

Application Note – SolarEdge TerraMax™ Inverter Isolation Fault Troubleshooting

Version History

- Version 1.2, April 2024 – Product name change to SolarEdge TerraMax Inverter
- Version 1.1, September 2023 – Updated SetApp screens and options
- Version 1, September 2019 – first version

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Introduction

In photovoltaic systems with a transformer-less inverter, the DC is isolated from the Ground. Modules with defective module isolation, unshielded wires, defective power optimizers, or an inverter internal fault can cause DC current leakage to the Ground (PE - protective earth). Such a fault is also called an isolation fault.

This document describes how to identify and locate an isolation fault in a SolarEdge system.



WARNING

This guide is intended to aid in troubleshooting a SolarEdge installation that has a ground fault. Persons using this guide should be completely familiar with SolarEdge systems, their concept of operation, safety features, and all applicable safety procedures and requirements. Do not attempt any troubleshooting without adequate safety equipment and a thorough understanding of all procedures.



WARNING

Troubleshooting of PV systems may involve exposure to hazardous voltage levels and should be conducted by qualified personnel only. The presence of ground faults in PV systems may result in hazardous voltages or currents on normally grounded conductors or exposed metal elements. Extreme caution must be used when troubleshooting PV systems with ground faults.

Identifying an Isolation Fault

Each time that the SolarEdge TerraMax Inverter enters operational mode and begins producing power, the resistance between the ground and the DC current-carrying conductors is checked. The inverter displays an isolation error when it detects a total combined isolation resistance of less than 50 k Ω .



NOTE

You can identify an isolation fault using SetApp.

An isolation fault may disappear and recur after a short period (especially if it is caused by morning moisture), therefore it is recommended to troubleshoot the fault as soon as it occurs before it temporarily disappears. Before troubleshooting on-site, you may check the isolation value in the SolarEdge Monitoring Platform. If the isolation value is borderline (within 10%) or below the limit (50 k Ω), proceed to troubleshoot the fault on site. If the value is at least 10% higher than the limit, it is better to wait until an isolation fault error recurs.

→ **To check the isolation value in the SolarEdge Monitoring Platform:**

1. In the Layout window right-click on the inverter and select **Choose Operations** → **Reset**.
2. In the Layout window, right-click on the inverter and select **Info** to display information on the inverter.
3. In the **General** parameter list, check the **Last Isolation Value**.

Details for Inverter 1

System data | Current Operations | Errors

Last Measurement: 08/31/2014 14:03 Refresh

General

Parameter	Value
I RCD [mA]	0.01
Inverter Mode	MPPT
Last Isolation Value [KOhm]	6,000
P AC [W]	2,235

Figure 1: System Data Tab in the Details Window

Identifying an Isolation Fault Using SetApp

If an isolation error occurs, error 33x58 is displayed in the banner at the top of the screen, in the SetApp Status screen, and by selecting **Information** → **Error Log**.

→ To access the SetApp status screen and view error details:

1. From the Commissioning menu select **Status**. The inverter Status is displayed.

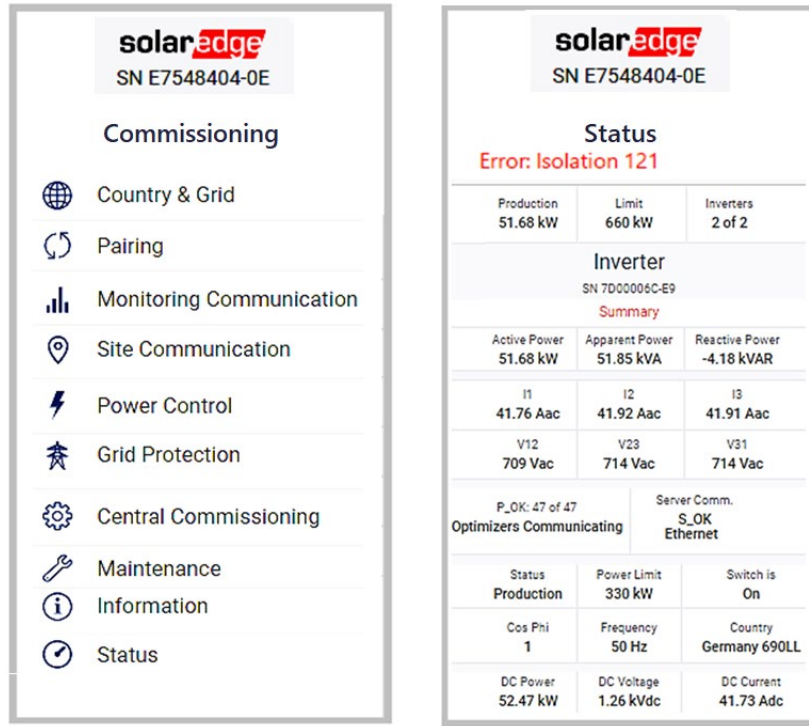


Figure 2: Isolation Data on the Status Page

Troubleshooting an Isolation Fault

The following sections describe how to identify the source of an isolation fault if Error 33x58 is displayed. You can troubleshoot the isolation fault using the following methods:

