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.
**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.

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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="General warning symbol" /></td>
<td><strong>General warning</strong> - Important safety information. Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td><img src="image" alt="Dangerous Voltage symbol" /></td>
<td><strong>Dangerous Voltage</strong> - 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.</td>
</tr>
<tr>
<td><img src="image" alt="Hot parts symbol" /></td>
<td><strong>Hot parts</strong> - 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.</td>
</tr>
<tr>
<td><img src="image" alt="Risk of injury symbol" /></td>
<td>Risk of injury due to the weight of the equipment. Take care during lifting and transport</td>
</tr>
<tr>
<td><img src="image" alt="Ground connection point" /></td>
<td>Ground connection point.</td>
</tr>
<tr>
<td><img src="image" alt="Rated temperature range" /></td>
<td>Rated temperature range.</td>
</tr>
<tr>
<td><img src="image" alt="DC symbol" /></td>
<td>Direct current</td>
</tr>
<tr>
<td><img src="image" alt="AC symbol" /></td>
<td>Alternating current</td>
</tr>
<tr>
<td><img src="image" alt="Positive terminal" /></td>
<td>The DC input voltage positive terminal</td>
</tr>
<tr>
<td><img src="image" alt="Negative terminal" /></td>
<td>The DC input voltage negative terminal</td>
</tr>
</tbody>
</table>

- DC: Direct current
- AC: Alternating current

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000623AG
**Intended use**

ABB is not be 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 manuals, 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**

The inverter are 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.

The safety approval label contains the following information:
1. Manufacturer
2. Model
3. Rating data
4. Certification marks
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 display the following information:

- Inverter or wiring box model
- Inverter Part Number
- Inverter/wiring box Serial Number consisting of:
  - YY = Year of manufacture
  - WW = Week of manufacture
  - SSSSSS = sequential number
- Week/Year of manufacture

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.
## 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

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCWB-1-TRIO-60.0-TL-OUTD-US-480</td>
<td>Input lugs for use with external combiner, DC disconnect switch, conduit entry</td>
</tr>
<tr>
<td>DCWB-2-TRIO-60.0-TL-OUTD-US-480/12</td>
<td>Touch-safe fuse holder 12 string combiner, DC disconnect switch, AFCI, DC SPD, conduit entry</td>
</tr>
<tr>
<td>DCWB-2-TRIO-60.0-TL-OUTD-US-480/16</td>
<td>Touch-safe fuse holder 16 string combiner, DC disconnect switch, AFCI, DC SPD, conduit entry</td>
</tr>
</tbody>
</table>

### AC Wiring Box Model Number

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACWB-TRIO-60.0-TL-OUTD-US-480 (standard model)</td>
<td>AC output lugs, conduit entry</td>
</tr>
<tr>
<td>ACWB-A-TRIO-60.0-TL-OUTD-US-480</td>
<td>AC output lugs, conduit entry and AC SPD</td>
</tr>
<tr>
<td>ACWB-B-TRIO-60.0-TL-OUTD-US-480</td>
<td>AC output lugs, conduit entry, AC SPD and AC disconnect switch</td>
</tr>
</tbody>
</table>

### Power module Model Number

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIO-60.0-TL-OUTD-US-480-POWER MODULE</td>
<td>Inverter section / power module</td>
</tr>
</tbody>
</table>

### Bracket Model Number

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIO-60.0-BRACKET-VERTICAL</td>
<td>Wall mounting bracket; 90 to 16 degrees from horizontal</td>
</tr>
<tr>
<td>TRIO-60.0-BRACKET-HORIZONTAL</td>
<td>Mounting bracket; 15 to 0 degrees horizontal</td>
</tr>
</tbody>
</table>
## Component reference designators

<table>
<thead>
<tr>
<th>Component</th>
<th>Reference Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting bracket</td>
<td>01</td>
</tr>
<tr>
<td>DC wiring box</td>
<td>02</td>
</tr>
<tr>
<td>Power module</td>
<td>03</td>
</tr>
<tr>
<td>Quick disconnect connector cover</td>
<td>04</td>
</tr>
<tr>
<td>AC wiring box</td>
<td>05</td>
</tr>
<tr>
<td>Handles (sold separately)</td>
<td>06</td>
</tr>
<tr>
<td>Metal locking fork</td>
<td>07</td>
</tr>
<tr>
<td>Front cover</td>
<td>08</td>
</tr>
<tr>
<td>Communication and control board</td>
<td>09</td>
</tr>
<tr>
<td>Positive (+) side string fuses</td>
<td>10</td>
</tr>
<tr>
<td>Ground cable attachment points</td>
<td>11</td>
</tr>
<tr>
<td>AC filter board</td>
<td>12</td>
</tr>
<tr>
<td>DC input terminal block</td>
<td>13</td>
</tr>
<tr>
<td>DC disconnect switch</td>
<td>14</td>
</tr>
<tr>
<td>DC surge protection device</td>
<td>15</td>
</tr>
<tr>
<td>1-1/2” DC conduit opening</td>
<td>16</td>
</tr>
<tr>
<td>AC output terminal block</td>
<td>17</td>
</tr>
<tr>
<td>AC surge protection device</td>
<td>18</td>
</tr>
<tr>
<td>2” DC conduit opening</td>
<td>19</td>
</tr>
<tr>
<td>Protective Earth (PE) connection point</td>
<td>20</td>
</tr>
</tbody>
</table>
Inverter

- Mounting bracket
- DC wiring box
- Power module
- Quick disconnect connector cover
- AC wiring box
- Handles (sold separately)
- Metal locking fork
- Front cover
- DC disconnect switch
- Quick disconnect connectors
- Spacers
- Heatsink
- Rear pins attached to inverter back side
- Stabilization fork
- Conducting springs
- Key lock
- Quick disconnect cover storage rack
- Ground brackets
- AC disconnect switch
- Ground bracket attachment points
- Plastic locking fork
ATTENTION
UTILISEZ SEULEMENT CÂBLES EN CUIVRE OU ALUMINIUM 75 °C OU 90 °C. Consultez le manuel d'instructions pour la taille des fils approprié (AWG) et pour couples de serrage à appliquer aux bornes de câblage.

CAUTION
USE 75 °C OR 90°C COPPER WIRE ONLY. Refer to the instruction manual for suitable wire size (AWG) and for tightening torque to be applied to the wiring terminals.

Communication and control board
Positive (+) side string fuses
Ground cable attachment points
DC input terminal block
DC disconnect switch
DC surge protection device
1-1/2" DC conduit opening
2" DC conduit opening
Anti-condensation valve
Negative (-) side string fuses
Quick disconnect connectors
Key lock
Quick disconnect cover storage rack
Ground brackets
WiFi antenna opening plug (M20 size)
Signal conduit opening for 3/4" (PG21 size)
AFD reset button or 1/2" signal conduit opening (PG16 size)
Ground bracket attachment points
Equipment Grounding Conductor (EGC) terminal block
AC wiring box

ACWB

ACWB-A

ACWB-B

Side view (AC)
(All models)

11 Ground cable attachment points
12 AC filter board
17 AC output terminal block
18 AC surge protection device
20 Protective Earth (PE) connection point
21 Anti-condensation valve
23 Quick disconnect connectors
30 Key lock
31 Quick disconnect cover storage rack
32 Ground brackets
35 AC disconnect switch
36 Ground bracket attachment points
38 Marking for 1-1/2” AC conduit opening
39 1-1/2” AC conduit opening
AC and DC wiring box main components

**AC line disconnect switch (AC wiring box -B)**
Model: OT100F4N2 or equivalent

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Utilisation category</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>500Vac</td>
<td>AC22A</td>
<td>100A</td>
</tr>
<tr>
<td>500Vac</td>
<td>AC23A</td>
<td>60A</td>
</tr>
</tbody>
</table>

**DC line disconnect switch (All DC wiring boxes)**
Model: OTDC200U02 or equivalent

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Utilisation category</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 V DC</td>
<td>DC-21B</td>
<td>200A</td>
</tr>
</tbody>
</table>

**String fuses (DC wiring box -2 models)**
The standard string protection fuses installed in the inverter have the following specifications:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Rating</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 Vdc</td>
<td>15 A (Max. Rating 20A)</td>
<td>gPV</td>
</tr>
</tbody>
</table>

**DC surge protection device (class 2, for DC wiring box -2)**
The DC surge protection devices installed in this wiring box model are Dehn DG M YPV SCI 1000 FM (6 cartridges) or Dehn DG M PV2 SCI 1000 FM (5 cartridges). The surge protection devices have replaceable cartridges, type DG MOD PV SCI 500 (A) and DG MOD PV 500 (B).

If the SPDs are damaged, spare parts may be ordered by requesting Part Number KIT SURGE DC SIDE TRIO.

**AC surge protection device (for wiring boxes -A, -B)**
The AC surge protection devices are type Dehn DG M TT 275 FM (or equivalent), composed of four replaceable cartridges, type DG MOD 275 (D) and DG MOD NPE (C).

If the SPDs are damaged, spare parts may be ordered by requesting Part Number KIT SURGE DC SIDE TRIO.
## Technical data

<table>
<thead>
<tr>
<th>Table: Technical Data</th>
<th>TRIO-60.0-TL-OUTD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td></td>
</tr>
<tr>
<td>Absolute maximum DC input voltage (Vmax,abs)</td>
<td>1000 Vdc</td>
</tr>
<tr>
<td>Start-up DC input voltage (Vstart)</td>
<td>420...700 Vdc (default 500 Vdc)</td>
</tr>
<tr>
<td>Operating DC input voltage range (Vdcmin...Vdcmax)</td>
<td>0.7xVstart...950 Vdc (min 360 Vdc)</td>
</tr>
<tr>
<td>Rated DC input voltage (Vdcr)</td>
<td>720 Vdc</td>
</tr>
<tr>
<td>Rated DC input power (Pdcr)</td>
<td>61800 W</td>
</tr>
<tr>
<td>Number of independent MPPT</td>
<td>1</td>
</tr>
<tr>
<td>MPPT input DC voltage range (VMPPT min ... VMPPT max) at Pacr</td>
<td>520...800 Vdc</td>
</tr>
<tr>
<td>Maximum DC input current (Idc max)</td>
<td>108 A</td>
</tr>
<tr>
<td>Maximum input short circuit current (Isc max)</td>
<td>170 A</td>
</tr>
<tr>
<td>Number of DC inputs string / pairs</td>
<td>12 or 16 DCWB-2 models available / 1 pair DCWB-1</td>
</tr>
<tr>
<td>DC connection type</td>
<td>Field-wired fuse holders (DCWB-2) / Terminal blocks in DCWB-1 model</td>
</tr>
<tr>
<td><strong>Input protection</strong></td>
<td></td>
</tr>
<tr>
<td>Reverse polarity protection</td>
<td>Yes, from current-limited source</td>
</tr>
<tr>
<td>Input over voltage protection - Varistor</td>
<td>Yes</td>
</tr>
<tr>
<td>Input over voltage protection Plug-in modular surge protection device</td>
<td>Type II SPD (optional 12 and 16 string DCWB-2 option)</td>
</tr>
<tr>
<td>Photovoltaic array isolation control</td>
<td>According to local standards</td>
</tr>
<tr>
<td>DC switch rating</td>
<td>1000 Vdc / 200 A</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
</tr>
<tr>
<td>AC Grid connection type</td>
<td>3Ø grounded WYE system only; 3W+GND (w/o N wire) or 4W+GND (with N wire)</td>
</tr>
<tr>
<td>Rated AC power (Pacr@cosφ=1)</td>
<td>60000 W</td>
</tr>
<tr>
<td>Maximum AC output power (Pac max@cosφ=1)</td>
<td>60000 W</td>
</tr>
<tr>
<td>Maximum apparent power (Smax)</td>
<td>60000 VA</td>
</tr>
<tr>
<td>Rated AC grid voltage (Vacr)</td>
<td>480 Vac</td>
</tr>
<tr>
<td>AC output voltage range (Vacmin...Vacmax)</td>
<td>422...528 Vac</td>
</tr>
<tr>
<td>Maximum AC output current (Iac max)</td>
<td>77.0 A</td>
</tr>
<tr>
<td>Contributory fault current</td>
<td>92.0 A</td>
</tr>
<tr>
<td>Rated output frequency (fr)</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Output frequency range (fmin...fmax)</td>
<td>57...63 Hz</td>
</tr>
<tr>
<td>Nominal power factor and adjustable range</td>
<td>&gt; 0.995, 0...0...± 1 with Smax</td>
</tr>
<tr>
<td>AC connection type</td>
<td>Screw terminal block</td>
</tr>
<tr>
<td><strong>Output protection</strong></td>
<td></td>
</tr>
<tr>
<td>Anti-islanding protection</td>
<td>According to local standard</td>
</tr>
<tr>
<td>Maximum external AC overcurrent protection</td>
<td>100 A</td>
</tr>
<tr>
<td>Output over voltage protection - Varistor</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Operating performances</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum efficiency (ηmax)</td>
<td>98.5 %</td>
</tr>
<tr>
<td>Weighted efficiency (CEC)</td>
<td>98.0 %</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td></td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>VSN300 Wifi Logger Card (optional), VSN700 Data Logger (optional)</td>
</tr>
<tr>
<td>Wireless local monitoring</td>
<td>VSN300 Wifi Logger Card (optional)</td>
</tr>
<tr>
<td>User interface</td>
<td>LEDs / No display</td>
</tr>
<tr>
<td>Available ports</td>
<td>2 RS-485 ports</td>
</tr>
</tbody>
</table>
### Table: Technical Data

