Application note

How to find miswired or mislabeled strings in a solar PV combiner box or inverter

Learn how to use the MAP function on the Fluke GFL-1500 Solar Ground Fault Locator to match each negative conductor to its fuse without lifting a single conductor

By Will White, Fluke Senior Product Manager, Solar



Verifying string identity at the combiner is the step every downstream measurement depends on.

A fuse labeled “String 7” does not always connect to the string labeled negative 7. The MAP function on the Fluke GFL-1500 Solar Ground Fault Locator proves which negative conductor belongs to which fuse without lifting a single conductor. This replaces a long afternoon of troubleshooting trial and error with one check per string.

The problem: the label says one thing, the wire does another

Miswired and mislabeled strings are a common finding during commissioning and troubleshooting of solar arrays, and they usually trace back to installation. Conductors get pulled in bulk, landed out of sequence, and labeled from a plan rather than from the wire in hand. The result is a combiner box or inverter where the fuse marked “String 7” does not feed the wire labeled “String 7” on the negative busbar.

The wiring architecture makes the error hard to see. In most combiner boxes and inverters, the positive conductors are individually fused, but the negative conductors are landed in parallel on a common busbar. An open-circuit voltage measurement taken in that box reads the combined condition of everything tied to the negative busbar. It confirms that the negative end of the string is landed there, but not which wire is the correct one.

Until the two ends of a circuit are positively matched, every downstream activity rests on an assumption. Troubleshooting chases a module or voltage problem that is really a labeling problem, and a repair crew ends up at the wrong row.

The old process: pulling negative conductors one at a time

Without a way to inject and trace a signal, the circuit needs to be taken apart to prove which negative belongs to each positive. Consider the steps:

1. Open the combiner or inverter disconnect and verify there is no current flowing through any circuits.
2. Open all of the positive fuses.
3. Lift one negative conductor off the busbar at a time.
4. Test that isolated negative against a known positive to see whether it is the string you are looking for.
5. If it doesn’t match, reland it, move it to the next conductor, and repeat.

On a box with twenty or thirty strings, this takes a long afternoon, and the odds are not in the technician’s favor as the conductor you want is rarely one of the first few you pull. The cost is not only time. Every additional termination lifted and relanded is another chance for a loose connection, a damaged conductor, or a torque error, and every additional minute inside an energized enclosure raises the electrical hazard exposure. It is a brute-force routine that produces the right answer slowly and introduces new risks along the way.

How do you map a string with the GFL-1500?

The MAP function on the GFL-1500 replaces disassembly with a traceable signal. Instead of taking the circuit apart to find where it goes, you transmit a signal on one circuit that the receiver or signal-tracing clamp can follow, and the string identifies itself.

1. Open the combiner or inverter disconnect. Verify there is no current flowing through any circuits.
2. Apply the red test lead with an alligator clamp from the GFL-1500 transmitter to the positive busbar and the black test lead with an alligator clamp to the negative busbar.
3. Open every positive fuse except for the one string under test, so the trace signal will only flow through that string.
4. Set the GFL-1500 FUNCTION dial to MAP, then press TRACE.
5. Identify the negative conductor carrying the signal using the receiver in PINPOINT mode or the signal tracing clamp.

The signal travels through the one closed fuse, down the string through the modules, and returns on that string's negative conductor. The negative conductor carrying the signal is where the string actually terminates. If that label does not match the label on the fuse, the string is miswired, and you have confirmed it without lifting a single conductor.

Because MAP will send a signal through any complete circuit connected between the positive and negative terminals of the transmitter, isolating a single string with the fuses is what makes the result unambiguous. One fuse in, one answer out. Simple as that.

