<u>**Fixed Solar Panel Install on 2014 Forest River R-Pod 178**</u>

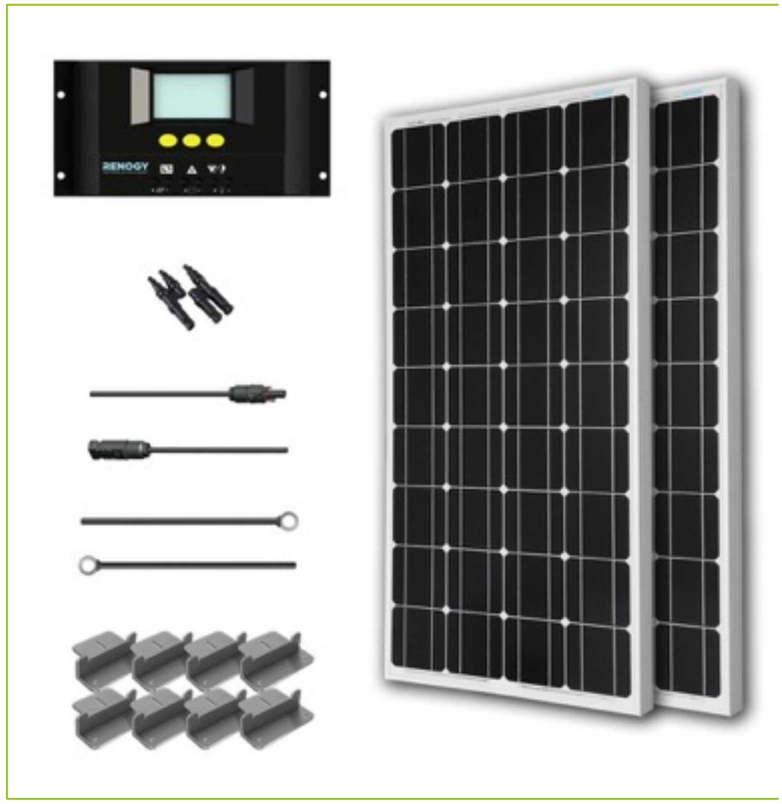
The following is a walkthrough of my installation of a fixed solar panel kit on my own R-Pod. You are welcome to use this information, at your discretion, in any non-commercial form to benefit yourself or others. I am not liable for damage/harm arising from your use of this information to attempt installation of your own. Please do extensive research for your own project. See the Appendix for further information.

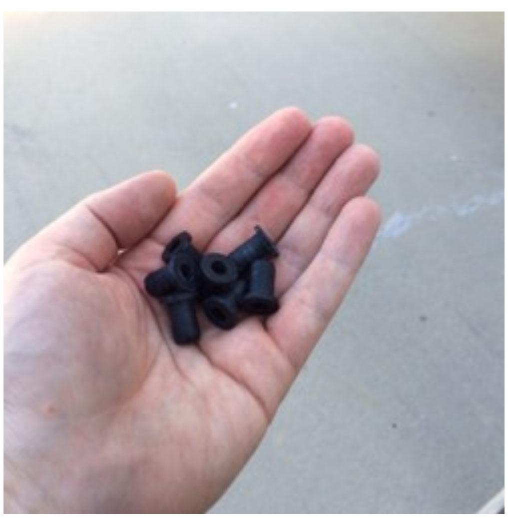
Supplies:

I purchased the following:

- Renogy 200W Solar Kit Bundle (Pictured), with PWM controller. (In hindsight I should have splurged on the MPPT controller, but in my research I had some bad information that they are not as effective in solar panels that move (i.e. on a trailer). Probably a future purchase for me))
- #10-32 tpi x 5/8 in. Brass Expansion Nut (Pictured below) (I bought 20, although I only needed 16. That worked out as I ended up destroying 2)
- Dicor Self-Leveling Lap Sealant
- Eternabond RSW-4-50 Roof Seal
- ATC Water-Resistant Fuse Holders and 30 Amps fuses.

All-in it was about a $450 install in August 2015.





Install:

Renogy has install documents of their own that can be referenced so I won't repeat them here, or cover the basics of installation. You should always look for the latest version that matches your install. I used:

http://renogy.com/wp-content/uploads/2014/04/off-grid-general-manual.pdf

With that said, I'll cover my specifics of installing on the Forest River R-pod 178.