<table>
<thead>
<tr>
<th>Environment</th>
<th>TRIO-60.0-TL-OUTD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-13...+144°F (-25...+60°C) with automatic power limiting &gt; 113°F (45°C)</td>
</tr>
<tr>
<td><strong>Relative humidity</strong></td>
<td>0...100% condensing</td>
</tr>
<tr>
<td><strong>Typical acoustic emission pressure</strong></td>
<td>75 dB(A) @ 1 m</td>
</tr>
<tr>
<td><strong>Maximum operating altitude without derating</strong></td>
<td>6560 ft / 2000 m</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental protection rating</strong></td>
<td>Certified to NEMA 4X (NEMA 3R for fan tray)</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td>Forced air through external heatsink</td>
</tr>
<tr>
<td><strong>Size (W x H x D)</strong></td>
<td>58.7&quot; x 28.5&quot; x 12.4&quot; / 1491mm x 725mm x 315 mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>210 lb overall (145 lb electronic compartment, ≤33 lb wiring box)</td>
</tr>
<tr>
<td><strong>Mounting system</strong></td>
<td>Wall bracket or horizontal support</td>
</tr>
<tr>
<td><strong>Overvoltage category according to IEC 62109-1</strong></td>
<td>II (DC input) III (AC output)</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Isolation level</strong></td>
<td>Transformerless</td>
</tr>
<tr>
<td><strong>Marking</strong></td>
<td>TÜV</td>
</tr>
<tr>
<td><strong>Safety and EMC standards</strong></td>
<td>UL1741, UL1699B, IEEE1547, IEEE1547.1, CSA C22.2 107.1-01-2001, FCC Part 15 Sub-part B Class B Limits</td>
</tr>
</tbody>
</table>

**Note.** Features not specifically listed in the current data sheet are not included in the product.
To maintain the NEMA 4X rating of the inverter and for correct installation, the following torques must be used:

### DC Wiring box

<table>
<thead>
<tr>
<th>Item</th>
<th>Torque (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front cover</td>
<td>2.4</td>
</tr>
<tr>
<td>DC input terminal block 3/0 AWG (-1 model)</td>
<td>20</td>
</tr>
<tr>
<td>Mounting screws for ground brackets</td>
<td>11</td>
</tr>
<tr>
<td>Signal terminal block (26...15AWG)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

### Power module

<table>
<thead>
<tr>
<th>Item</th>
<th>Torque (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting screws for earth connection brackets</td>
<td>11</td>
</tr>
</tbody>
</table>

### AC Wiring box

<table>
<thead>
<tr>
<th>Item</th>
<th>Torque (N-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front cover</td>
<td>2.4</td>
</tr>
<tr>
<td>AC output terminal block 4/0 AWG (Standard/-A version)</td>
<td>2.5</td>
</tr>
<tr>
<td>AC disconnect switch terminal block 1/0 AWG (-B version)</td>
<td>6</td>
</tr>
<tr>
<td>Mounting screws for ground brackets</td>
<td>11</td>
</tr>
</tbody>
</table>
Outer dimensions

The outer dimensions (inches) include the vertical or horizontal wall installation bracket.

58.30”
58.08”
27.50”
27.63”
12.40”
**Vertical wall mounting bracket dimensions**

The wall mounting bracket dimensions are given in inches.

**Horizontal mounting bracket**

The horizontal mounting bracket dimensions are given in inches.
Efficiency curves

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

The efficiency curves are 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>10min (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.
Description of the inverter

This string inverter converts the direct current from a single PV array into alternating current, and feeds it into the electrical distribution grid. This conversion, known as inversion from DC to AC, is done efficiently, and electronically, without rotating machinery.

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

The inverter automatically reduces the power fed into the grid under adverse environmental conditions, such as high temperature, unsuitable input voltages or grid instability.

Additional inverter functions and features

Configurable relays
The inverter is equipped with two signal relays whose opening/closing is configurable with Aurora Manager LITE software. A typical use might be closing the contact when an alarm is triggered. Their use is optional.

Remote on/off
This command turns the inverter on or off remotely. It must be enabled through Aurora Manager LITE software.

When active, it requires the inverter to have a “remote on” signal in addition to all other normal power up conditions (such as grid within spec, input voltage within spec, etc).

Reactive power
The inverter is capable feeding reactive power to the grid. The power factor can be controlled directly by the utility via a dedicated serial RS-485 interface or it can be set with Aurora Manager LITE software. For detailed information on the parameters and characteristics of this function, contact ABB Technical Sales (1-877-261-1374).

Limiting the active power fed into the grid
When enabled and set with Aurora Manager LITE software, the inverter limits the active power fed into the grid.

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 (viewable with a monitoring system or Aurora Manager LITE software).

Data transmission and control
The inverter or networks of several inverters can be monitored locally or remotely using an RS-485 serial interface with ABB proprietary “Aurora” protocol or public “ModBus RTU” protocol.
Multiple-inverter system

Multiple inverters may be used at large-capacity sites. Each inverter must have its own individual PV array input, and on the AC side, and its own AC disconnect to the grid.

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

Notes on system sizing

Decisions on how to design a photovoltaic system depend on a number of factors, such as the type of panels, the space available, the location of the system, energy production goals, choice of inverter, etc.

A setup program to help correctly size the photovoltaic system is available on the ABB website (http://stringsizer.abb.com).

Inverter block diagram

The diagram shows the internal structure of the inverter. It has two stages:
- DC/DC input converter (boost)
- DC-AC output inverter

The DC-DC converter and the DC-AC inverter work at high switching frequencies, and are small and relatively light.

The converter input has maximum power point tracking (MPPT) to optimize energy production.

The inverter has no internal isolation transformer (no gavlanic insulation between input and output), which reduces weight and increases efficiency. It has all protection necessary for safe operation and compliance with safety stanards.

The inverter’s operation and management of its protection features are controlled by two independent digital signal processors (DSP) and a central microprocessor. The connection to the grid is thus controlled by two independent computers, in full compliance with requirements for connection to the grid, and for safe and secure operation.
**PV plant block diagram**

- **PV Panels**
- **External or internal DC disconnect**
- **Power module**
- **External AC disconnect**
- **Step-up transformer**
- **Distribution grid**
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.

The AFD circuitry runs a self-test at each power up.

Arc fault detection is not available for the DC wiring box -1 model.

String fuses

In the DC wiring box -2 models, the negative side (-) string fuses and the positive side (+) string fuses 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 (2 model only) and AC surge protection devices (-A / -B models) are integrated inside the wiring boxes.

Ground fault detection and interruption scheme

As required by UL1741 CRD 2010, the TRIO 50kW 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 is detected in measured values of differential current (IDIF) or a rapid change of IDIF over time (ΔIDIF/Δt), the inverter will automatically disconnect from the grid and the red front panel GF LED will illuminate:

- If IDIF > 300 mA for a period of 300 msec
- If ΔIDIF/Δt > 30 mA/sec for a duration of 300 msec
- If ΔIDIF/Δt > 60 mA/sec with duration of 150 msec
- If ΔIDIF/Δt > 150 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.

ABB is willing to train customer employees, at its premises or on site.

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. Follow guide 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.) so 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.
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

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

Weights

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
<th>Lifting points (Qty)</th>
<th>Min. cable length</th>
<th>Holes for Eyebolts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power module</td>
<td>145 lbs</td>
<td>4</td>
<td>14 feet</td>
<td>M 12 Handles and eyebolts may be ordered</td>
</tr>
<tr>
<td>DC wiring box</td>
<td>≤33 lbs</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AC wiring box</td>
<td>≤33 lbs</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
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 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 shipped with all DC wiring boxes

<table>
<thead>
<tr>
<th>Component</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configurable relay connectors</td>
<td>2</td>
</tr>
<tr>
<td>Communication and control signal connectors</td>
<td>4</td>
</tr>
<tr>
<td>M6 hex nuts to clamp ground cables to the wiring boxes</td>
<td>2</td>
</tr>
<tr>
<td>M6x16 hex screw</td>
<td>1</td>
</tr>
<tr>
<td>M6 serrated lock washers for securing the ground terminal to the AC wiring box</td>
<td>6</td>
</tr>
<tr>
<td>Quick installation guide (QIG)</td>
<td></td>
</tr>
</tbody>
</table>

### Components included in mounting kit

<table>
<thead>
<tr>
<th>Component</th>
<th>Qty (vertical kit)</th>
<th>Qty (horizontal kit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bracket  for vertical wall mounting.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bracket  for horizontal wall mounting.</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Countersunk M5 x 14 hex screws for assembling the attachment bracket</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>M6x16 hex screws (4 to clamp ground brackets and 2 for cage nuts)</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
4 - Lifting and transport

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization forks to attach the power module to the wiring box</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M6 cage nuts</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M6 hex nuts to clamp ground cables to the power module</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Back spacers  for wall alignment (vertical installation)</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Ground cables for wiring box/power module connection</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ground brackets  for wiring box-power module connection</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M6 flat washer (4 for ground brackets and 2 for cage nuts)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>M6 serrated lock washers for ground connection bracket</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Conducting springs</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>KEYS for the front cover of AC wiring box</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>KEYS for the front cover of DC wiring box</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Spare parts kits**

The following spare parts may be ordered from ABB:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Part description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIO HANDLING KIT</td>
<td>Handles and eyebolts for lifting the power module</td>
<td>4 handles 2 eyebolts</td>
</tr>
<tr>
<td>KIT 10 FUSES 12A</td>
<td>12A fuses (gPV - 1000Vdc)</td>
<td>10</td>
</tr>
<tr>
<td>KIT 10 FUSES 15A</td>
<td>15A fuses (gPV - 1000Vdc)</td>
<td>10</td>
</tr>
<tr>
<td>KIT SURGE DC SIDE TRIO</td>
<td>Spare cartridges for DC surge protection devices (SPD) type 2</td>
<td>2 (Dehn PN. 952051) 1 (Dehn PN. 952041)</td>
</tr>
<tr>
<td>KIT SURGE AC SIDE TRIO</td>
<td>Spare cartridges for AC surge protection devices type 2</td>
<td>3 (Dehn PN. 952010) 1 (Dehn PN. 952050)</td>
</tr>
</tbody>
</table>
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 terminal.

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

The wire 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 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:
  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 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 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 4/0AWG, copper or aluminum, (AC output terminal block 17).  
  ACWB-B → 7AWG to 1/0AWG, copper (AC disconnect switch terminal block 5).