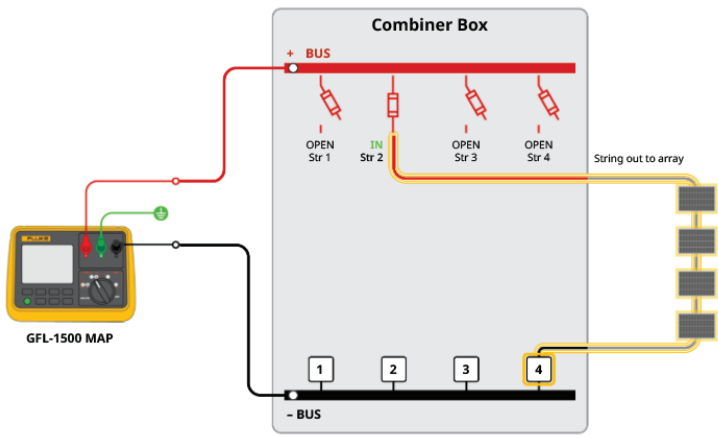

Figure 1. With only the String 2 fuse closed, the injected signal returns on the negative string labeled 4 - strings 2 and 4 were swapped. (Wiring for only the string being tested shown for clarity).

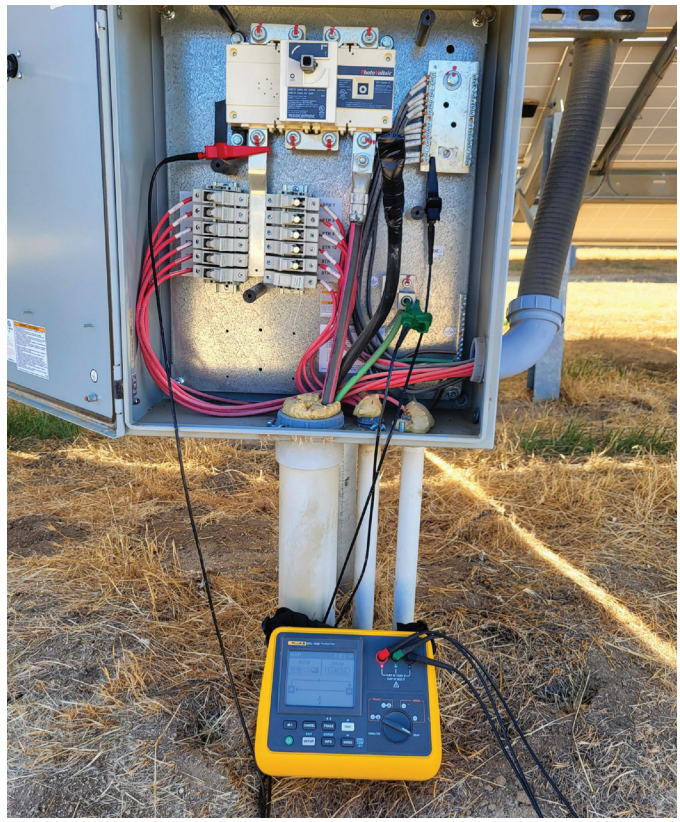

Figure 2. The GFL-1500 transmitter connected at a combiner with all fuses removed except the string under test.

Why it saves time

- **No disassembly.** The conductors stay landed and torqued.
- **Deterministic, not sequential.** The old method is a search whose length depends on luck. The GFL-1500 MAP function gives you the answer on the first string you test, and every test after that takes the same short, predictable amount of time.
- **Less time in the enclosure.** Fewer minutes with hands inside the box directly reduce arc flash and shock exposure, and fewer terminations disturbed means fewer new defects introduced.
- **Clean commissioning data.** Once the strings are correctly identified, test results, performance comparisons, and as-built documentation match what is installed.
- **Findings you can act on.** "The negative conductor labeled 4 is actually String 2" is a straightforward work order and repair. "Something in this box is wrong" can send a crew into hours of troubleshooting.

On a thirty-string combiner, this difference can add up to hours. String verification stops being a step you take only when something is wrong, and there is no time to troubleshoot and becomes one you complete as a matter of course.

About the author

Will White is a solar industry leader with two decades of hands-on experience spanning installation, sales, design, project management, and product strategy. Beginning as a solar installer in 2005, Will advanced to Director of Operations for the East Coast, overseeing large-scale projects and teams. At Solar Energy International, he modernized curriculum and taught solar professionals worldwide.

At Fluke, Will supported renewable energy testing solutions and now serves as Senior Product Manager – Solar, where he drives strategy, innovation, and business results for solar products. A NABCEP-certified PV Installation Professional since 2006, Will is dedicated to advancing high-quality, code-compliant solar practices. He holds a B.A. in Business Management from Columbia College Chicago and an MBA from the University of Nebraska–Lincoln.



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