Solar Panel Reuse : A Case Study by Reuse Alliance

Funded by The California Product Stewardship Council, Zero Waste Marin, and the Department of Energy Re-X Prize

In this guide we will show you how to connect a used solar panel to a portable power station. This is just one example of solar panel reuse, and the tips below can apply to many other applications.

Necessary Tools:

- Used Solar Panels
- Multimeter
- Soapy water and a rag
- A Portable Power Station with a built-in MPPT (consider buying used or renting)
- MC3 to MC4 set of connectors (optional)

Step One: Acquire Used Solar Panel(s)

The California Product Stewardship Council has a Solar Reuse Resource Map, which lists solar reuse resources including recyclers, thrifts, installers and more. Zero Waste Sonoma also has a list of resources for household hazardous waste, including solar panels. Local reuse stores like Recycle 1234 offer refurbished used panels, with guaranteed quality. Online resources for finding used panels include Fabtech, Rheaply, Craigslist, ebay and other online secondhand marketplaces. You can always reuse your own used panels too!

Step Two: Test the Panel(s)

To test a panel, you will need a multimeter and some sunlight (readings will vary depending on cloud cover, direction of the sun, etc).

1. *Clean The Solar Panel*

Before testing a solar panel, remove any dust or debris from its surface. Not doing so will result in a weak reading. Clean the panel using soapy water and a rag.

2. Check the Voltage and Current Ratings

Before testing your solar panel, you'll need to know its original ratings so that you can determine its current condition. On the back of the panel you should find a sticker containing several metrics (these stickers may have deteriorated, and be hard to read).

Pay special attention to the following:

- **open-circuit voltage (Voc)**
- **amperage (Imp)**.

NOTE: some panels may have different nomenclature for these metrics.

3. Set Your Multimeter to Volts

Configure your multimeter so that the **red,** positive lead is attached to the volt port (usually denoted as VΩmA or mAVΩ - see image 1 below), and the **black**, negative lead is attached to the COM port.

Set the multimeter to a voltage greater than the panel's Voc rating; this will produce the most accurate reading.

Finally, check that the multimeter is set to DC voltage - not AC. DC is generally denoted by a V with two parallel lines above it: one dotted, one solid. AC is depicted as a V with a squiggly line on top.

4. Connect Your Multimeter to the Solar Panel

Attach the multimeter to the solar panel. The positive lead (red wire) should be connected to the panel's positive terminal. Likewise, the negative lead (black wire) should be connected to the panel's negative terminal.

The panel's voltage will appear on the multimeter's screen. Write this down.

5. Set Your Multimeter to Amps

Transfer the positive lead from the volt port to the amps port, usually depicted with a capital A (see image 2 below). Like with voltage, set the current to any amount greater than the panel's Imp rating.

6. Reconnect Your Multimeter to the Solar Panel

Attach the multimeter to the solar panel. The positive lead (**red** wire) should be connected to the panel's positive terminal. Likewise, the negative lead (**black** wire) should be connected to the panel's negative terminal.

The panel's Current/Amps will appear on the multimeter's screen. Write this down.

7. Calculate Solar Panel Output

Power (Watts) = Voltage (Volts) X Current (Amps)

Multiply the voltage by the current using the amounts shown on your multimeter. The result is power, measured in watts. Watt-hours are, simply, Watts multiplied by Time: 100 Watts produced over 1 hour equals 100 Watt-hours, 100 Watts produced over 10 hours equals 1 kilowatt hour (kilo = 1000), etc.

Due to changes in cloud cover, angle of the sun, dirt on the solar panels, etc. the actual output of the solar panels will differ from the measurements you just took. So, make sure to account for that when sizing your system.

Step Three: Acquire Portable Power Station

If you don't have one yet, you will want to find a portable power station with a built-in MPPT (Maximum Power Point Tracking) controller. This device will ensure that everything works well together, and will extend the life/performance of your solar system.

If you already have a generator that doesn't have a built-in MPPT controller, you can buy an external one. Ensure that the one you get can handle the output of your solar panels per Step Two above.

Additionally, controllers can come with SAE, XT60, MC3 or MC4 connectors. Make sure all your connectors will work in sequence to convert from MC3 or MC4 to DC.

Explore solar controller options here:
https://blog.powerfilmsolar.com/solar-charge-controllers-what-they-are-why-you-need-one-and-which-is-best

Step Four: Connectors

MC3 vs. MC4

Type	Pin Size	Locking Mechanism	Age
MC3	3 mm	No	Discontinued in 2016
MC4	4 mm	Yes	Introduced in 2004

Explore MC4 connectors here: https://en.wikipedia.org/wiki/MC4_connector

Converting to MC4

Converting an MC3 to MC4 connector is not necessary, but it's pretty simple, requiring only basic tools. There are two ways to convert from MC3 to MC4:

1. Adapters: You can purchase an MC3 to MC4 set of connectors - one for each wire (see image 4 below). This is the easiest way; it'll cost more for the adapters, but save a bunch of time. The downside is that you will still have the older style of connector that doesn't latch together, and is a bit less waterproof.
2. Conversion: You can purchase MC4 connectors (by the pair, or in multiple sets) that are pretty low-cost. To make the change, you simply cut off the MC3 connectors, strip the wires, and install the new MC4 connectors following the manufacturer's instructions (see an example in image 5 below).