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%]*Vnom 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 +/- 6% of Vnom and line voltage drop in this case should be limited to less than 3% of Vnom. 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):

<table>
<thead>
<tr>
<th>TRIO-60.0-TL-OUTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Typical installations use a 3-pole/600V rated bi-directional thermalmagnetic circuit breaker, UL489 or equivalent.</td>
</tr>
<tr>
<td>Maximum Current/Voltage</td>
</tr>
</tbody>
</table>

- 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 90 Amps.
- The AC 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 (DC wiring box -2 models only)

The correct sizing of the positive side (+) and 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 not be paralleled in the PV array. The maximum string fuse size is 30A.

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 maximum series fuse rating found on the PV modules’ technical datasheet. 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:

\[ I_{rated} > (1.4 \approx 1.5) \times I_{sc} \]

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 Isc based on high PV module temperature
- fuse thermal derating
- maximum return current of the PV modules

12A and 15A fuses are available from ABB:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIT 10 FUSES 12A</td>
<td>Kit of 12A fuses</td>
<td>10</td>
</tr>
<tr>
<td>KIT 10 FUSES 15A</td>
<td>Kit of 15A fuses</td>
<td>10</td>
</tr>
</tbody>
</table>

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

![Diagram showing installation dimensions](image)

- 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.

**Vertical installation bracket**

<table>
<thead>
<tr>
<th>NO</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>75° MAX</td>
<td></td>
</tr>
</tbody>
</table>

**Horizontal installation bracket**

| OK |
| 15° MAX |
- Position multiple inverters side by side, maintaining at least 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.

⚠️ 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.

### Installation sites with high humidity

⚠️ Do not open covers to install the inverter if there is precipitation or >95% humidity.
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 moderate/low condensation phenomena inside the inverter. In fact since the inverter is almost completely insulated from the outside once the covers are back in place, after the installation, still some damp air could remain trapped inside the wiring boxes and determine moderate condensation level lately when the temperature drops down at night.
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 on the bracket.

3. Position the bracket 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) to mount the bracket.

4. Attach the bracket to the wall or frame
5. Install spacers in the two lower rear attachment pins 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 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 into the slots on the bracket and confirm that the slots 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
   - Pull off the quick disconnect cover
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.

11. Unscrew the 8 screws holding the front covers of the DC wiring box and AC wiring box in place. Don’t lose the screws!

12. Open the key locks. Remove each wiring box’s cover.

13. Install spacers in the lower rear attachment pin 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 shipped:
   - 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, which was used to secure the wiring box cover, over the two covers. Be sure the fork is plastic, not metal.
   - C Insert the two connector covers and plastic locking fork in the dedicated space in the wiring box.
   - D 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 baggie shipped with the inverter. For the moment, leave screws loose and not tightened.

![Diagram](image)

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 into the seats on the quick disconnects. Through this step the wiring boxes will be attached to the power module.

21. Insert the stabilization forks 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 at the threaded inserts 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 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 wiring box.

If needed, a second AC conduit opening may be added at the location silkscreened on the right-side chassis wall. Use a punch tool to cut the opening.

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. Three signal conduit openings (3/4” / PG21 size) are available.

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

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

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

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

3. Position the bracket 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 (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 are firmly positioned in the slots on the bracket.

8. Remove handle or eye bolts (if used)

9. Remove the quick disconnect connector covers as follows:
   - Pull the metal locking fork outwards
   - Pull off the quick disconnect cover
   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.

11. Unscrew the 8 screws holding the front covers of the DC wiring box and AC wiring box 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 shipped:
- 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, which was used to secure the wiring box cover, over the two covers. **Be sure the fork is plastic, not metal.**
- C Insert the two connector covers and plastic locking fork in the dedicated space in the wiring box. **Do not place the fork in the electrical components.**
- D Repeat the same operation for the other wiring box.
14. Attach the two green/yellow ground wires to the attachment points 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, the 2 holes will face downwards -- Loosely attach the ground bracket to the attachment point on each wiring box with the M6 flat washer, M6 lock washer and the M6 hex screw, all of which are in a plastic baggie 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 one at a time the top three rear pins into the slots in the bracket.

Confirm that the rear pins 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.
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 at the threaded inserts 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 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 wiring box.

If needed, a second AC conduit opening may be added at the location silkscreened on the right-side chassis wall. Use a punch tool to cut the opening.

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. Three signal conduit openings (3/4” / PG21 size) are available.

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

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

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

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

**DCWB-2**: EGC terminal block 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.

**ACWB**: Attach the system (site) ground cables on the terminal block 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 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 4/0AWG (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 in the AC wiring box.
- Torque to 14N-m (10.3ft-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 in the AC wiring box.
- Torque to 6 N-m (53in-lb)
- Give each wire a pull test to confirm the connection is secure.
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 Voc/2, then bleed off to ~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....

\[
\begin{array}{c}
V_a = \text{voltage measured between + terminal and } \text{ground} = 200V \\
V_b = \text{voltage measured between - terminal and } \text{ground} = 300V
\end{array}
\]

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 ☭) 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 ($R_{iso}$) using a megohmmeter positioned between the two shorted terminals and ground (of the inverter).

If the measured insulation resistance ($R_{iso}$) is less than 500 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 ($V_{oc}$) 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 is 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.
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 UL-listed, 1000V minimum rating, 90°C minimum temperature rating.

**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 ( + 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 terminal block (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 30A
- 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.
Control and communication board

A removable plastic cover prevents accidental contact with the communication card. To access it, remove the four screws holding the cover in place, then remove the cover. Save the screws. Connect the signal cables to the control and communication card using the mating connectors supplied in the hardware baggie shipped with the inverter.

<table>
<thead>
<tr>
<th>Code</th>
<th>Reference</th>
<th>Description of the control and communication board</th>
</tr>
</thead>
<tbody>
<tr>
<td>J15</td>
<td>a02</td>
<td>Connector for expansion board installation (optional)</td>
</tr>
<tr>
<td>A5</td>
<td>a04</td>
<td>SD CARD housing</td>
</tr>
<tr>
<td>S8 - S9</td>
<td>a05</td>
<td>Rotary switches for setting the country standard</td>
</tr>
<tr>
<td>J5 - J6</td>
<td>a09</td>
<td>Connectors for the multifunction relay (ALARM and AUX)</td>
</tr>
<tr>
<td>J7</td>
<td>a11</td>
<td>Connectors for the RS-485 (PC) lines; the remote ON/OFF and 5V auxiliary lines (and the tachometer signal found only on wind inverters)</td>
</tr>
<tr>
<td>S6</td>
<td>a12</td>
<td>RS-485 line (1) termination resistance selector switch</td>
</tr>
<tr>
<td>S5</td>
<td>a13</td>
<td>RS-485 line (2) termination resistance selector switch</td>
</tr>
<tr>
<td>J9 - J10</td>
<td>a14</td>
<td>RS-485 (1) line connection on RJ45 connector</td>
</tr>
<tr>
<td>J8</td>
<td>a15</td>
<td>RS-485 (1) communication card housing</td>
</tr>
<tr>
<td>J11 - J12</td>
<td>a16</td>
<td>RS-485 (2) line connection on RJ45 connector</td>
</tr>
<tr>
<td>J16</td>
<td>a17</td>
<td>RS-485 (2) communication card housing</td>
</tr>
<tr>
<td>S7</td>
<td>a18</td>
<td>Switch for setting the inverter to normal or service mode</td>
</tr>
<tr>
<td>J22</td>
<td>a19</td>
<td>Inverter data memory card housing</td>
</tr>
<tr>
<td>X5</td>
<td>a20</td>
<td>Battery housing</td>
</tr>
<tr>
<td>J24</td>
<td>a21</td>
<td>AFD (arc fault detector) housing</td>
</tr>
<tr>
<td>J1</td>
<td>a22</td>
<td>Grounding kit housing (optional)</td>
</tr>
<tr>
<td>J18</td>
<td>a23</td>
<td>Connector for PMU card installation (optional; not used in North America)</td>
</tr>
</tbody>
</table>
Remote ON/OFF control connection, operation

The connection and disconnection of the inverter to and from the grid may be controlled externally using remote ON/OFF functionality.

- Check site wiring diagrams to determine if Remote ON/OFF wires are needed.
- Retrieve the J7 (a11) terminal headers from the hardware baggies shipped with the inverter. Either or both of the J7 headers may be used.
- Connect two wires for each Remote ON/OFF signal: R1 ON/OFF (J7-pin 4) and RTN (J7-pin 6), and/or R2 ON/OFF (J7 pin 12) and RTN. Header slots each accept a single wire, 26AWG to 15AWG. The second header accommodates additional wires. Significant current carrying capability is not required, so smaller wires are fine. Twisted pair may reduce noise pickup.
- Torque the screws atop the header to 0.25 N-m (2.2 in–lb).
- Give each wire a pull test.
- Firmly seat the header on the terminal block on the inverter’s PCB.
- Confirm the conduits on the side of the chassis is water tight.

To understand how this feature works, see “Operating parameter settings” at chapter 7

Configurable Relay connection (ALARM and AUX)

The inverter has two relays which can be configured, with Aurora Manager LITE software (see , to open and close in response to various events, such as when the inverter connects to the grid).

- Follow any site wiring plans for connecting wires to the N/O, C or N/C terminals on the AUX and ALARM relay headers. Terminal labels are on the PCB silkscreen.
- Header slots each accept a single wire, 26AWG to 15AWG. The second header accommodates additional wires.
- Torque the screws on the AUX and ALARM headers to 0.25 N-m (2.2 in–lb).
- Give each wire a pull test.
- Firmly seat the header on the AUX and/or ALARM terminal on the PCB.
- Confirm the conduits on the side of the chassis is water tight.

To understand how this feature works, see “ Operating parameter settings” at chapter 7
Expansion board connector (optional)

The J15 (a02) connector is for any optional expansion boards.

To install any expansion boards:
- Very carefully, align the PCB with the connector
- Confirm all PCB pins are indeed in the connector. If they are offset, the PCB or the inverter may suffer out-of-warranty damage
- Gently push the PCB downwards to insert the pins into the connector
- Tighten the screw to 2.4Nm.

RS-485 serial communication connection

The inverter has two RS-485 communication lines, which can be set for “Aurora” (ABB proprietary) or ModBus (public) communication protocols. The factory default protocol for both ports is ABB “Aurora” but this can be changed with Aurora Manager LITE software.

The 2 serial ports can be must be used for:
- RS485-1:
  Purposes: Monitoring, Power (Active/Reactive) Control, Parameters Configuration, FW Update;
  Protocols: Aurora, Modbus RTU (ABB map);
- RS485-2:
  Purposes: Monitoring, Power (Active/Reactive) Control, Parameters Configuration;
  Protocols: Aurora, Modbus RTU (ABB map), Modbus RTU (SunSpec map);

To understand how this feature works, see “Operating parameter settings“ at chapter 7

Use cable designed for RS-485 communications, such as Belden 3106A, which has one twisted pair for the ±T/R signals, one ground conductor, and a shield with drain wire (equivalent).
- **Wiring RS-485 buses to the J7 (a11) headers**

  - Note that there are two J7 headers in the hardware baggie. Either or both may be used; the second one is handy if the communications bus is to be daisy chained among multiple inverters at a site; use one header for outgoing signals and the other for incoming signals.

  - **±T/R wires**: Connect the ±T/R wires to the correct slots on the headers for the J7 connector. The signal names are shown on the PCB silkscreen:
    - J7-pin 1; RS485-1-T/R
    - J7-pin 2; RS485-1+T/R
    - J7-pin 7; RS485-2-T/R
    - J7-pin 8; RS485-2+T/R

  - **RTN**: Connect the RS-485 reference (mid-point) wires to the RTN slot (pin 6) on the J7 header. Note that if the wires are closer to 25AWG than 15 AWG, more than one wire will fit in each slot. A second header is provided (in the hardware baggies) if more space is needed. Do not skip this connection. It is required for the RS-485 bus; it’s part of the data.

  - **SHIELD**: The shield wires require thought, care and understanding of the plant.

    For multiple inverters with daisy-chained communication signals, connect the shields to the SH slots (J7-pin 3) on all except the last inverter in the series. Do not connect these mid-bus shield lines to RTN.

