

Technical note

ABB string inverter reconnection delay when used with Rapid Shutdown Device (RSD)



Contents

Introduction	2
Instructions for reprogramming inverter models PVI-3.0/3.6/3.8/4.2 and PVI-5000/6000	2
Equipment and software needed	2
Warning.....	3
Applicable Inverters.....	3
Contact Information	3
Notes	3
Step 1 - Turn OFF inverter.....	3
Step 2 - Remove AC grid.....	4
Step 4 - Make RS-485 connections.....	4
Step 5 - Turn ON inverter	5
Step 6 - Open Aurora Manager TL interface on PC	5
Step 7 - Connect Aurora Manager TL to inverter	5
Step 8 - Configure reconnection delay	6
Step 9 - Prepare inverter for normal operation	6
Step 10 - Simulate grid failure	6
Step 11 - Test reconnection time	6

Introduction

For all grid-tied inverters, the IEEE1547 standard, section 4.2.6, *Reconnection to Area EPS*, specifies a reconnection delay after a grid fail event has occurred. The delay is typically set for five minutes, but may be adjustable for up to five minutes (300 seconds). See Figure 1 below for the IEEE1547 requirement.

4.2.6 Reconnection to Area EPS

After an Area EPS disturbance, no DR reconnection shall take place until the Area EPS voltage is within Range B of ANSI C84.1-1995, Table 1, and frequency range of 59.3 Hz to 60.5 Hz.

The DR interconnection system shall include an adjustable delay (or a fixed delay of five minutes) that may delay reconnection for up to five minutes after the Area EPS steady-state voltage and frequency are restored to the ranges identified above.

Figure 1 - IEEE1547 requirement for reconnection delay

ABB single phase inverters respond to power outages differently, depending on whether just AC or AC and DC power is lost. Default reconnection delays for ABB single phase inverters are as listed in Table 1 that follows, and are adjustable using a PC software interface called Aurora Manager TL, which can be downloaded from ABB's download center web page at <http://www.abb.com/abblibrary/DownloadCenter/>. Enter "Aurora Manager TL" in the search for box on this web page to locate the download link to the latest software version. .

ABB's Rapid Shutdown Device (RSD) limits the DC voltage to less than 30 volts within ten seconds of initiation, as required by the 2014 National Electric Code section 690.12. When the PV system is connected to the load side of the service disconnecting means per 705.12(D), the initiation of rapid shutdown occurs from an AC grid fail event, forced by a disconnection of the PV system disconnecting means or PV breaker, removal of the utility meter, or by pressing an optionally-installed emergency stop button. When connected to the supply side of the service disconnecting means, as permitted by 705.12(A), the initiation of rapid shutdown occurs from an AC grid fail event, forced disconnection of the PV system disconnecting means, or by pressing an optionally-installed emergency stop button.

Default reconnection delay

Inverter model	AC grid fail only	AC grid fail + rapid shutdown initiation	Delays adjustable through
PVI-3.0-OUTD-S-US-A	300s	30s	Aurora Manager TL v3.23 or later
PVI-3.6-OUTD-S-US-A	300s	30s	Aurora Manager TL v3.23 or later
PVI-3.8-OUTD-S-US-A	300s	30s	Aurora Manager TL v3.23 or later
PVI-4.2-OUTD-S-US-A	300s	30s	Aurora Manager TL v3.23 or later
PVI-5000-OUTD-US-A	300s	30s	Aurora Manager TL v3.23 or later
PVI-6000-OUTD-US-A	300s	30s	Aurora Manager TL v3.23 or later

Table 1 - Default reconnection times for ABB single phase inverters

Contact the local utility company for specific requirements. If the utility company requires modifications to the default reconnection delays specified in Table 1 above, these settings can be modified as described in the following instructions.

Instructions for reprogramming inverter models PVI-3.0/3.6/3.8/4.2 and PVI-5000/6000

This installation instruction provides the method to use Aurora Manager TL software to reprogram inverters to reconnection times in response to an AC grid fail event.