- Using the Inverter Diagnostics Screen in SetApp. Select **Maintenance** → **Diagnostics** → **Isolation Status**.
- Using an insulation tester (for example, a unit from Megger).

Checking the DC Voltage

During the troubleshooting process, strings and/or Power Optimizers will be disconnected.

1. Turn the inverter ON/OFF switch at the bottom of the inverter to OFF.
2. Make sure that the DC switch is ON.
3. Wait until the DC voltage is safe.
4. Remove the required string, Power Optimizer, or module.

Turn the inverter ON, and check that the Vdc level displayed in SetApp is +/-1250V.

solar edge		
SN E7548404-0E		
Status		
Error: Isolation 121		
Production	Limit	Inverters
51.68 kW	660 kW	2 of 2
Inverter		
SN 7D00006C-E9		
Summary		
Active Power	Apparent Power	Reactive Power
51.68 kW	51.85 kVA	-4.18 kVAR
I1	I2	I3
141.76 Aac	141.92 Aac	141.91 Aac
V12	V23	V31
1200 Vac	1250 Vac	1250 Vac
P_OK: 47 of 47	Server Comm.	
Optimizers Communicating	S_OK Ethernet	
Status	Power Limit	Switch is
Production	330 kW	On
Cos Phi	Frequency	Country
1	50 Hz	Germany 690LL
DC Power	DC Voltage	DC Current
52.47 kW	1.26 kVdc	41.73 Adc



Locating the Leaking String

1. If multiple strings are connected to the inverter, find the faulty string by connecting one string at a time to the inverter and checking if the error is still displayed (follow the procedure [Identifying an Isolation Fault Using SetApp](#)).
2. Verify that only the faulty string is connected to the inverter. If there is more than one faulty string, check each string separately.

Locating the Leakage within a String Using SetApp

1. Access the isolation status screen: From the Commissioning menu, select **Maintenance** → **Diagnostics** → **Isolation Status**.