    If there are multiple inverters with their communication lines daisy-chained in series, on only the last inverter in the series, connect the shield to **RTN** (J7-pin 6). “Last” means the inverter on the RS-485 bus farthest away from the monitoring device.

    The SH terminal on the inverter connector is provided as a floating tie point. It allows shields (drain wires) from incoming and outgoing daisy-chained cables to be secured together but not grounded.
- RS-485 bus connection with RJ45 connectors J9,J10 (a14) and/or J11, J12 (a16)

RS-485 buses may be terminated on RJ-45 connectors instead of the green terminal headers. However, not all the pins in a regular RJ45 cable are needed.

- Leave the wires on pins 1,2,4,6,8 open. Cut them so they won’t be terminated on the connector
- Terminate the cable with a metal RJ45 connector so the shield will be terminated
- Connect the ±T/R (data) and RTN signals at positions 3, 5, and 7 as shown in table below
- Confirm the crimps are good and continuity exists

Table: crimping diagram for RJ45 connectors

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>+T/R</td>
</tr>
<tr>
<td>5</td>
<td>-T/R</td>
</tr>
<tr>
<td>7</td>
<td>RTN</td>
</tr>
<tr>
<td>1, 2, 4, 6, 8</td>
<td>Leave open</td>
</tr>
</tbody>
</table>

Plug the RS-485 cables into the RJ45 connectors:
RS-485(1) is wired to the lower two RJ45 connectors, J9 and J10. RS-485(2) is wired to the upper two RJ45 connectors, J11 and J12. The two RJ45 connectors in each pair are identical to each other, and may be used interchangeably for ingoing or outgoing daisy-chained connections.

Setting the RS-485 bus termination resistor

Set the RS-485 termination resistance based on where the inverter is located in a daisy chain. (The process for the resistors will be similar to that for choosing where the terminate the cable shields.)

Switch S6 (a12) is for RS-485(1). It’s on the lower, left edge of the PCB. Switch S5 (a13) for RS-485(2). It’s towards the middle of the PCB.

- If there is only one inverter on a given RS-485 bus, set the RS-485 termination resistor switch ON. Repeat for the 2nd RS-485 bus if both are being used.

For multiple inverters with daisy-chained RS-485 comunication signals, set the RS-485 termination resistors OFF on all but the last inverter in the series. See the diagram below. Repeat, as needed, for the 2nd RS-485 bus.
On the last inverter in an RS-485 bus daisy chain, set the RS-485 termination resistor switch ON. See the diagram below. Repeat, as needed, for the 2nd RS-485 bus.

The opposite end of the daisy-chained bus must be connected to a data logger with RS-485 hardware, or an RS485-USB communication adapter such as the AURORA PVI-USB-RS-485_232, to allow the bus to be interfaced to a computer or other (e.g., SCADA) system.
Setting the country grid standard

Different location countries have different grid voltages and other settings, and the grid standard must be set before commissioning.

- Choose the correct grid setting from the table below.

- Locate rotary switches S8 and S9 (a05) in the top right of the control and communication PCB

- Use a small flat screwdriver to turn the rotary switches to the code for the desired grid setting

Table: Country grid standard

<table>
<thead>
<tr>
<th>Switch</th>
<th>Country grid standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0</td>
<td>NOT ASSIGNED</td>
</tr>
<tr>
<td>0 4</td>
<td>UL 1741 @ 480V Three phase (IEEE 1547-2003 settings)</td>
</tr>
<tr>
<td>3 4</td>
<td>USA - RULE 21 Three phase</td>
</tr>
<tr>
<td>3 B</td>
<td>USA - Hawaii (HECO) Three phase</td>
</tr>
</tbody>
</table>

The default setting is 0 0 and means that no grid standard is selected.

Saving the Country grid standard and language “freeze”

The settings are frozen after the inverter has been in operation for 24 hours. It does not matter whether or not it is connected to the grid, it only has to be under power.

The time remaining before the settings are frozen can be viewed using "Aurora Manager LITE" software.

Once the settings have been frozen, nothing will happen if the rotatary switches are turned.
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 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 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.
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. We, therefore, 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:
- does 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.

- **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.

- **YELLOW**
  The yellow LED indicates that the inverter has detected an anomaly. Use the "Aurora Manager LITE" software to determine the nature of the warning.

- **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.

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).
**Ground fault reset button**

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

If a ground 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. Ground 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.
Aurora Manager LITE - Advanced configuration software

For the characteristics and functions that Aurora Manager LITE makes available is indicated for:

1. Local monitoring of the inverter.
   It is possible to monitor the main parameters relating to:
   - General state
   - Statistical data relating to the production of energy
   - Input and output values
   - Internal temperature
   - Values relating to the insulation of the photovoltaic generator
   - Date and time

2. Advanced configuration of the inverter (INSTALLER access level):
   Offers the option of applying advanced settings for the inverter. Access to this section of the software is password protected as it permits the modification of sensitive parameters such as those relating to the standard for connection to the grid in force in the country of installation.

   The password can be obtained by registering on the site https://registration.abbsolarinverters.com/

3. Updating of the inverter firmware.
   Updating the inverter Firmware is process which may become necessary to improve the performance of the inverter or increase its functions.

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.

In all cases, the use of ABB products is recommended to avoid problems of incompatibility with the inverter.
Introduction and operation warnings

Before commissioning of 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 operates automatically without the aid of an operator; the operating state should be controlled through the equipment’s instrumentation (LED’s, Aurora Manager LITE).

The input voltage must not exceed the maximum values shown in the technical data, section 2 in order to avoid damaging the equipment.
Normal operation and monitoring inverter status

As a rule, the inverter operates automatically and does not require special checks. When there is not enough solar radiation to supply power for export to the grid (e.g. during the night), it disconnects automatically and goes into stand-by mode. Operation resumes when there is sufficient solar radiation. At this point, the green LED on the front panel will indicate normal operation.

User interfaces

The inverter provides information about its operation through the following indicators:
• Front panel LEDs
• Data transmission on a dedicated RS-485 serial line. Data can be collected by a PC or a data logger equipped with an RS-485 port. Contact the ABB technical support (1-877-261-1374) with any queries about device compatibility.

Types of data available

The inverter provides two types of data, which can be retrieved through Aurora Manager LITE or other appropriate software.

Real-time operating data
Real-time operating data can be transmitted on request through the communication lines, and are not recorded in the inverter.

Internally stored data
The inverter internally stores data that is necessary for processing statistical data, and an error log with time stamps.

Measurement tolerances

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

The inverter tolerances are generally:
- ±5% for real-time measurements with output power below 20% nominal power
- ±3% for real-time measurements with output power above 20% nominal power
- ±4% for all statistical data.
Commissioning

Pre commissioning inspection

Before commissioning the inverter confirm that confirm all installation procedures have been completed. In particular:
- confirm the grid standard have been setted
- confirm the grid type (3WIRES/4WIRES) have been setted
- confirm the covers are well seated and the seals are intact
- confirm all cover screws were reinstalled and torqued
- leave the disconnects OFF
- confirm the key switches are closed
- confirm all other openings and knockouts are sealed and water tight
- confirm the inverter and its external disconnects are locked out/tagged out and that the grid standard have been setted

Commissioning procedure

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

The commissioning procedure of the inverter is as follows.

- Confirm all wires and all covers are installed and secured.
- Close (turn ON) the external AC disconnect switch. For the moment, leave the AC disconnect on the inverter OFF.
- Close (turn ON) DC disconnect switch(es).
- Watch for the green “Power” LED to begin flashing a few seconds after the DC disconnect is closed.
- Wait for the yellow “alarm” LED to light up and remain on, indicating there is no AC mains.
- Close (turn ON) the inverter AC disconnect.
- Watch for the yellow LED to turn off, while the green LED continues to flash while the inverter runs self-tests and grid checks. The time required varies from ~30 seconds to a few minutes, depending on the grid condition and standards.

During the initialization phase the inverter may automatically run some firmware updates in its various microprocessors. This is indicated by rapid blinking of the yellow LED blinking.

- Watch for the green LED to stop flashing remain ON if when self-tests and grid checks are complete and the inverter starts production.

Any configuration of the inverter must be carried out through Aurora Manager LITE software. The software and its own manual are available at www.abb.com/solarinverters.

Possible LEDs behaviour are described in the following paragraph.
## LED behavior

The LEDs on the front panel give basic information about the inverter’s state.

Use Aurora Manager LITE software to detailed information behind each LED combination. 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 of the conditions described above (i.e. don’t care)

<table>
<thead>
<tr>
<th>LED status</th>
<th>Operating state</th>
</tr>
</thead>
<tbody>
<tr>
<td>green: ○</td>
<td>Firmware programming The inverter is being programmed</td>
</tr>
<tr>
<td>yellow: ○</td>
<td>Night mode (inverter automatically turns off) The inverter is in nighttime mode (input voltage less than 70% of the set start-up voltage).</td>
</tr>
<tr>
<td>red: ○</td>
<td>Inverter initialization DC input is &gt; of Vstart voltage. The inverter continually checks DC and AC.</td>
</tr>
<tr>
<td>green: *</td>
<td>The inverter is connected and is feeding power into the grid Normal operation. During this stage, the inverter automatically tracks and analyses the photovoltaic array’s maximum power point (MPP).</td>
</tr>
<tr>
<td>yellow: ○</td>
<td>Grid disconnect No grid voltage</td>
</tr>
<tr>
<td>red: ○</td>
<td>Warning indication: (W message codes) or Error: (E message codes) - Indicates that the inverter control system has detected a warning (W) or error (E). Identify the type of problem using an Aurora Manager LITE software connection to the inverter.</td>
</tr>
<tr>
<td>green: ○</td>
<td>Temperature protection trip One or more internal temperatures was too low or too high.</td>
</tr>
<tr>
<td>yellow: ○</td>
<td>PV array ground leakage The inverter disconnected from (or won’t connect to) the grid because it detects excessive ground leakage.</td>
</tr>
<tr>
<td>red: ○</td>
<td>Front cover open The cover is not closed on one or both wiring boxes. The inverter can not power up in this state.</td>
</tr>
<tr>
<td>LED status</td>
<td>Operating state</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>green:</strong>&lt;br&gt;<strong>yellow:</strong>&lt;br&gt;<strong>red:</strong></td>
<td>• <strong>Cooling failure</strong>&lt;br&gt;Indicates an anomaly in the operation of the internal ventilation system that could limit output power at high ambient temperatures.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Failed association of internal inverter components (after hardware replacement)</strong>&lt;br&gt;Indicates that a newly installed part of the system (wiring boxes or power module) was not correctly associated to the other parts.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Surge protection devices triggered (where installed)</strong>&lt;br&gt;Indicates that any class II surge protection devices installed on the AC or DC side have been triggered. Check to see if replacement is needed.</td>
</tr>
<tr>
<td></td>
<td>• <strong>String fuse opened (where installed)</strong>&lt;br&gt;Indicates that one or more string (input) fuses opened.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Anomaly in internal statistics memory anomaly</strong>&lt;br&gt;Indicates an operating anomaly in the internal memory in which the inverter statistics are stored.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Backup battery discharged</strong>&lt;br&gt;The buffer battery is low and the inverter cannot maintain the correct time.</td>
</tr>
<tr>
<td><strong>green:</strong>&lt;br&gt;<strong>yellow:</strong>&lt;br&gt;<strong>red:</strong></td>
<td>• <strong>Initial configuration failure</strong>&lt;br&gt;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.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Firmware revision level incompatibility</strong>&lt;br&gt;The firmware versions of the various devices comprising the equipment are incompatible and are being updated (this is an automatic operation).</td>
</tr>
<tr>
<td></td>
<td>• <strong>Temperature sensor anomaly detected</strong></td>
</tr>
<tr>
<td><strong>green:</strong>&lt;br&gt;<strong>yellow:</strong>&lt;br&gt;<strong>red:</strong></td>
<td>• <strong>Firmware update from an SD card</strong>&lt;br&gt;A firmware update from an SD card is in progress.</td>
</tr>
<tr>
<td></td>
<td><em>LEDs light sequentially</em></td>
</tr>
<tr>
<td><strong>green:</strong>&lt;br&gt;<strong>yellow:</strong>&lt;br&gt;<strong>red:</strong></td>
<td>• <strong>Firmware update failed</strong>&lt;br&gt;Firmware upgrade from SD card failed.</td>
</tr>
<tr>
<td></td>
<td><em>Firmware update from an SD card completed</em>&lt;br&gt;The equipment firmware has been successfully updated from an SD card</td>
</tr>
<tr>
<td></td>
<td><em>blink 3 times</em></td>
</tr>
<tr>
<td><strong>green:</strong>&lt;br&gt;<strong>yellow:</strong>&lt;br&gt;<strong>red:</strong></td>
<td>• <strong>Remote OFF activated</strong>&lt;br&gt;The inverter was turned OFF remotely. It will remain off until given a remote ON command.</td>
</tr>
</tbody>
</table>
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. Aurora Manager software can be used to adjust grid parameters. An RS485-USB adapter (not included) is required to modify settings using the Aurora Manager software. The USB driver files and instructions for installation can be found online at www.abb.com/solarinverters.