Equipment and software needed

- PVI-3.0/3.6/3.8/4.2/5000/6000 product manual, for reference as needed.
- >100Vdc available to the inverter, from PV array or external 100Vdc power supply.
- PC with Aurora Manager TL software, version 3.23 or newer, and an available USB port (the "Installation and setup of Aurora Manager TL software and ABB/Power-One PVI-USB-RS232_485 adapter" installation instruction details the installation on a user's computer of Aurora Manager TL software and device drivers for the ABB/Power-One PVI-USB-RS232_485 adapter).
- USB-to-RS-485 adapter such as the ABB PVI-USB-RS232_485. (See the "Installation and setup of Aurora Manager TL software and ABB/Power-One PVI-USB-RS232_485 adapter" installation instruction if PC drivers need to be installed).
- The nominal RMS grid voltage (Vnom) (e.g., 240 Vac) must be known.

Warning

- Only trained, qualified individuals who understand the ABB/Power-One PVI-3.0/3.6/3.8/4.2/5000/6000 inverter box wiring and the location of hazardous voltages may undertake this task.
- The RS-485 connections required for this instruction are adjacent to the AC Grid connections. The inverter must be disconnected from the AC grid to safely connect and disconnect the RS-485 communications bus.

Applicable Inverters

This instruction applies to these ABB inverter models:

Mode	Firmware version
PVI-5000-OUTD-US-A	
PVI-6000-OUTD-US-A	
PVI-3.0-OUTD-x-US-A	C.0.4.1 or later
PVI-3.6-OUTD-x-US-A	
PVI-3.8-OUTD-x-US-A	
PVI-4.2-OUTD-x-US-A	

Where x = blank OR x = S (DC switch and wiring box); y = blank OR y = A (arc fault detector and interrupter)

Inverters with this firmware version noted above will have a date code of 13/2014 or later. The date code is located on the product label. The firmware version can also be verified by utilizing information displayed on the LCD panel on front of the inverter as follows:

1. Press ESC
2. Press UP/DOWN to navigate to the Info menu
3. Press ENTER
4. Press UP/DOWN to navigate to the Firmware
5. Press ENTER

Verify that the inverter's firmware version displayed on the LCD screen complies with the version noted in the table above. If not, contact ABB solar inverter technical support to discuss inverter compliance options, which are to replace the inverter or have a field service engineer visit the site to upgrade the inverter; both options are at an additional cost.

Contact Information

For firmware upgrades or answers to other questions, contact ABB solar inverter technical support at 1-877-261-1374, 6 a.m. – 6 p.m. MST.

Notes

- This instruction applies primarily to an installed, operational inverter.
- Reprogramming may also be done on an uninstalled inverter (e.g., in a warehouse). See steps a-f within Step 1 that follow.

Step 1 - Turn OFF inverter

Turn the inverter's DC disconnect switch OFF, as shown in Figure 2. This removes DC array power from the inverter chassis.



Figure 2 - DC disconnect switch

If the inverter is NOT installed, remove the inverter from its box and make it readily accessible, such as placing it on a bench top, and follow steps a-f below.

- a. Remove the switch box cover.
- b. Connect a 100Vdc (1A is sufficient), isolated source to either one of the MPPT inputs (see Figure 3).
- c. Bring the power supply wiring through one of the open knockouts on the DC side.
- d. Replace and secure the switch box cover.
- e. Confirm the DC switch is operable.
- f. Confirm the DC switch is still OFF.