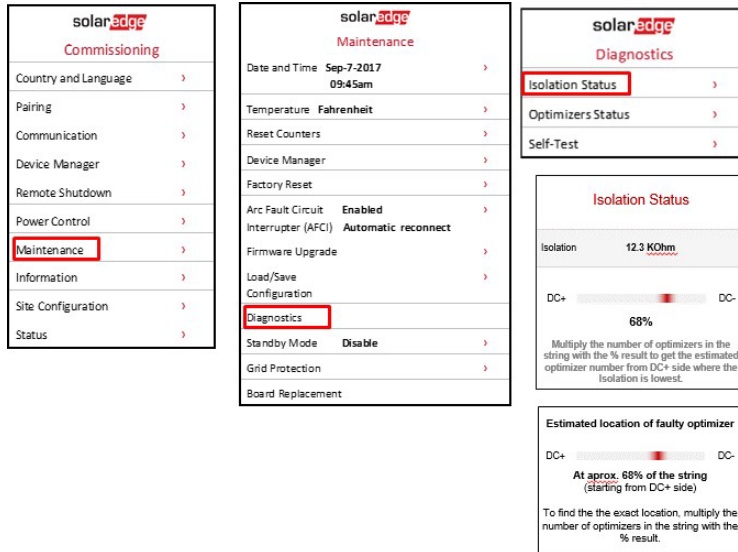


Figure 3: Isolation Status Diagnostics

2. The value of the isolation resistance (in kOhm) indicates whether the fault is at DC+ or DC-

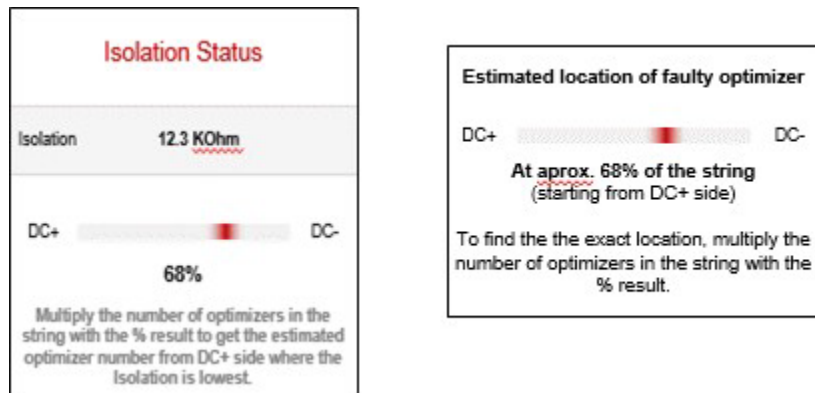


Figure 4: Viewing the Isolation Resistance Value

- 0% indicates the fault is at DC+
- 100% indicates the fault is at DC-
- Using the screen, identify the fault source area: Multiply the number of Power Optimizers in the string by the percentage value. The result is the module near which the fault occurred. For example, in a string with 15 modules, 36 Power Optimizers and a percentage value of 55%: $36 \times 55\% = 19.8$. This means that the fault is near Power Optimizer #19, counted from the DC+ side.

Using an Insulation Tester

Using an insulation tester and a connector branch cable, you can check the resistance of system components, drilling down from string level, through Power-Optimizer/module pairs, and finally a single component – a Power Optimizer or a module. also, check the wiring between components.

→ To check the resistance of components using an insulation tester and a connector branch cable:

1. Turn OFF the inverter ON/OFF switch and wait until the DC voltage is safe (<50V). Check the DC voltage using one of the following methods:

- Using SetApp, check the inverter's **Status** page.
- Using an external voltmeter.



WARNING

If SetApp or an external voltmeter is unavailable, wait five minutes for the input capacitors of the inverter to discharge.

2. Disconnect all the DC cables connecting the strings to the inverter or the Safety Switch.
3. Test the resistance of the extension DC cables between the strings (or the combiner box) and the inverter (home-run cables): Disconnect the home runs at both ends and measure each wire by connecting it to the positive probe, while the negative probe remains connected to the ground.
4. If the wiring resistance on the string level is less than 5 MΩ, the wire is faulty; replace any faulty wires. If the wiring resistance is 5 MΩ or more, the fault is in the string that was connected to this extension cable; check the string (without the extension cable) as described in the following step.
5. Test the string resistance using the insulation tester (see Figure 5 below):
 - a. Verify safe string voltage: max. 50V
 - b. Connect the positive and negative connectors of the first or last optimizer in the string to the branch cable.
 - c. Connect the positive probe of the insulation tester to the branch cable.
 - d. Connect the negative probe of the insulation tester to a ground point.
 - e. Select 1000V to 1500V testing on the insulation tester.



NOTE

Up to 1500V testing is supported when using H-Series optimizers.

6. Test the insulation. If the resistance is less than $1\text{M}\Omega$, continue checking this string's components to isolate the source of leakage, as detailed in the following steps. Always make sure to connect both negative and positive output connectors to the tester using a branch cable.

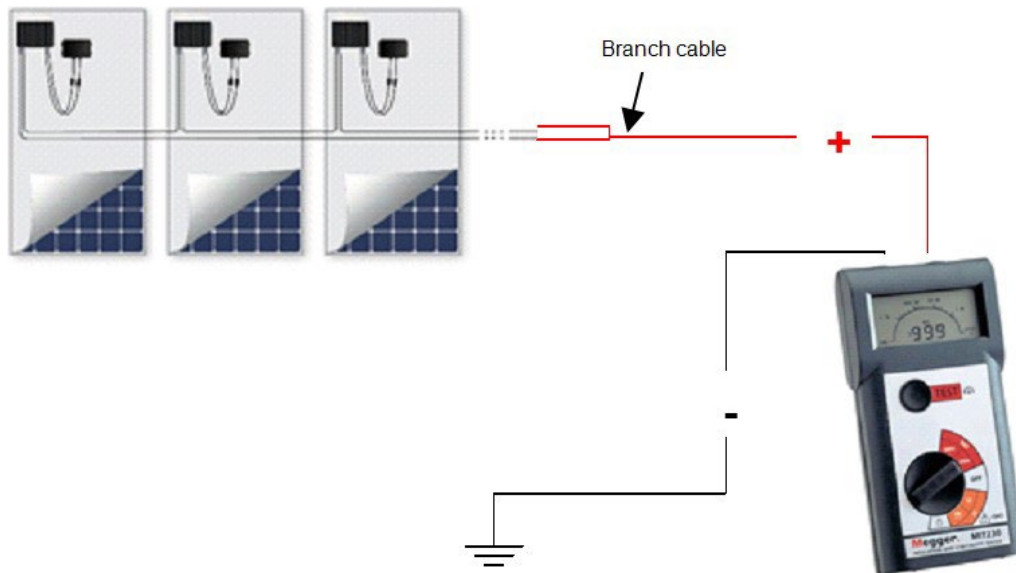


Figure 5: Connecting the Insulation Tester to the PV String

7. Test the Power Optimizers' and modules' resistance using the insulation tester (see Figure 6 below):
 - a. Disconnect the Power Optimizer from the string; it should remain connected to the PV module.
 - b. Verify safe Power Optimizer voltage: max. 1V.
 - c. Connect the Power Optimizer's positive and negative output connectors to the branch cable.