1. Voltage ride-through
   This inverter provides parameters to respond to undervoltage and overvoltage events. The inverter is designed to operate normally within the specified operating range. If voltage excursions occur, the inverter is designed to continue operating normally or cease to export power for a specified delay. Beyond this programmed delay, the inverter disconnects from the grid in the event of an abnormal voltage condition. The parameters that control voltage ride-through can be accessed from Aurora Manager software.

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 modes
   This inverter is designed to export active as well as reactive power into the utility grid. 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 a power factor of 1.0.
   - Fixed power factor control (Fixed cos-phi): In this mode, the operator can set the output power factor to a fixed value. When enabled, Set percentage will appear on the display, allowing the setting of the value of Cos-Phi as a percentage from 0.1 to 100.
   - Power factor as function of output power (Std cosphi 0.9): In this mode, the inverter reduces the output power as a function of the output power at a given operating point. The default curve can be modified using the Aurora Manager LITE software program, which can be downloaded from ABB’s download center web page at http://www.abb.com/abblibrary/DownloadCenter/.
   - Dynamic Volt/VAR control (Std Q(U)): 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 default Volt/VAR curve can be modified using the Aurora Manager LITE software program software program.
4. Power reduction
This inverter offers two modes for active power reduction.
- Power limitation: When enabled from the Settings menu, this mode limits the active power that the inverter can export to the grid. The setting is specified as a percentage of the rated power of the inverter, from 0% to 100% in steps of 1%.
- Frequency/Watt function (Set F Derating): In this mode, the inverter limits the active power as a function of the grid frequency. The default frequency/watt can be modified using the Aurora Manager software.

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 dramatic fluctuations in the output power in order to prevent instabilities on the utility grid.
- Slow ramp: 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 specifications. Default voltage and frequency trip limit and trip time settings to comply with these standards are shown in table below. Aurora Manager software can be used to adjust Voltage and Frequency Trip Limit and Trip Time Parameters according to Grid requirements of installation locale. Refer to product manual for instructions on how to use Aurora Manager software.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Voltage (V)</th>
<th>Frequency (Hz)</th>
<th>Max. time (sec) at 60Hz before cessation of current</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 0.50 Vnom (Fixed)</td>
<td>Rated (60Hz)</td>
<td>0.16 (default) (Adj. Set Points 0.16 to 1.5s)</td>
</tr>
<tr>
<td>B</td>
<td>0.50 Vnom ≤ V &lt; 0.88 Vnom (Adj. Set Points 55% to 88%)</td>
<td>Rated (60Hz)</td>
<td>2 (Default) (Adj. Set Points 0.16 to 30 sec)</td>
</tr>
<tr>
<td>C</td>
<td>1.10 Vnom &lt; V &lt; 1.2 Vnom (Adj. Set Points 110% to 120%)</td>
<td>Rated (60Hz)</td>
<td>1 (Default) (Adj. Set Points 0.16 to 30 sec)</td>
</tr>
<tr>
<td>D</td>
<td>1.2 Vnom ≤ V (Fixed)</td>
<td>Rated (60Hz)</td>
<td>0.16 (Adj. 0.001 to 0.16s)</td>
</tr>
<tr>
<td>E</td>
<td>Rated</td>
<td>f&gt;60.5Hz (Default) (Adj. 60.2 to 64.0 Hz)</td>
<td>0.16 (Default) (Adj. 0.16 to 300 sec)</td>
</tr>
<tr>
<td>F</td>
<td>Rated</td>
<td>f&lt;59.3 Hz (Default) (Adj. 59.8 to 50.0 Hz)</td>
<td>0.16 (Default) (Adj. 0.16 to 300 sec)</td>
</tr>
<tr>
<td>G</td>
<td>Rated</td>
<td>f &lt; 57.0 Hz</td>
<td>0.16 (Default) (Adj. 0.16 to 300 sec)</td>
</tr>
<tr>
<td>H</td>
<td>Rated</td>
<td>f &gt; 63.0 Hz</td>
<td>0.16 (Default) (Adj. 0.16 to 300 sec)</td>
</tr>
</tbody>
</table>
Operating parameter settings

- Choose a time when the PV array provides at least 300Vdc to the inverter.
- Confirm the external AC disconnect is still locked out/tagged out.
- Connect the inverter’s RS-485 bus (wired during installation) to a laptop computer, equipped with a RS-485/USB converter and loaded with Aurora Manager LITE software.
- Remove any lockout/tag out on the DC side.
- Close (turn ON) the DC wiring box disconnect switch.
- Use Aurora Manager LITE to set any of the following parameters, or any others, which will be required for the site:

- **Grid parameters**: The table below shows the operating parameters (trip limits, thresholds and time) that can be changed, and the range of values that may be set for each.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set U&gt;&gt;</td>
<td>Grid overvoltage (OV) threshold (extended range)</td>
<td>Unom … (Unom x 1.3)</td>
</tr>
<tr>
<td>Set U&lt;&lt;</td>
<td>Grid undervoltage (UV) threshold (extended range)</td>
<td>10V … Unom</td>
</tr>
<tr>
<td>Set F&gt;&gt;</td>
<td>Grid overfrequency (OF) threshold (extended range)</td>
<td>Fnom ... (Fnom + 5Hz)</td>
</tr>
<tr>
<td>Set F&lt;&lt;</td>
<td>Grid underfrequency (UF) threshold (extended range)</td>
<td>(Fnom - 5Hz) ... Fnom</td>
</tr>
<tr>
<td>Set U&gt;</td>
<td>Grid overvoltage (OV) threshold (restricted range)</td>
<td>Unom ... (Unom x 1.3)</td>
</tr>
<tr>
<td>Set U&lt;</td>
<td>Grid undervoltage (UV) threshold (restricted range)</td>
<td>10V ... Unom</td>
</tr>
<tr>
<td>Set F&gt;</td>
<td>Grid overfrequency (OF) threshold (restricted range)</td>
<td>Fnom ... (Fnom + 5Hz)</td>
</tr>
<tr>
<td>Set F&lt;</td>
<td>Grid under-frequency (UF) threshold (restricted range)</td>
<td>(Fnom - 5Hz) ... Fnom</td>
</tr>
<tr>
<td>Set Uconn&gt;</td>
<td>Max. permissible voltage prior to grid connection</td>
<td>Unom ... (Unom x 1.3)</td>
</tr>
<tr>
<td>Set Uconn&lt;</td>
<td>Min. permissible voltage prior to grid connection</td>
<td>10V ... Unom</td>
</tr>
<tr>
<td>Set Fconn&gt;</td>
<td>Max. permissible frequency prior to grid connection</td>
<td>Fnom ... (Fnom + 5Hz)</td>
</tr>
<tr>
<td>Set Fconn&lt;</td>
<td>Min. permissible frequency prior to grid connection</td>
<td>(Fnom - 5Hz) ... Fnom</td>
</tr>
<tr>
<td>Set Time U&gt;&gt;</td>
<td>Overvoltage U&gt;&gt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time U&lt;&lt;</td>
<td>Undervoltage U&lt;&lt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time F&gt;&gt;</td>
<td>Overfrequency F&gt;&gt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time F&lt;&lt;</td>
<td>Underfrequency F&lt;&lt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time U&gt;</td>
<td>Overvoltage U&gt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time U&lt;</td>
<td>Undervoltage U&lt; protection trip timeout</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time F&gt;</td>
<td>Overfrequency F&gt; protection trip time</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set Time F&lt;</td>
<td>Underfrequency F&lt; protection trip time</td>
<td>0 … 327670mS</td>
</tr>
<tr>
<td>Set time conn 1</td>
<td>Grid check timeout prior to connection</td>
<td>0 … 65535mS</td>
</tr>
<tr>
<td>Set time conn 2</td>
<td>Grid check timeout prior to connection after a grid fault</td>
<td>0 … 65535mS</td>
</tr>
<tr>
<td>Disable U&gt;&gt;</td>
<td>Disables the U&gt;&gt; (OV) protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable U&lt;&lt;</td>
<td>Disables the U&lt;&lt; (UV) protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&gt;&gt;</td>
<td>Disables the F&gt;&gt; (OF) protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&lt;&lt;</td>
<td>Disables the F&lt;&lt; (UF) protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable U&gt;</td>
<td>Disables the U&gt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable U&lt;</td>
<td>Disables the U&lt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&gt;</td>
<td>Disables the F&gt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&lt;</td>
<td>Disables the F&lt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable U&gt; (10Min)</td>
<td>Disables the U&gt; (10Min) protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable U&lt;</td>
<td>Disables the U&lt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&gt;</td>
<td>Disables the F&gt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Disable F&lt;</td>
<td>Disables the F&lt; protection</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>U&gt; (10Min) Der.</td>
<td>Enables power limit mode due to high average grid voltage readings</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Slow Ramp</td>
<td>Enables gradual ramp up of power after the grid connection.</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Reset Country S.</td>
<td>Unlocks the grid standard selection (resets the 24 hours available for changing the grid standard)</td>
<td>Enabled/Disabled</td>
</tr>
<tr>
<td>Accept boards</td>
<td>Used to assign a new PCB to the inverter (after a replacement)</td>
<td>Enabled/Disabled</td>
</tr>
</tbody>
</table>

**DO NOT set parameters outside the ranges required by local grid standard.**
• **Date and time:** Greenwich meantime is the factory default date/time settings. Change to local standard time for accurate statistics and error code logging.

• **RS-485 bus addresses:** settings required in the case of system monitoring via the RS485 lines;
  RS485 (1) default setting on AUTO
  RS485 (2) default setting on AUTO
  *If multiple inverters are on an RS-485 bus, assign them unique addresses. The addresses that can be assigned go from 2 to 63.*

• **RS-485 communication protocol:** The inverter has two RS-485 communication lines, which can be set for “Aurora” (ABB proprietary) or ModBus (public) communication protocols. The factory default protocol for both ports is ABB “Aurora” but this can be changed with Aurora Manager LITE software.

  *Do not set the Modbus communication protocol on the line used to connect the Aurora Manager LITE software. This setting results in the immediate loss of communication with the inverter.*

• **Vstart:** Default 420 V
  This section of the menu allows you to set the Vstart voltage to suit the system requirements.

  *Change Vstart only if the sizing tool, available on the ABB website, indicates that the Vstart needs changing; discuss this with Technical Sales or customer technical support.*

• **Configurable Relay (ALARM and AUX)**
  The two configurable relays a09 (J5 and J6) are identical. They may be connected to an external audible or visual indicator, but their use is not required, but they may be wired N/O or N/C during installation, after which they may be configured with Aurora Manager LITE software in one of the following modes (which are described below):
  - Production
  - Alarm
  - Configurable Alarm
  - Crepuscular
  - Alarm latch
  - Latch configurable alarm
  - External configurable alarm
  Error and warning codes may be retrieved with Aurora Manager LITE software, and are described in the “Alarm messages and troubleshooting” table (chapter 8)

  - **Production mode**
    Production mode is the default mode for both relays.
    The relay is energized when the inverter connects to the grid. The relay is de-energized when the inverter disconnects from the grid.
- Alarm mode with reset when alarm clears

The relay is energized when there is an error code (Exxx) or warning (Wxxx) for out-of-range grid parameters. The relay is de-energized when the grid parameter error or warning clears, before the inverter reconnects to the grid.