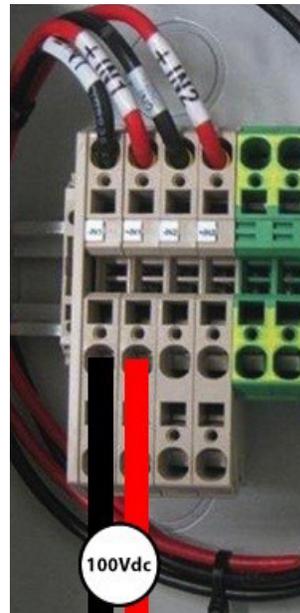


Figure 3 - 100Vdc inputs to an uninstalled inverter

After steps a-f directly above have been completed, continue with the remaining steps 2-11 for an installed inverter that follow.

Step 2 - Remove AC grid

- Open (turn OFF) the external downstream AC disconnect switch or grid connect circuit breaker. This step removes AC grid power within the inverter chassis.
- Open the inverter switch box cover.
- Using a multimeter, measure the voltage between all three terminals to ensure that it is de-energized.
- After confirming that the AC grid connection is de-energized, remove the AC wires from terminals 1, 2 and 3 as shown in Figure 4 below.
- Secure the exposed wires using wire nuts as shown in Figure 5 below.
- Close the switch box cover and keep the DC disconnect switch in the OFF position.



Figure 4 Remove AC wires from terminals 1, 2 and 3



Figure 5 Secure the exposed wires using wire nuts

Step 3 - Open inverter to access RS-485 terminals

- Remove the inverter chassis cover. Leave the switch box cover in place.

Step 4 - Make RS-485 connections

- Locate the RS-485 terminal block to the right of the grid voltage terminal block. It is marked “RS485” (white square box, Figure 6).
 - Temporarily disconnect any existing RS-485 from a system data logger at the RS-485 terminal block.
- (If the system has multiple inverters where the RS485 bus wiring is daisy-chained, leave the daisy-chain wiring in place. It can be used to access other inverters on the same bus.)

Connect the three-wire cable from the RS-485 adapter to the inverter RS-485 terminal block.

- Confirm those three wires are connected to the correct terminal.
- Ensure the terminator resistor is in the ON position (show below in the white ovals of Figure 6 and Figure 7). The switch could be in various locations or colors, depending upon model.

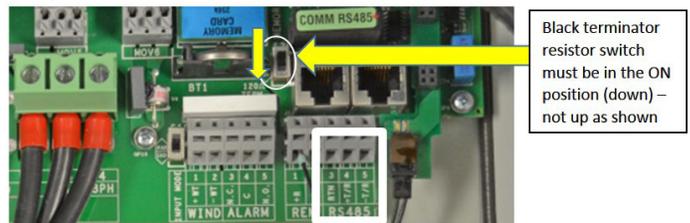


Figure 6 RS-485 connection locations inside the inverter box

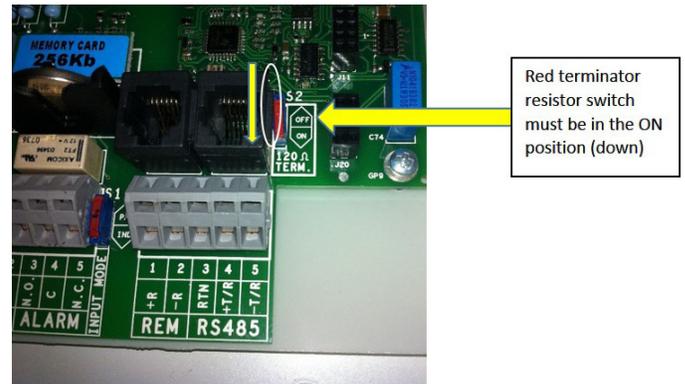


Figure 7 RS-485 connection locations inside the inverter box

Step 5 - Turn ON inverter

- Close (turn ON) the external downstream AC disconnect switch or grid connect circuit breaker to power the rapid shutdown power supply without connecting the inverter outputs to the AC grid, thereby enabling various configuration controls on the inverter.
- Turn ON the DC voltage using the switch on the front of the inverter switch box, as shown in Figure 8 below.