**CAUTION!**

Connecting the insulation tester to just one of the Power Optimizer connectors or just one of the DC cables may cause irreversible damage to the Power Optimizer.

- d. Connect the positive probe of the insulation tester to the branch cable.
- e. Connect the negative probe of the insulation tester to a ground point.
- f. Select 1500V testing on the insulation tester.
- g. If the measured resistance is $200\text{M}\Omega$ or more, the Power Optimizer and module are not faulty. If the measured value is less than $200\text{M}\Omega$ - the optimizer, the module, or both are faulty. Continue checking as specified in the following steps.

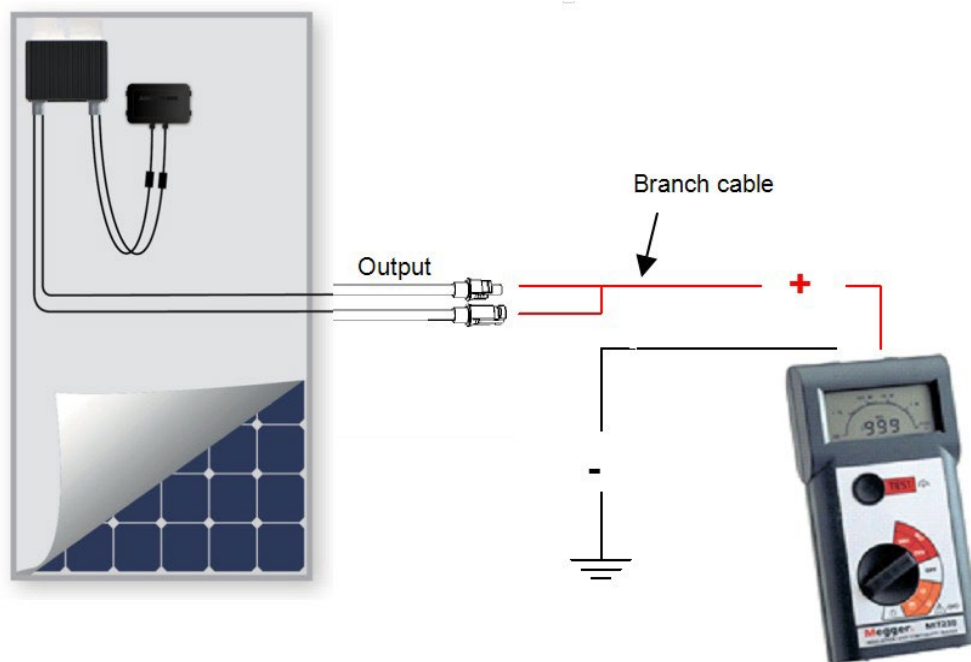


Figure 6: Connecting the Insulation Tester to the Power Optimizer and Module

8. Find whether the leakage is from the module or the Power Optimizer. Test each component individually by measuring the resistance between negative wires and ground:
 - a. Disconnect the module from the Power Optimizer.
 - b. Connect the Power Optimizer's positive and negative output connectors to the branch cable (see Figure 7 below).
 - c. Connect the positive probe of the insulation tester to the branch cable.
 - d. Connect the negative probe of the insulation tester to the Power Optimizer frame (ground point).
 - e. Select 1000V to 1500V testing on the insulation tester.

**NOTE**

1000V to 1500V testing is supported when using H-Series optimizers.

- f. Measure the resistance; if the value is $200\text{M}\Omega$ or more – the module is faulty; if the value is less than $200\text{M}\Omega$, replace the optimizer and test the module in case it is faulty as well.