<table>
<thead>
<tr>
<th>Alarms for which the relay is activated</th>
</tr>
</thead>
<tbody>
<tr>
<td>E001</td>
</tr>
<tr>
<td>E007</td>
</tr>
<tr>
<td>E014</td>
</tr>
<tr>
<td>E020</td>
</tr>
<tr>
<td>E026</td>
</tr>
<tr>
<td>E032</td>
</tr>
<tr>
<td>E046</td>
</tr>
<tr>
<td>E057</td>
</tr>
<tr>
<td>E089</td>
</tr>
</tbody>
</table>

In the presence of warning codes W003, W004, W005, W006, W007, the relay is de-energized at the end of the alarm signal. This means that during the absence of grid voltage the relay contact remains de-energized.

- Configurable alarm (Alarm Conf.) with reset when alarm clears

The relay is energized when there is one of the error or warning codes from the list below: The relay is de-energized when the error or warning clears, before the inverter reconnects to the grid.

<table>
<thead>
<tr>
<th>Selectable alarms for which the relay is activated</th>
</tr>
</thead>
<tbody>
<tr>
<td>E001</td>
</tr>
<tr>
<td>E007</td>
</tr>
<tr>
<td>E014</td>
</tr>
<tr>
<td>E020</td>
</tr>
<tr>
<td>E026</td>
</tr>
<tr>
<td>E032</td>
</tr>
<tr>
<td>E046</td>
</tr>
<tr>
<td>E057</td>
</tr>
<tr>
<td>E089</td>
</tr>
<tr>
<td>W006</td>
</tr>
<tr>
<td>W047</td>
</tr>
</tbody>
</table>

After a W002 error and when Vin(dc) is low, the alarm is de-energized.

In the presence of W003, W004, W005, W006, or W007 signals, the relay contacts switch to then reset itself at the end of the alarm signal. This means that during the absence of grid voltage the relay contacts remain in their resting position.
- **Crepuscular mode:**
The relay is energized as soon as the inverter’s input voltage reaches the start up level (Vstart).

The relay is de-energized when Vin drops below 70% of the preset start-up voltage.

This mode is useful for disconnecting any output transformers that might consume power during the night.

- **Alarm Latch mode**
The relay is energized when there is a grid out-of-range error or warning code. The relay is de-energized after the inverter reconnects to the grid and resumes to normal operation.

Alarms for which the relay is activated

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

If the alarm condition is persistent, the relay will remain energized.
- Latched configurable alarm (Al. Conf. Latch)

The relay is energized during one of the error or warning codes in the table below. The relay is de-energized after the inverter reconnects to the grid and resumes to normal operation.

<table>
<thead>
<tr>
<th>Selectable alarms for which the relay is activated</th>
</tr>
</thead>
<tbody>
<tr>
<td>E001</td>
</tr>
<tr>
<td>E007</td>
</tr>
<tr>
<td>E014</td>
</tr>
<tr>
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<td>E026</td>
</tr>
<tr>
<td>E032</td>
</tr>
<tr>
<td>E046</td>
</tr>
<tr>
<td>E057</td>
</tr>
<tr>
<td>E089</td>
</tr>
<tr>
<td>W006</td>
</tr>
<tr>
<td>W047</td>
</tr>
</tbody>
</table>

If the alarm condition is persistent, the relay will remain energized.

- External configurable alarm (Al. Conf. Ext.)

Use Aurora Manager LITE software to create a customize list of error and warnings codes for which the relays will be energized and to indicate when the relays will be de-energized -- as soon as the fault clears, or after the inverter reconnects to the grid ("latch" or "No latch" mode)

- Remote control

The connection and disconnection of the inverter to and from the grid may be controlled externally. Use of this feature is not required. To set up the remote ON/OFF, two items are required:

1) connect control wires to the RTN signal and R1 ON/OFF, and/or R2 ON/OFF and RTN, on the header for the J7 (a11) connector on the control and communication board (see “Remote ON/OFF control connection”, installation chapter)
2) Enable Remote ON/OFF using the Aurora Manager LITE software interface.

To put the inverter in remote OFF mode, short the R1 ON/OFF and/or the R2 ON/OFF to the RTN line. The inverter will disconnect from the grid. To enable the inverter for turn on after it determines its environmental parameters (voltages, temperatures) are in spec and completes its self tests, leave BOTH signals floating (open). With Remote ON/OFF enabled, it requires one Remote ON/OFF signal low to turn the inverter OFF, but both signals floating to enable turn ON.
• **Reactive power:**

Use the Aurora Manager LITE > Reactive power menu to simulate reactive power production.

There are 5 possible types of management.

- **No regulation:** only active power. This is the default setting. To enable this mode, select Enable, then select OK.

- **Cos-phi fixed:** this option sets the power factor to a fixed value. To enable it, select Enable and then OK. Once enabled use Set value to specify a fixed power factor (0.8 to 1.0, leading or lagging).

- **Q fixed:** Sets the reactive power rating to a fixed value. To enable this mode, select Enable and then OK (using the UP / DOWN arrows) When enabled, Set value will appear on the display, allowing you to set the value of reactive power rating (as either Over or Under excited, from 1.000 to 0.001).

- **Cos-phi = f(P):** this option sets the power factor as a custom function of active power output. To enable it, select Enable and then OK. Once enabled, a default standard curve will appear on the screen. Modify it as needed.

- **Q = f(U):** reactive power is defined as a function of the grid voltage (as measured by the inverter). To enable it, select Enable and then OK. Once enabled, a default standard curve will appear on the screen. Modify it as needed.
• **UV Protection Time**: Default 60 sec.
  Set the time during which the inverter remains connected to the grid after \( V_{in} \) drops to \( V_{in} < (70\% \times V_{start}) \). The factory default value is 60 seconds.

  *The user-settable range is from 1 to 3600 seconds.*

  During this time the inverter backs up its internal bulk voltage from the grid. Active power consumption is minimal. Reactive power can be maintained.

• **MPPT scan**: The factory default is ON (active)
  This sets maximum power point tracking (MPPT) parameters. This function is useful when there are shady areas on the PV array which may create several points of maximum power on the operating curve.
  - **Enable/Disable**: Enable/disable the MPPT scan.
  - **Scan Interval**: This sets the scan frequency manually, overriding the default.

• **Power reduction**: The factory default is 100%.
  Set the active power that the inverter can feed into the grid by changing the percentage of nominal power.
  Setting it to 100% resets the default maximum power, which in some installation country standards may be 110% of nominal power.
Basic inverter data available in Aurora Manager LITE

This following Inverter ID information available through the Aurora Manager LITE software.

1. **Product ID**
   Displays model PN and the T.ID code that identifies the inverter hardware level.

2. **Serial No**
   Displays the equipment serial number.

3. **Firmware**
   Displays the firmware version installed in the equipment and the “update version” field.

4. **Country standard and language**
   Displays the grid standard set with the rotary switches.
   - **Current value**: Displays the grid standard set.
   - **New value**: If the position of the rotary switches is changed (and therefore a new grid standard is selected) during operation, the new standard selected will be displayed. This will only become effective the next time the equipment is turned off and then on again, and provided the time remaining (24h in operation) to carry out that operation has not expired
   - **Set new value**: This sets and confirms a new grid standard set in the “New value” section of the previous menu.
   - **Residual time**: Displays the time remaining in which it will still possible to set a new grid standard. When the time expires, “Locked” will be displayed, which indicates the grid standard can not be changed again.
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 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 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.
Preventive maintenance

Routine maintenance is required to maintain the warranty and the efficiency of the PV system.

Maintenance may done only by qualified personnel or ABB personnel under a service contract. Maintenance more frequently than once/year may be required for harsher site locations. Before starting work, confirm site environmental conditions are acceptable for maintenance -- NO rain, hail, snow, haboobs, high winds, insects or blowing grass,

Table: routine maintenance

<table>
<thead>
<tr>
<th>Before power down:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Check that the inverter is operating properly, without any alarm signals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>After power down, after lockout/tagout of the external disconnects:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ensure all labels and safety symbols are visible</td>
</tr>
<tr>
<td>• Check the integrity of the cables, conduit, connectors and cable glands outside the inverter. Check insulation for wear or damage.</td>
</tr>
<tr>
<td>• Check input/output cable connections for tightness</td>
</tr>
<tr>
<td>• Confirm that environmental conditions have not changed dramatically from those on installation.</td>
</tr>
<tr>
<td>• Check there are no obstacles (animals, insects, leaves) which could reduce the heat exchanging capacity of the heat sink: Check the heatsink top, bottom and between the fins and around the fan blades.</td>
</tr>
<tr>
<td>• Check cover seals for any signs of damage or wear</td>
</tr>
</tbody>
</table>

Remove the DC and AC wiring box covers.

• Examine terminal blocks and disconnect switches for signs of heating, discoloration, oxidation by-products, arcs or corrosion. Before returning the inverter to operation, call ABB to service any damaged components

• Examine the interior for any signs of humidity, moisture, liquid residue, dirt ingress, rust or corrosion. If any is found, locate the entrance point and correct the problem. Before returning the inverter to operation, call ABB to service any damaged components

• Check the conduit entrances from the inside. Reseal if necessary

Annual operations

• Use the monitoring system or Aurora Manager LITE to check error and warning record. Look for any recent malfunctions or patterns, especially Riso or ground faults after times of rain, humidity or dew.

• At night or when there is minimal sun, open and close any inverter AC and/or DC disconnect switches 10 times to help keep the contacts clean and prevent oxidation.

Annual cleaning

• Clean the equipment; verify, in particular, clean the lower array of the cooling fan assembly and the heat sink. Do not use compressed air inside the inverter, as this will push dirt into the corners.

Reinstall the covers, and return the inverter to operation. Confirm it powers back up and runs normally.
# Alarm Messages and troubleshooting

Error and warning codes may be ready by Aurora Manager LITE when the inverter’s input voltage is greater than V<sub>dcmin</sub> (>300Vdc). The green LED will be flashing or lit. This requires a PC, an RS-485-to-USB converter and Aurora Manager LITE software available at www.abb.com/solarinverters (select the country, select string inverter, 3-phase, TRIO-60 page).

