpose.

**Table: component composition**

COMPONENT	CONSTRUCTION MATERIAL
Frame, brackets, supports .....	Arc-welded steel FE37
Casing or covers .....	Arc-welded steel FE37, aluminum
Gaskets and seals .....	Rubber / Teflon / Viton
Electrical cables .....	Copper / Rubber
Backup battery .....	Nickel / Lead/ Lithium

## Attachments

# 9

## Port and network services used by the inverter

### IP Network Services

Any network connected to the inverter must allow traffic to pass on the following ports. Network firewall rules (if present) must allow responses to the inverter over existing TCP connections.

Direction	Service/Port	Protocol	Description
Out	ssh/22	Tcp	For remote debugging by ABB service personnel, the inverter utilizes encrypted SSH Remote Login Protocol. To allow service personnel remote access to the inverter, this port has to be opened in any firewall and forwarded to the inverter. (preferred)
Out	domain/53	Tcp/udp	The inverter must be able to resolve domain names, to ensure scalability and dynamic changes on the Internet (DNS). (required)
Out	https/443	Tcp	As an HTTP client, the inverter uses SSL/TLS protocol connections to Aurora Vision® servers for secure communication. The inverter uses this port for all services, including data transmission, firmware upgrade, configuration management, and remote command transmission. (required)
Out	dhcp/67, dhcp/68	Udp	If DHCP service is not available, static network information must be assigned to the inverter (preferred)
Out	ntp/123	Udp	The inverter uses this port for network time services (NTP). (preferred)

## Network Hosts

The inverter will connect to the following hosts. Some servers owned by ABB, and others are customer or ISP servers. Servers listed as owned by "Customer IT/ISP" must be configured in the inverter using either DHCP or as static network information.

Host	Purpose	Port	Owner/Manager
platform.auroravision.net	Data, configuration	TCP:443	ABB
gw1.auroravision.net and/or apt.fatspaniel.net	Inverter firmware upgrade	TCP:443	ABB
Site dependent	DHCP (optional)	UDP:67, UDP:68	Customer IT/ISP
Site dependent	DNS	UDP:53, TCP:53	Customer IT/ISP

## Inverter network configuration

The inverter requires a valid network configuration in order to operate. This information can either be provided by a DHCP server provided by the customers network (the default), or the inverter can be configured with static network information. Regardless of how the inverter is configured, the following information is required.

Configuration	Purpose
IP Address	Allows the inverter to take part in the local network. This does not need to be a public IP address. In most cases this is a private IP address.
Subnet mask	Used to determine if two computers are on the same network.
Gateway	The IP address of the computer which will forward network traffic from the local network to an external network
DNS Server	The IP address(es) of the computer(s) which resolve domain names.



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## Further information

For more information on ABB solar products and services,  
visit [www.abb.com/solarinverters](http://www.abb.com/solarinverters)

# Contact us

[www.abb.com/solarinverters](http://www.abb.com/solarinverters)