First-off, I had to get my location set. Space is limited on the small trailer and I had done some measurement before I ordered the panels. I knew, going into it, that I'd be able to put one panel on the front that would likely have little shading and the second panel would go on the drivers side, near enough to the air conditioner that it would get some shading effect (depending on the north/south or east/west parking of the trailer).

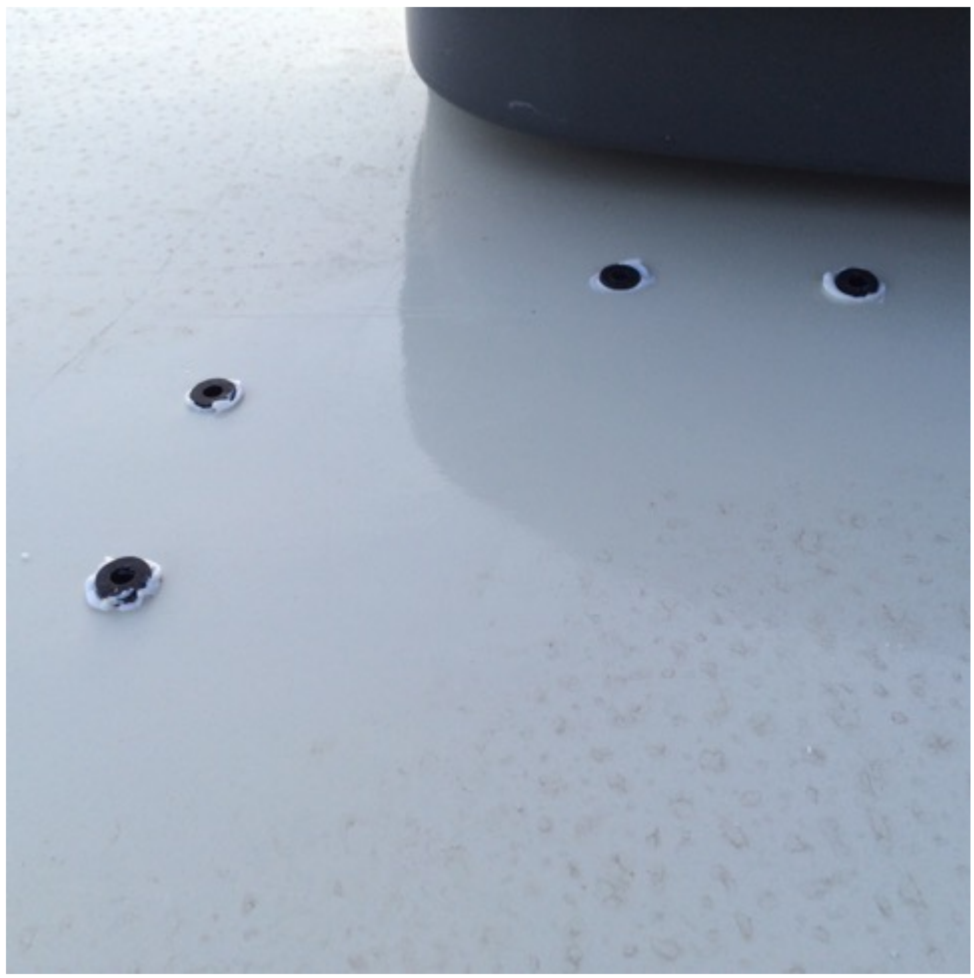
Controversy #1 - Shading: Inevitably I expect the placement of the panels to be the most controversial topic of the install, since one of the panels is guaranteed to get shading for a least half of the day (from the AC unit). Given that fact, I went with two 100-watt panels and chose to squeeze them onto the small roof.