In order to understand and resolve the warning (Wxxx) or error (Exxx) signals, refer to the table provided in the following paragraph.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Error message</th>
<th>Name of Alarm and Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No error code</td>
<td>- Ground Fault</td>
<td>Photovoltaic array ground fault: The alarm is generated when leakage current to ground is detected in the DC section of the system.</td>
<td>• Measure the insulation resistance using a megohmmeter in the photovoltaic array (positive terminal short-circuited to the negative terminal, 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 Megohm, have a qualified system technician identify and eliminate the problem. - If the value measured is higher than 1 megohm and the error signal persists, contact Customer technical support.</td>
</tr>
<tr>
<td>- No error code</td>
<td>- SET COUNTRY or NO NATION</td>
<td>SET COUNTRY or NO NATION: The grid standard was not set on the inverter.</td>
<td>• Set the grid standard of the country of installation following the instructions given in this inverter manual. - If the signal persists also after the grid standard has been set, contact Customer technical support.</td>
</tr>
<tr>
<td>- No error code</td>
<td>- Missing Grid</td>
<td>Missing Grid: The inverter does not detect grid voltage (AC side).</td>
<td>• Check the grid voltage on the inverter's AC terminal block. - Should it be absent, check any AC line disconnects. Confirm the grid is actually present.</td>
</tr>
<tr>
<td>- No error code</td>
<td>- Memory fault</td>
<td>Memory fault: The inverter has detected a communication problem with the memory board on which the inverter saves the daily value of energy produced.</td>
<td>• Remove the memory board and inspect its leads. Carefully reinsert it, being sure to get it in its slot correctly. - If the signal persists, contact Customer technical support.</td>
</tr>
<tr>
<td>- No error code</td>
<td>- Waiting Sun</td>
<td>Waiting for Sun: The inverter goes into “Waiting for Sun” mode when, following a W001 and/or W002 warning, the voltage from the photovoltaic array is less than the startup voltage (V&lt;sub&gt;start&lt;/sub&gt;).</td>
<td>• Check the input voltage on the inverter. - If it does not exceed V&lt;sub&gt;start&lt;/sub&gt;, check for sufficient irradiation and the correct composition of the system. - If it exceeds V&lt;sub&gt;start&lt;/sub&gt;, contact customer support.</td>
</tr>
<tr>
<td>- W001</td>
<td>- Sun Low</td>
<td>Insufficient irradiation (Low input voltage when the inverter was switched on): Incorrect configuration of the PV array or a borderline string configuration for the inverter's minimum input voltage.</td>
<td>• Check the input voltage on the inverter. - If it does not exceed V&lt;sub&gt;start&lt;/sub&gt;, check for the presence of sufficient irradiation and the correct composition of the system. - If it exceeds V&lt;sub&gt;start&lt;/sub&gt;, contact Customer technical support.</td>
</tr>
<tr>
<td>- W002</td>
<td>- Input UV</td>
<td>Insufficient irradiation (Low input voltage on switching off): Incorrect configuration of the photovoltaic generator or an “on the limit” configuration for the inverter's minimum input voltage.</td>
<td>• Check the input voltage on the inverter. - If it does not exceed V&lt;sub&gt;start&lt;/sub&gt;, check for the presence of sufficient irradiation and the correct composition of the system. - If it exceeds V&lt;sub&gt;start&lt;/sub&gt;, contact customer assistance.</td>
</tr>
<tr>
<td>- W004</td>
<td>- Grid OV</td>
<td>Grid overvoltage: This error signal occurs when during the inverter's normal operation the grid voltage exceeds the maximum limit set by the operator.</td>
<td>• Check the grid voltage on the inverter. - If the voltage tends to rise (when the inverter is connected), there is a problem of high line or grid impedance. - • Check the grid voltage also on the supply. - 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. - 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). - If the voltage and the grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance.</td>
</tr>
<tr>
<td>Error code</td>
<td>Name of Alarm and Cause</td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------------------</td>
<td>----------</td>
<td></td>
</tr>
</tbody>
</table>
| W005       | Grid undervoltage:     | • Check the grid voltage on the inverter.  
|            | This error signal occurs when during the inverter's         | • Check the grid voltage also on the supply.  
|            | normal operation the grid voltage exceeds the               | - 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. 
|            | minimum limit set by the operator.                           | - 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).  
|            |                                                                     | - If the voltage and grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance. |
| W006       | Grid over-frequency:   | • Check the grid frequency in the inverter.  
|            | This error signal occurs when during the inverter's         | • Check the grid frequency also on the supply:  
|            | normal operation the grid frequency exceeds the              | - If the voltage and grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance. |
|            | maximum limit set by the operator.                           | • Check the grid frequency in the inverter.  
| W007       | Grid under-frequency:  | • Check the grid frequency in the inverter.  
|            | This error signal occurs when during the inverter's         | • Check the grid frequency also on the supply:  
|            | normal operation the grid frequency exceeds the              | - If the voltage and grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance. |
|            | minimum limit set by the operator.                           | • Check the grid frequency in the inverter.  
| W010       | Fan Fail:              | • Check the grid frequency in the inverter.  
|            | This error occurs when there is a malfunction in the fan/fans inside the inverter. | • Error inside the inverter and cannot be checked externally.  
|            |                                                                     | - If the alarm repeats persistently, contact customer assistance. |
| W011       | Low “Bulk” voltage (DC-DC circuit):                          | • Raise the value of the activation voltage (Vstart) so as to have sufficient power from the PV array when the inverter connects to the grid.  
|            | The alarm (which is a warning, not an error) is generated     | • Check the input voltage on the inverter. If it does not exceed Vstart, check for the presence of sufficient irradiation and the correct composition of the system.  
|            | when the voltage on the bulk capacitors does not reach the   | - If it exceeds Vstart, contact Customer technical support. |
|            | threshold for the operation of the inverter (an internal     | • Check the grid frequency also on the supply:  
|            | unchangeable threshold).                                     | - If the voltage and grid frequency come back within the limits (also when the inverter is connected to the grid), contact customer assistance. |
| W012       | Battery Low:           | • Check that the date/time are set correctly and, if they are not, set them.  
|            | The inverter detected low backup battery voltage              | Arrange to completely switch off the inverter (on both AC and DC) and wait a few minutes.  
|            |                                                                     | Finally, restart the inverter and check whether the date/time are now correct, or whether they have reset themselves to 01/01/2000. If they reset, completely turn off the inverter (isolate AC and DC sides). Note battery polarity. |
| W013       | Clock Fail:            | • Error inside the inverter and cannot be checked externally.  
|            | The alarm occurs when there is a difference of more than 1   | - If the alarm repeats persistently, contact Customer technical support. |
|            | minute in the time shown via the Aurora Manager LITE         | • Error inside the inverter and cannot be checked externally.  
|            | compared to the internal time of the microprocessors and     | - If the alarm repeats persistently, contact Customer technical support. |
|            | indicates a malfunction of the clock circuit.                | • Error inside the inverter and cannot be checked externally.  
| W015       | Disconnection due to   | • Check that the grid to which the inverter is connected is not an island grid:  
|            | Anti-Islanding:      | - If the grid to which the inverter is connected is not an island grid, switch the inverter off and then on again if the problem persists, contact Customer technical assistance. |
|            | The inverter had been improperly connected to an island      | • Check the grid to which the inverter is connected is not an island grid.  
|            | grid.                                                        | - If the grid to which the inverter is connected is not an island grid, switch the inverter off and then on again if the problem persists, contact Customer technical assistance. |
| W017       | Error recorded in     | • Disconnect the DC to the inverter and use a multimeter to  
|            | measuring string currents:                                   | check the fuses.  
|            | Damaged string protection fuse(s)                            | - If any fuses are open, arrange to have them replaced.  
|            | (only for models with monitored string fuses)               | But confirm that the string input currents do not exceed the rating of the fuses, especially if strings have been paralleled outside the inverter.  
|            |                                                                     | • If there are no damaged string fuses and the inverter continues to show the alarm message, check whether the settings in the Aurora Manager LITE software are correct (presence or absence of one or more input strings). |
| W018       | Intervention of surge protection devices on DC side:        | • Disconnect the inverter. Observe the inspection window on  
|            | Surge protection devices on DC side:                        | each DC side surge protection device (SPD). If it is red, the surge protection device is damaged and the cartridge must be replaced.  
<p>|            | Surge protection devices on the DC side are damaged.        | • If the alarm status persists, even if all the surge protection devices have a green inspection window, contact Customer technical support. |</p>
<table>
<thead>
<tr>
<th>Error code</th>
<th>Name of Alarm and Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>W019</td>
<td>Intervention of surge protection devices on AC side: Surge protection devices situated on the AC side are damaged.</td>
<td>• Disconnect the inverter. Observe the inspection window on each AC side surge protection device (SPD). If it is red, the surge protection device is damaged and the cartridge must be replaced. - If the alarm status persists, even if all the surge protection devices have a green inspection window, contact Customer technical support.</td>
</tr>
<tr>
<td>W022</td>
<td>Variation in means of managing reactive power: Variation in the means of managing reactive power; this change can be made via Aurora Manager LITE software.</td>
<td>The variation in the management of reactive power is done directly by the customer and is not an error. The information is only saved on the inverter’s event history.</td>
</tr>
<tr>
<td>W023</td>
<td>Variation in the inverter’s date and time: Variation of the inverter’s date and time; this change can be made via Aurora Manager LITE software.</td>
<td>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.</td>
</tr>
<tr>
<td>W024</td>
<td>Zeroing of the statistical energy data memorised in the EEPROM: Reset of the energy data saved in the inverter; this operation can be made via Aurora Manager LITE software.</td>
<td>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.</td>
</tr>
<tr>
<td>W026</td>
<td>Resetting of the Arc Fault error: Manual reset of the Arc Fault error; this operation can be made via Aurora Manager LITE software.</td>
<td>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.</td>
</tr>
<tr>
<td>W027</td>
<td>Resetting of the Latch alarm conditions: Manual reset of the Latch alarm conditions; this operation can be made through the Aurora Manager LITE software.</td>
<td>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.</td>
</tr>
<tr>
<td>W046</td>
<td>Connection to the grid unsuccessful 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.</td>
<td>Once the error occurs, the inverter tries to return to normal operation. If the problem persists after a number of attempts to connect the inverter, switch the inverter off and then on again. - If the problem persists, contact Customer technical support.</td>
</tr>
<tr>
<td>W047</td>
<td>FW update unsuccessful The alarm occurs when a firmware update has not been completed.</td>
<td>Complete any pending firmware updates. - If the problem persists once the firmware updates have been completed, switch the inverter off and on again. - If the problem persists, contact Customer technical support.</td>
</tr>
<tr>
<td>W048</td>
<td>Automatic disconnection from the grid due to time limit: If the inverter exceeds the set grid connection timeout set by the grid standard, it will automatically disconnect and reconnect to the grid, and complete the the Riso test.</td>
<td>The presence of this alarm is not an error. The automatic disconnection is prescribed by safety regulations. - If the inverter disconnects in a shorter time than expected, contact Customer technical support.</td>
</tr>
<tr>
<td>W049</td>
<td>Variation of the grid standard: Variation of the inverter’s grid standard; this change can be made via Aurora Manager LITE software.</td>
<td>A change in the inverter’s grid standard is done directly by the customer. The information is saved in the inverter’s event log.</td>
</tr>
<tr>
<td>W050</td>
<td>One temperature sensors is in fault state: The inverter has detected a failure of an Internal temperature sensor.</td>
<td>Internal error that cannot be checked externally. The inverter keeps working using other internal temperature sensors.</td>
</tr>
<tr>
<td>W065</td>
<td>An hardware module of the system was replaced: Information relating to the alignment of the inverter identification data after an hardware (example: the power module) replacement</td>
<td>After an hardware replacement, the identification data of the internal devices are aligned. The information is saved in the inverter’s event log only.</td>
</tr>
<tr>
<td>W067</td>
<td>ID data was set on the system: Information relating to the alignment of the inverter identification data during first installation</td>
<td>During the first installation, the identification data of the wiring box are aligned with those of the power module. The information is saved in the inverter’s event log only.</td>
</tr>
<tr>
<td>E001</td>
<td>Input overcurrent (photovoltaic array): The input current exceeded the inverter’s maximum input current threshold.</td>
<td>Confirm the PV array does not allows input current to exceed the maximum allowed by the inverter. - If needed, contact Customer technical support.</td>
</tr>
<tr>
<td>Error code</td>
<td>Name of Alarm and Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| - E002     | Input OV                | - Measure the input voltage at the inverter with a voltmeter.  
- If it is higher than the maximum allowable, reconfigure the PV array.  
- If the voltage also exceeded the absolute maximum input voltage, the inverter could have been damaged.  
- If the input voltage is not out of range, contact Customer technical support.  |
| - E003     | DSP initialization error:  
- No Parameters | - Internal error that cannot be checked externally.  
- Recycle power to the inverter.  If the problem persists, contact Customer technical support.  |
| - E004     | “Bulk” overvoltage (DC-DC circuit):  
- Bulk OV | - The alarm may be triggered by causes external to the inverter:  
- Excessive input voltage may result in E004.  Check the inverter’s input voltage.  See E002.  
- Excessive grid voltage may trigger an E004.  In these cases the alarm is transitory and the inverter automatically restarts  
- There may be internal causes.  In this case, contact Customer technical support.  |
| - E005     | Internal communication error:  
- Comm.Error | - Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
| - E006     | Output overcurrent:  
- Output OC | - Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
| - E007     | Saturation recorded on the IGBT components:  
- IGBT Sat | Once the error appears, the inverter attempts to resume normal operation.  
- Should the error occur sporadically, it may be caused by an abrupt change in input voltage or grid voltage.  This is not an inverter malfunction.  
- If the error won’t go away, it’s may be an internal fault.  
- Contact Customer technical support.  |
| - E009     | Internal error:  
- Internal error | - Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
| - E010     | Low “Bulk” voltage (DC-DC circuit):  
- Bulk Low | - Low bulk voltage may occur during periods of limited irradiation.  
- If the error signal occurs sporadically, it may be due to limited irradiation and accompanying limited power availability from the PV array.  
- If the problem occurs consistently with input voltage higher than the startup voltage, contact Customer technical support.  |
| - E011     | Boost circuit took too long to reach steady state:  
- Ramp Fail | - Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
| - E012     | “Boost” circuit (DC-DC side) error reported by the “Inverter” DSP:  
- DcDc Fail | Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
| - E014     | Excessive temperature inside the inverter:  
- Over Temp. | - Confirm inverter ambient temperature is within spec.  
- Allow the inverter to cool off  
- Confirm no hot walls or other equipment is radiating heat in the direction of the hot inverter.  Confirm there is plenty of space on all sides of the inverter for air circulation and heat dissipation.  
- If the problem persists once the inverter has cooled down and the environmental conditions have been confirmed, contact Customer technical support.  |
| - E015     | Failure sensed on the “Bulk” capacitor:  
- Bulk Cap Fail | - Internal error that cannot be checked externally.  
- Recycle inverter power.  If the problem persists, contact Customer technical support.  |
<table>
<thead>
<tr>
<th>Error code</th>
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</table>
| E016       | Inverter Fail          | • Internal error that cannot be checked externally.  
| Solid alarm LED | A problem was sensed in the DC-AC circuitry. |
| E017       | Start Timeout          | - The inverter’s input voltage was below its minimum threshold, perhaps just above the startup voltage, but not accompanied by enough power availability from the PV array.  
| Solid alarm LED | Internal error related to inverter circuitry start up. |
| E018       | Ground Fault           | - If the resistance is lower than 500KOhm, have the array and connections checked out by a qualified technician who can identify and eliminate the problem.  
| Red LED | High leakage current on the DC side (photovoltaic array): During normal operation of the inverter, leakage current to ground was detected. |
| E019       | Leak sense fail        | • Internal error that cannot be checked externally.  
| Solid alarm LED | DC side leakage current sensor self-test failed: Before connecting to the grid the inverter runs a self-test on the leakage current sensor. The test fails if certain readings do not line up. |
| E020       | Self Test Error 1      | The error occurs only before connection to the grid.  
| Solid alarm LED | Output relay 1 self-test failure: The inverter tests output relay function before connecting to the grid. An error was found in the expected readings from the output relay controlled by the boost DSP. |
| E021       | Self Test Error 2      | The error occurs only before connection to the grid.  
| Solid alarm LED | Output relay 2 self-test failure: The inverter tests output relay function before connecting to the grid. An error was found in the expected readings from the output relay controlled by the inverter DSP. |
| E022       | Self Test Error 4      | The inverter attempts to reconnect to the grid.  
| Solid alarm LED | Output relay test timeout: The output relay self-test was not completed in the allotted time. |
| E023       | DC in error            | • Internal error that cannot be checked externally.  
| Solid alarm LED | DC injection out of range: The DC component on the AC output current exceeded the threshold of 0.5% of the rated operating current. |
| E025       | Riso Low               | • Check all junction box interiors for corrosion or signs of dampness |
| Solid GFI LED | Low insulation resistance: Before connecting to the grid, the inverter measures the PV array insulation resistance to ground. If the measurement is 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 (components not well sealed);  
| | • Poor quality cable joints;  
| | • Unsuitable (too low rating) or damaged DC surge protection devices (SPDs) external to the inverter.  
| | • Humidity inside any junction box |
### 8 - Maintenance

