

*This bulletin describes the process for testing individual PV strings to ensure their correct operation. The information provided applies to every individual string installed in a PV system and should be distributed to the Quality Engineer, Quality Inspector, Electrical Installer, and/or any other personnel responsible for inspecting and ensuring quality of the solar installation.*

## Safety Note

Performing electrical tests on PV equipment exposes testing personnel to risk of electric shock causing serious injury. Personal protective equipment shall be worn at all times and, at a minimum, shall include: insulating rubber gloves with leather protectors, safety glasses, work boots and hard hat. This testing should not be carried out in a dangerous or explosive atmosphere since the instrument could generate arcing in damaged installation.

## Preparation

The following is a list of typical tools, supplies, equipment, and documents needed to perform the tests. Other items may be needed based on equipment requirements.

Testing and measuring equipment

- Digital multi-meter (Seaward PV100 or similar)
- Insulation Tester / Megohm-meter (i.e. Fluke 1587 or similar)
- I-V Curve tracer (i.e. Solmetric PVA-600 PV Analyzer) [optional]

## Tools

- Screwdrivers, wrenches, sockets as appropriate and applicable to perform the work

## Documentation

- Most recent drawings.
- PV String Testing Checklist/Form.
- Appropriate manuals and guides for the installed equipment and testing and measuring equipment.

## Process for Checking PV String

1. PV string testing is performed at the combiner box.
2. Prior to performing any PV string tests, be sure that the string homerun positive cable leads are connected to the fuse block terminals and all negative cable leads are connected to the negative terminal block. Torque per combiner box's installation instructions.
3. The inverters should be shut down and all fuses, switches, and circuit breakers should be removed or opened.
4. Remove all connected surge arrestors from the circuits, if applicable.
5. If connected, remove the grounded (negative) combiner output cable from its terminal block at the combiner box so there is no connection to the inverter.
6. Insulation Test:
  - a. Connect the negative lead of the Insulation Tester to the grounding connection in the combiner box.
  - b. Connect the positive lead of the Insulation Tester to the negative connection in the combiner box.
  - c. Apply 1000Vdc to the negative connection and wait for the insulation resistance to achieve at least  $1M\Omega$ .
  - d. If confirmed, document on the checklist that the insulation tests have passed this inspection.
  - e. If the resistance did not pass the criteria then remove all the negative cable leads and test each individually to see if there are variations in resistance. If one is low, then the location of damage needs to be found and remedied.

7. Open-Circuit Voltage Test:
  - a. Connect the negative lead of the Digital Multi-meter to the negative terminal block in the combiner box.
  - b. Connect the positive lead of the Digital Multi-meter to the fuse block terminal or the PV string positive where it enters the fuse block terminal.
  - c. Ensure correct polarity of the reading (should be positive).
  - d. Obtain and document on the checklist the open-circuit voltage for every string. String voltages should not vary more than 3% under the same weather conditions.
8. I-V Curve Tracer Test (optional):
  - a. Follow manufacturer's instructions for procedure and obtaining results.

## Applicable Documents

- PV String Testing Checklist/Form
- Combiner Box Installation Instructions
- Digital Multimeter instruction manual and/or guidelines
- Insulation Tester instruction manual and/or guidelines
- I-V Curve Tracer instruction manual and/or guidelines (optional)

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