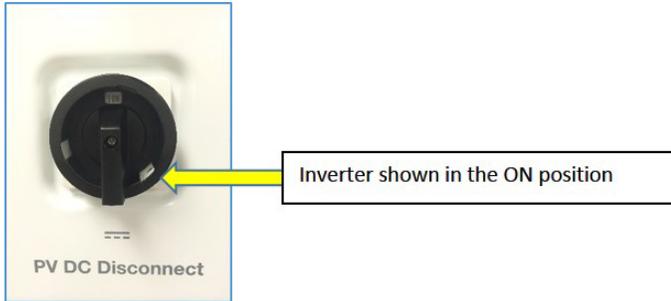


Figure 8 DC disconnect switch

- This will supply DC voltage from the PV array (or external 100Vdc supply) and power the inverter control system.
- Confirm the voltage is at least 100Vdc. If voltage is less than 100Vdc, the unit will not start.

Step 6 - Open Aurora Manager TL interface on PC

- Open Aurora Manager TL (version 3.23 or newer).
- Be sure the COM port address entered in the software matches where the USB cable of the RS-485 adapter is plugged in; otherwise, the software will not operate. Refer to steps 16-21 of the “Installation and setup of Aurora Manager TL software and ABB/Power-One PVI-USB-RS232_485 adapter” instruction for further details, if necessary.

Step 7 - Connect Aurora Manager TL to inverter

- In the Select Mode screen of the software, enter the RS-485 address of the target inverter into the Single Inverter address field as shown in Figure 9 below.

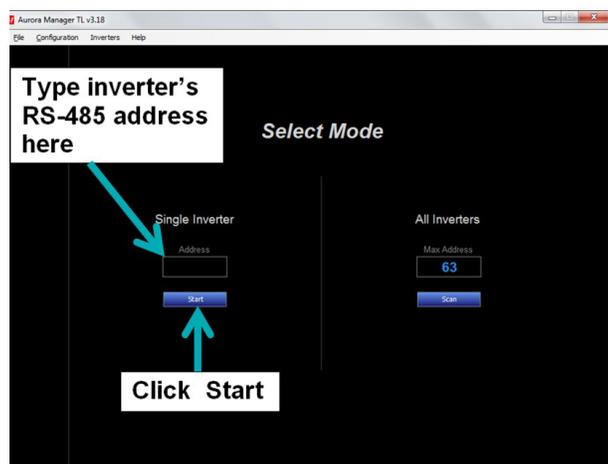


Figure 9 “Start” screen where inverter RS-485 address is entered

Note: The factory default RS485 address of all inverters is “2”. If this has been changed (which is necessary for multiple inverter installations), enter the correct RS-485 address (see NOTE below if it is unknown).

- Click START.

NOTE: IF the address for an inverter in a multiple-inverter system is unknown:

- Click “Scan” under the “All Inverters” field. This will produce a listing of all inverters on the RS-485 bus. See Figure 10 below.
- Wait for the scan to complete.
- Choose the inverter desired from the list, and continue with the next step.

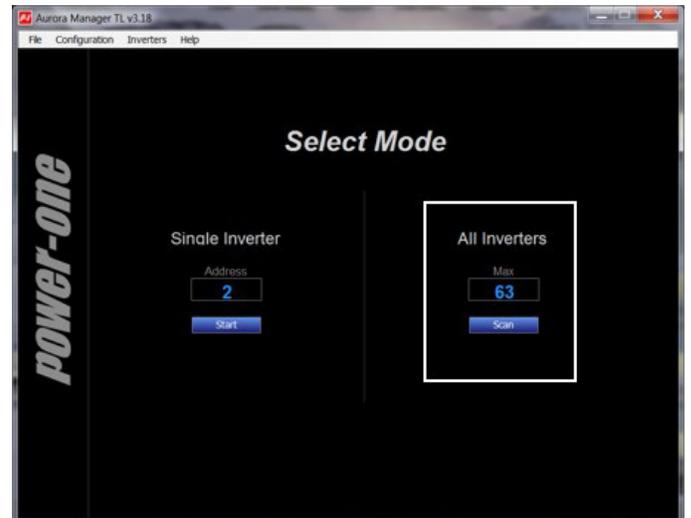


Figure 10 Click “scan” if the address for an inverter in a multiple-inverter system is unknown