XT60, SAE and DC Inputs

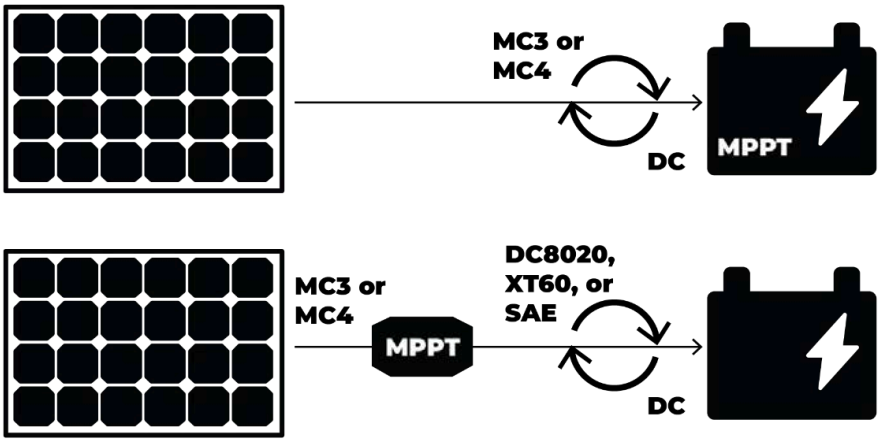
Most Solar Generators don't have MC4 (or MC3) inputs directly. The generator may come with an MC4 to DC Input adapter (see image 6 below), if not you can purchase one separately. If you have a controller, it could have SAE or XT60 connectors (see image 7 below).

Since every system can vary in design, it is important to follow the manufacturers specifications and utilize the appropriate/necessary equipment to have a safe and reliable setup.

The Jackery power station we used for this case study (see image 8 below) has a DC8020 input which required an MC4 to DC8020 adapter.

Step Five: Putting it all Together

There are two basic configurations depending on your portable generator:



NOTE: This case study is for connecting one solar panel to a portable power station. To connect more than one solar panel you would need to connect them in parallel (keeps the voltage the same, and doubles the Amps/current) which would require further adapters.

This video provides an overview.

That's it! Enjoy your new reused solar backup system!

IMAGES

Image 1 : Multimeter in VOLT Configuration:

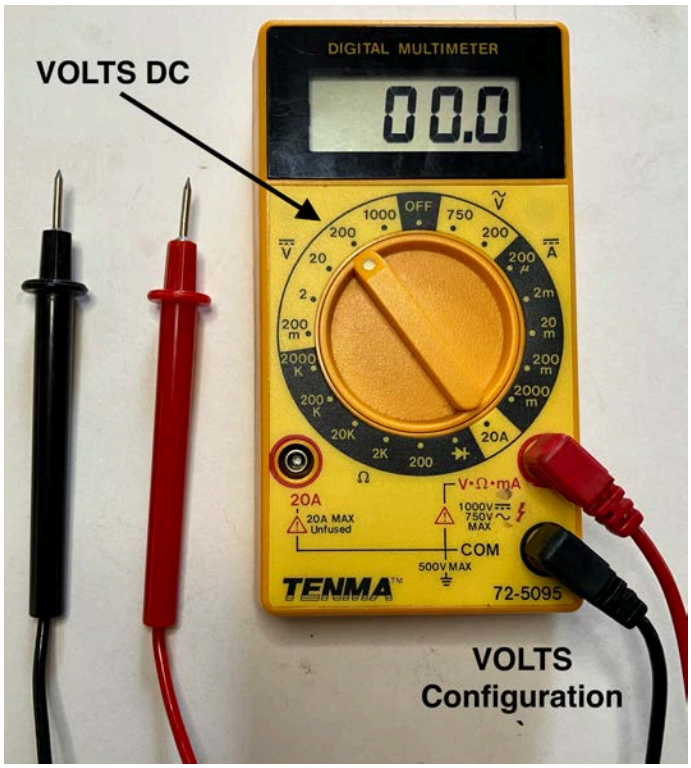


Image 2 : Multimeter in AMP Configuration:

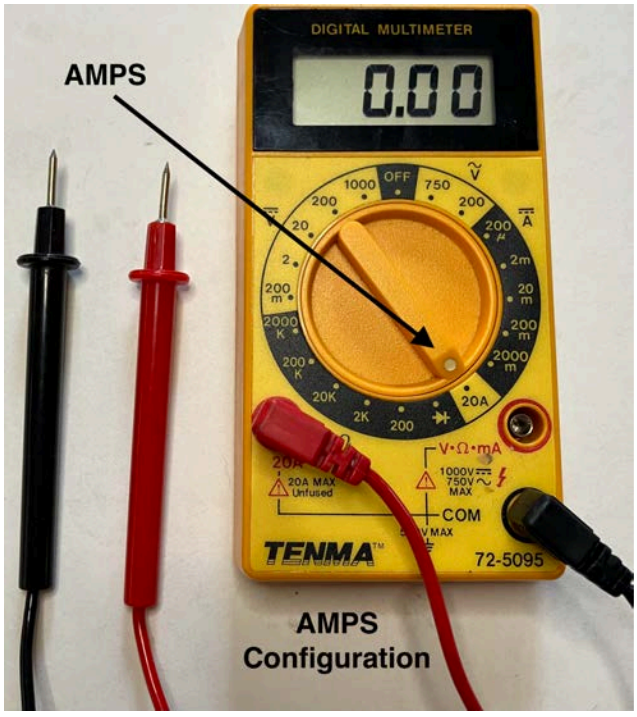


Image 3: MC3 vs MC4 Connectors:

Image 4 : MC3 to MC4 adapters:

Image 5: MC4 Connector Installation Example:

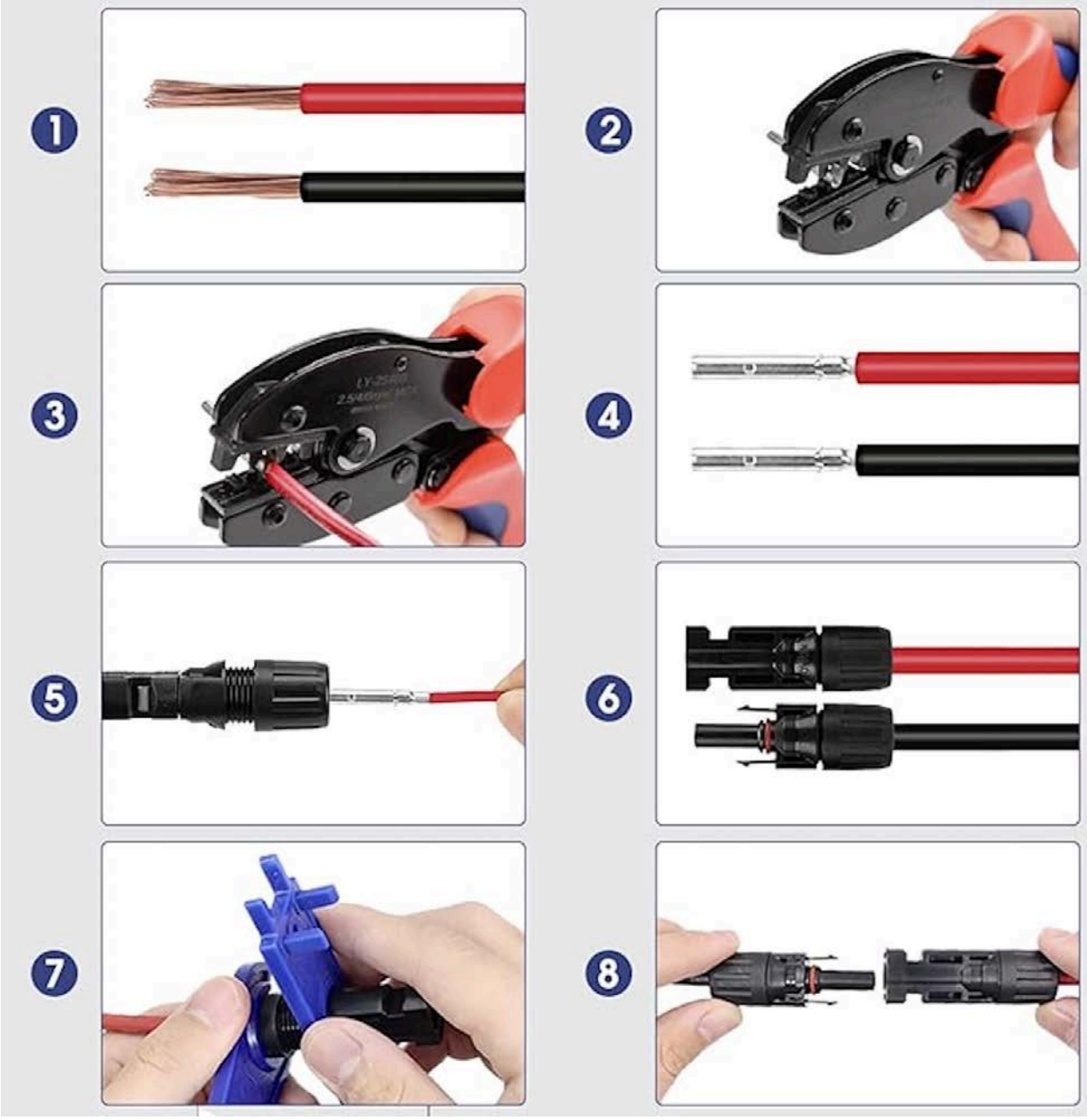


Image 6 : MC4 to DC Input Adaptor

Image 7 : Various connectors

Image 8 : Jackery power station connected to a used solar panel