

SEIA Conference 2025 PV array isolation faults & Tools for communication problem troubleshooting

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PV Array Earth Faults

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Tools for Communication Problems

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Inverter Safety Tests

- IEC 62109-1 & 2 contain insulation resistance tests
- Requirements for "non Isolated" inverters (transformerless)
 Array ground insulation resistance measurement

Before starting operation, per 4.8.2.1 or 4.8.2.2

Action on fault: indicate a fault in accordance with 13.9, and do not connect to the mains Array residual current detection

Either a) 30 mA RCDc between the inverter and the mains per 4.8.3.4, or b) monitoring for both continuous excessive residual current per 4.8.3.5.1 a) and excessive sudden changes per 4.8.3.5.1 b)

Action on fault: shut down the inverter, disconnect from the mains, and indicate a fault in accordance with 13.9



Inverter Safety Tests

Requirement summary:

- For "non-isolated" inverters, if the insulation resistance is less than $R = (V_{MAX PV}/30 \text{ mA})$ ohms, the inverter shall not connect to the grid and indicate a fault.
- For sudden changes in leakage currents the inverter needs to disconnect within these times

Residual current sudden change	Max time to inverter disconnection
30 mA	0,3 s
60 mA	0,15 s
150 mA	ි. දී 0,04 s

Table 31 – Response time limits for sudden changes in residual current

*These tests and measurements are OK for permanent earth faults BUT will have trouble detecting "intermittent" earth faults!

Typical Earth Fault Causes

(Intermittent Types)

Pinched or squashed cable



Knicked or sliced insulation



Typical Earth Fault Causes

(Intermittent Types)

Damaged or corroded MC4s



Damaged cable cable



Transformerless Inverters



Transformerless Inverters



e.g. 500kVA Transformer (6 – 10KA fault current)

The fault itself..?

What causes the "intermittency"?

Wind – causing the cable to physically move around to then touch a surface

Moisture – lowering the resistance of an unintentional connection

Rain – creating a bridge for a low impedance connection

Heat - cable or metal expanding to then create a connection.

Vibration – similar to wind can cause cable to move to a position of contact

*Impedance / resistance of the fault will determine what damage happens

Finding the fault...

- Start with passive Megger testing, however this will likely <u>not</u> show or find the fault
- Do a thorough visual & mechanical check of all cabling.
- Most faults are on fly leads, most are conduction against the railing, so look for cables that are touching railing or metal parts
- Use 2nd person with Megger tester at inverter while hosing down the PV array and all cabling

If a hard (low impedance) earth fault is has occurred usually the AC breaker will have tripped

..... intermittent earth faults are dogs to find..! \otimes





Tools for communication problem troubleshooting

(IP Networks)



Basic IP Networks Terms

Router/Modem

Often people use the two words interchangeably, however they are not the same thing. A modem brings internet service into the home from internet service providers (ISPs), while a router delivers that internet connection to the devices in your home, allowing them to connect wirelessly via Wi-Fi or through Ethernet cables.

IP Address

An Internet Protocol (IP) address is the unique identifying number assigned to every device connected to the internet. An IP address definition is a numeric label assigned to devices that use the internet to communicate.

Firewall

A network security device / function that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules

ISP

Internet Service Provider. The company that is providing the internet connection to customer

"Connection...?"

<u>What is really meant by the word "connected" or "online / offline"... ?</u>

Local Network connection:

- Connection only to the local network
- Has an IP address been assigned?
- Can the device been seen on the local network?

Cloud connection:

- Device communication to the cloud server
- First requires a network connection
- Firewall, Gateway, DNS settings can affect this connection

Basically 2 connections to consider





Hardware Tools

Laptop



Long LAN Cable



Cable Tester



Chargers



Phone

(with Hotspot)



Software Tools

TeamViewer (Free Support tool)



IP Scanner App





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Command Prompt (search "cmd")



Tips & Tricks

Wi-Fi

- Signal Strength
- Any special Characters in the PASSWORD?
- Is Band Steering in use?
- Can LAN be used?

Local Network

- Use IP Tester App
- Has an IP Address been assigned?
- Can ping the Router?
- Can you ping the Inverter?

Cloud / Internet

- Are there Firewalls?
- Does it connect using a phone hotspot?
- Does your laptop / phone allow you to get to google.com?
- Run Speed test



Thanks for listening

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