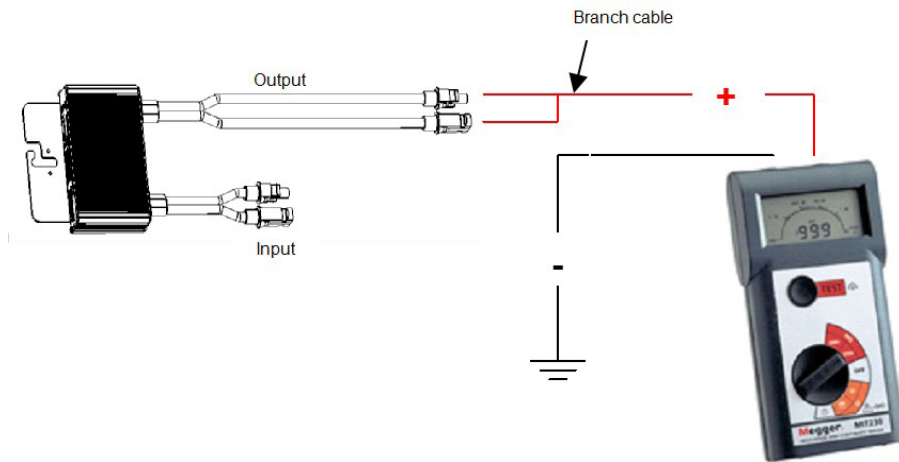


Figure 7: Connecting the Insulation Tester to the Power Optimizer

- g. Disconnect the branch cable from the Power Optimizer and connect it to the module using one of the connection schemes shown below (see Figure 8 below).



NOTE

Do not use the branch connector to perform measurements on a single module without an optimizer. The + and - of a single module should be measured separately.

- h. Measure the resistance; if the value is greater than $40 \text{ M}\Omega \cdot \text{m}^2$ or more – the module is OK; if the value is less than $40 \text{ M}\Omega \cdot \text{m}^2$, the module is faulty. The typical value is $80 \text{ M}\Omega$ for each panel.

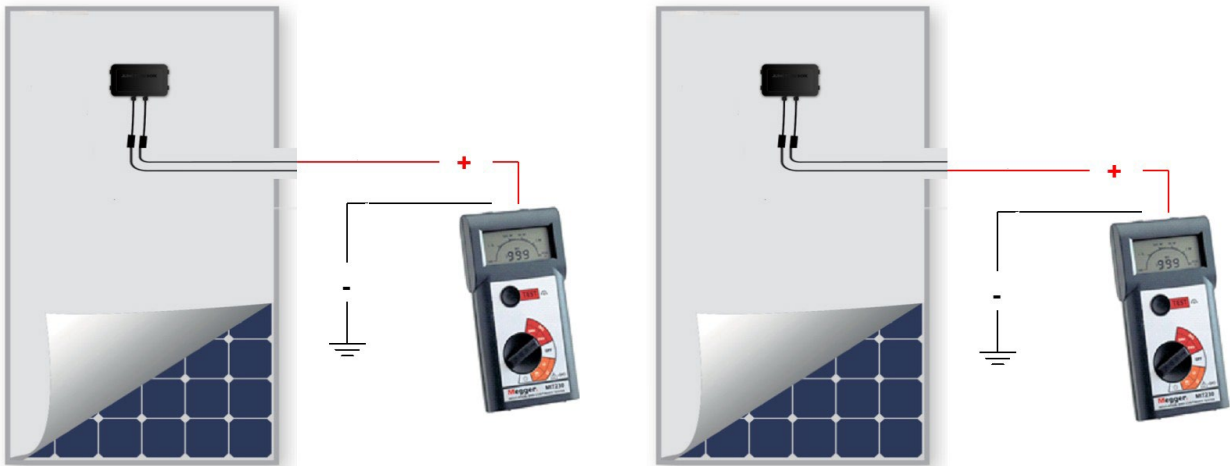


Figure 8: Connecting the Insulation Tester to the Module



NOTE

If you replace Power Optimizers, repeat the pairing process. For further information refer to the Inverter Installation Guide.

Safety Symbols Information

The following safety symbols are used in this document. Familiarize yourself with the symbols and their meaning before installing or operating the system.



WARNING

Denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in **injury or loss of life**. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.



CAUTION!

Denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in **damage or destruction of the product**. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.



NOTE

Denotes additional information about the current subject.



IMPORTANT SAFETY FEATURE

Denotes information about safety issues.

Disposal requirements under the Waste Electrical and Electronic Equipment (WEEE) regulations:



NOTE

Discard this product according to local regulations or send it back to SolarEdge.

Support Contact Information

If you are having technical problems concerning SolarEdge products, please contact us:



<https://www.solaredge.com/service/support>

Before contacting SolarEdge, make sure to have the following information at hand:

- The model and serial number of the product in question.
- The error indicated on the LEDs, the SetApp mobile application, the LCD screen, or on the monitoring platform, if there is such an indication.
- System configuration information, including the type and number of modules connected and the number and length of strings.
- The method of communications with the SolarEdge server, if the site is connected.
- The product's software version as it appears in the ID status screen.