Step 8 - Configure reconnection delay

Reprogram the “Conn. after no grid fault” parameter:

- In the “Conn. after no grid fault” field (see Figure 11 and Figure 12 below), enter 300 seconds or a value specified by the local utility.
- Click WRITE (lower right-hand corner of screen). This saves the value to the inverter memory.

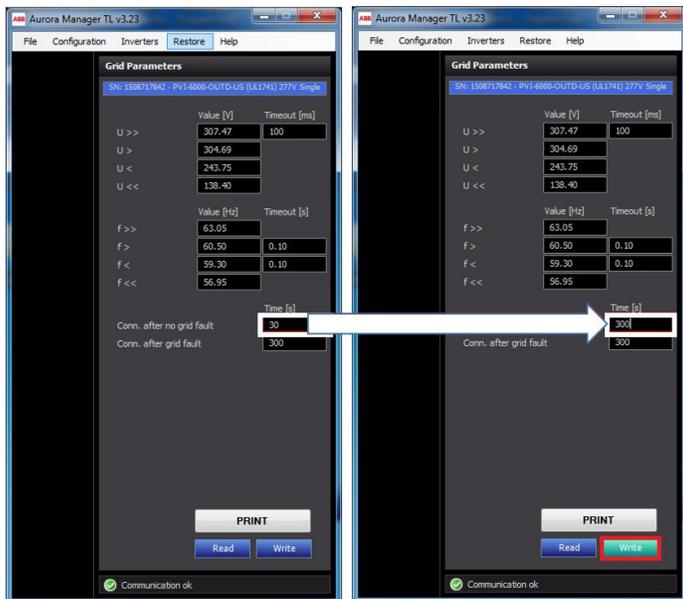


Figure 11 Before modification

Figure 12 After modification

The color of the WRITE button changes when any field has been changed. After clicking on WRITE, the button will change back to the default color. The values that have been programmed into the inverter can be read back by clicking on the READ button.

Step 9 - Prepare inverter for normal operation

- After the programming has been completed, turn the inverter DC disconnect switch to the OFF position.
- Open (turn OFF) the downstream AC disconnect switch or grid connect breaker.
- Open the switch box cover and measure the voltage across all three terminals to ensure that they are de-energized.
- After confirming that all terminals are de-energized, remove the wire nuts attached to the inverter output AC wires.
- Connect the wire labeled ‘1’ to terminal 1, wire labeled ‘2’ to terminal 2 and wire labeled ‘3’ to terminal 3, as shown in Figure 13.



Figure 13 Wires labeled 1, 2 and 3 reconnected to terminals 1, 2 and 3

CAUTION: Verify the correct wiring connections before proceeding to the next step. Incorrect wiring connections may damage the equipment.

- Close the switch box cover and keep the DC disconnect switch in the OFF position.
- Close (turn ON) the downstream AC disconnect switch or grid connect breaker.
- Turn the DC disconnect switch to the ON position and observe the inverter LCD screen. If all the connections are correctly made and with sufficient light available on the PV modules, the inverter will power up within a few seconds and connect to the AC grid after a 300 second countdown.

Step 10 - Simulate grid failure

Simulate a grid failure and wait for the inverter to turn completely off. This can be verified by observing the LCD screen -- when the screen goes completely blank, the inverter is off.

Step 11 - Test reconnection time

Turn on the AC grid voltage to the inverter. On the LCD panel, verify the correct time displays for the inverter to reconnect to the AC grid that was previously set in step 8 of this instruction.

For more information please contact:

www.abb.com/solarinverters

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