<table>
<thead>
<tr>
<th>Error code</th>
<th>Name of Alarm and Cause</th>
<th>Solution</th>
</tr>
</thead>
</table>
| - E029    | Internal overvoltage on the measurement of the "Mid bulk": internal error in measurement of an internal voltage | • Internal error that can not be checked externally.  
- Recycle inverter power. If the problem persists, contact Customer technical support |
| - E031    | Output relay damaged: Measurements of grid voltage before and after the output relays did not match | • Internal error that can not be checked externally.  
- Recycle inverter power. If the problem persists, contact Customer technical support |
| - E032    | Output current imbalance: Output current readings on the 3 phases did not match         | • Internal error that can not be checked externally.  
- Recycle inverter power. If the problem persists, contact Customer technical support |
| - E033    | Low ambient temperature: Temperature outside the inverter below -25°C                   | • Wait for the inverter’s ambient temperature and the inverter hardware to warm up to the specified operating range.  
- If the problem persists after both the environment and the inverter warm up, contact Customer technical support |
| - E034    | “IGBT” circuitry not ready: Error inside the inverter                                  | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
| - E035    | Inverter awaiting “remote ON” command: The inverter was given a Remote OFF command and is waiting for a Remote ON. | • Give the inverter a Remote ON command.  
- If the inverter doesn’t turn back on, disable the Remote on/off function.  
- Recycle power to the inverter.  
- Re-enable the REMOTE ON/OFF. If the problem persists, contact Customer technical support |
| - E036    | Average of the measurements of grid voltage outside range: The average value of the grid voltage (sampled every 10 minutes) did fall within the permitted range. The grid voltage 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 stabilized; if not, the inverter disconnects from the grid. | • Check the grid voltage at the inverter output.  
- If the grid voltage is too high, ask the grid operator to adjust the grid voltage. If the operator authorizes a change to the inverter’s grid parameters, confirm with Customer technical support that those new limits are compatible with the TRIO 50kW.  
- If the value measured is lower than 1 megohm, 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 megohm and the error signal persists, contact customer assistance. |
| - E037    | Low value of the insulation resistance (only with the “Amorphous” mode activated): 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. | • Check for the presence and correct contact between the two terminals of the grounding resistance installed inside the inverter  
- Measure the insulation 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 megohm, a check must be carried out by a technician/installer on 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 higher than 1 megohm and the error signal persists, contact customer assistance. |
| - E049    | Error in the “AC feed-forward” circuit: Error inside the inverter                      | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
| - E050    | Arc Fault protection activated: Possible photovoltaic arc detected on the DC side.     | • If it is the first time this problem has occurred, press the ESC button for 5 seconds and wait for the unit to restart.  
- If the problem persists (once the inverter has been switched off and back on again), contact customer assistance. |
| - E053    | Arc Fault board autotest failed: Problem detected during the AFD board autotest.       | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
| - E055    | Arc Fault board parameter reading error: Error in reading the AFD                      | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
| - E077    | Error in the system configuration: internal error.                                     | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
| - E078    | Riso test error: Problem detected during Riso preliminary self-test.                  | • Internal error that cannot be checked externally.  
- Recycle power to the inverter. If the problem persists, contact Customer technical support |
<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>E079</td>
<td>Phase connection error</td>
<td>• Invert two of the phases wired from the external disconnect to the AC output terminal block.</td>
</tr>
<tr>
<td>E080</td>
<td>Two or more temperature sensors are in fault state and system has to enter error state</td>
<td>• Internal error that can not be checked externally. • Recycle inverter power. If the problem persists, contact Customer technical support.</td>
</tr>
<tr>
<td>E084</td>
<td>Backfeed to photovoltaic field: The error occurs if the input voltage is particularly low, typically in the evening in conditions of low irradiation, and indicates a backfed current from the inverter to the photovoltaic panels.</td>
<td>If the error occurs in the evening or in conditions of low irradiation, it is not considered an inverter problem, but instead protection for the PV field. • If the error occurs with good irradiation, recycle power to the inverter. If the error persists, contact Customer technical support.</td>
</tr>
</tbody>
</table>
Power limit messages

The TRIO inverter sends messages -- readable Aurora Manager LITE software signals -- when power limiting has occurred due to:

- settings made by the user
- settings required by the grid standard of the country of installation
- protective devices inside the inverter

The following table lists power limit messages.

<table>
<thead>
<tr>
<th>Error/warning code</th>
<th>Power limit type and Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIMxxx% CODE:00</td>
<td>Power limit: The user set an output power limit the inverter. LIM xxx% = Power reduction percentage</td>
<td>• Check the limits in “Settings &gt; Power Reduction”.</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td></td>
</tr>
<tr>
<td>LIMxxx% CODE:01</td>
<td>Power limitation for overfrequency: The user set an overfrequency power limit, that reduces the maximum output power of the inverter when the grid frequency exceeds certain limits. LIM xxx% = Power reduction percentage</td>
<td>• Check the limits in “Settings &gt; Service Power &gt; OF Derating”</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td></td>
</tr>
<tr>
<td>LIMxxx% CODE:02</td>
<td>Power limit for overvoltage: The user set an overvoltage power limit (parameter U &gt; 10 min) that reduces maximum inverter power when the 10-minute average grid voltage reading exceeds certain limits. LIM xxx% = Power reduction percentage</td>
<td>• Check the limit in “Settings &gt; Service Power &gt; U(10min) Der.”</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td></td>
</tr>
<tr>
<td>LIMxxx% CODE:03</td>
<td>Anti-islanding power limit: The anti-islanding power limit is active; an &quot;islanding&quot; condition has been recorded. LIM xxx% = Power reduction percentage</td>
<td>• If the inverter remains connected to the grid and the limit is active, contact Customer technical support</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td></td>
</tr>
<tr>
<td>LIMxxx% CODE:04</td>
<td>Power limit due to low grid voltage: Power may be limited since a low grid (AC) voltage (AC) was recorded. LIM xxx% = Power reduction percentage</td>
<td>• Confirm that the grid voltage is lower than the minimal voltage. Should this condition persist, contact the grid operator to resolve the problem.</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td></td>
</tr>
<tr>
<td>LIMxxx% CODE:05</td>
<td>Power limit due to high temperature: The inverter detected an overtemperature and is limiting output power. Note the ambient temp at which the overtemperature condition is detected varies with inverter self-heating due to its own output power. LIM xxx% = Power reduction percentage</td>
<td>• Wait for the ambient temperatures to which the inverter is exposed to return to the operating range and for the inverter to cool down.</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td>- If the problem persists once the inverter cools off, contact Customer technical support.</td>
</tr>
<tr>
<td>LIMxxx% CODE:06</td>
<td>Power limit for input overvoltage: The inverter detected an input (DC) overvoltage and is limiting output power. LIM xxx% = Power reduction percentage</td>
<td>• Measure the DC input voltage at the inverter with a voltmeter.</td>
</tr>
<tr>
<td></td>
<td>Examples: LIM 100% = no power limit LIM 50% = limit to 50% nominal output power</td>
<td>- If it is higher than the maximum operating range voltage, check and change the PV array configuration. If the voltage also exceeded the absolute maximum input voltage limit, the inverter could be damaged.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- If the voltage is lower than maximum operating voltage spec, contact Customer technical support.</td>
</tr>
</tbody>
</table>
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  on the quick disconnect connectors  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 Aurora Manager LITE credentials - Registering at the “Registration” site

In order to obtain the release credentials for advanced configuration of the inverter using the “Aurora Manager LITE” software, 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.

The password enables access to the advanced “Installer” mode present on the configuration software for inverters. The configuration software can be downloaded from the website https://registration.abbsolarinverters.com
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 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
Replacement of the buffer battery

The backup battery, reference designator X5 (a20), is in the DC wiring box 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 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 front cover, 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 openings have water tight seals. 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

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CONSTRUCTION MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame, brackets, supports</td>
<td>Arc-welded steel FE37</td>
</tr>
<tr>
<td>Casing or covers</td>
<td>Arc-welded steel FE37, aluminum</td>
</tr>
<tr>
<td>Gaskets and seals</td>
<td>Rubber / Teflon / Viton</td>
</tr>
<tr>
<td>Electrical cables</td>
<td>Copper / Rubber</td>
</tr>
<tr>
<td>Backup battery</td>
<td>Nickel / Lead / Lithium</td>
</tr>
</tbody>
</table>
Further information

For more information on ABB solar products and services, visit www.abb.com/solarinverters
Contact us

www.abb.com/solarinverters