The Ideal: Non-fixed solar panels that will, or can, move to track the sun. (i.e. Zamp Portable Solar)

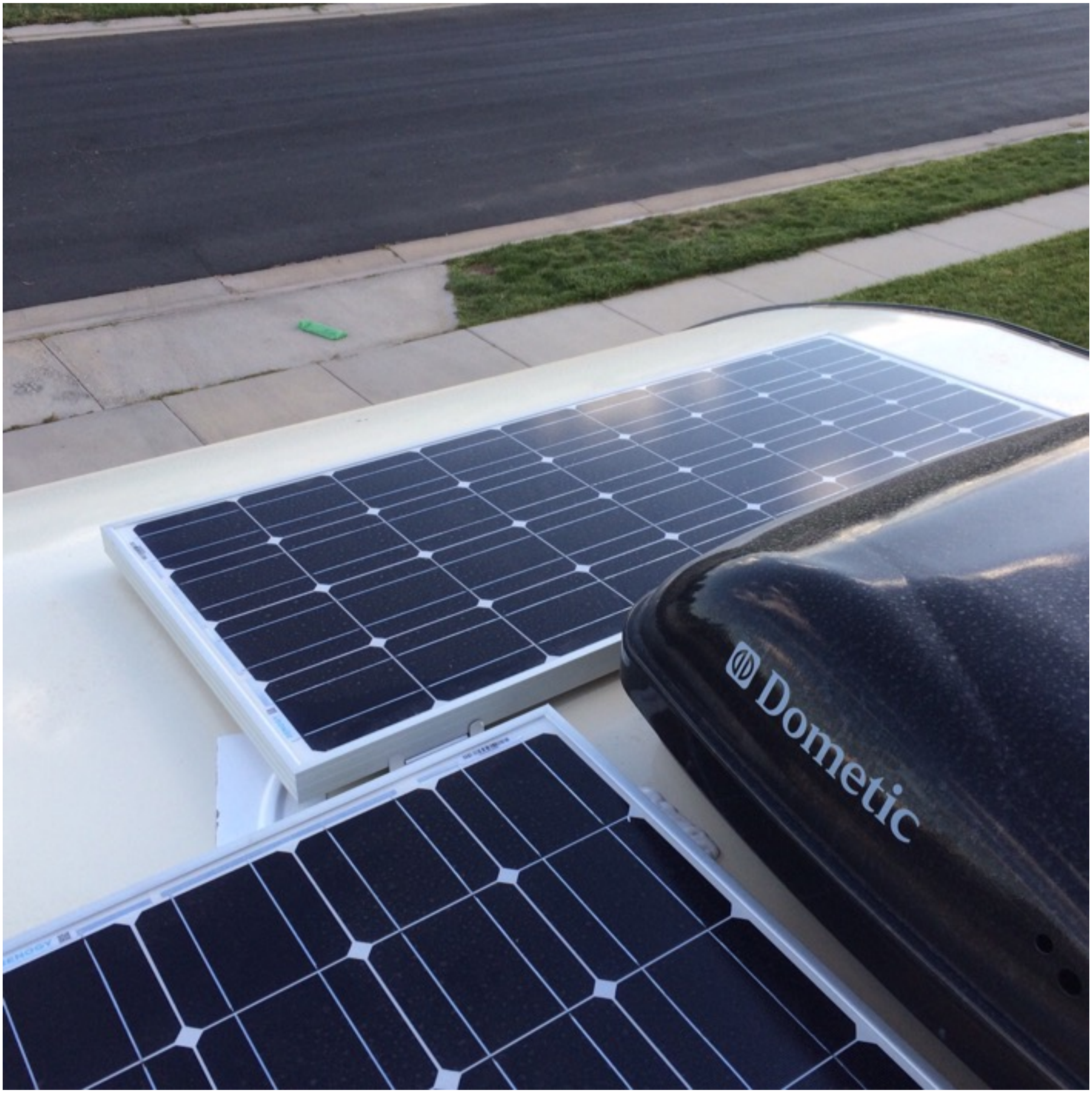
Real World: Non-fixed, or portable, solar panels, in an RV or trailer environment, are often stored away until needed during boondocking, which means they are of no-charging-value on an everyday basis. While fixed solar suffers from non-ideal sun conditions, it does offer daily value to keep batteries energized.

I also have to acknowledge that, when camping, the shadiest spot for the trailer is the worst spot for solar. I'll still pick the shadiest spot and then deal with the lower voltage/amperage by either conservation or augmenting the power source.

After finding the best position, in my opinion, I marked the holes and drilled (that part always makes me nervous). I went with the installation option of using Expansion Nuts. Although it's not required, I used sealant around the nuts. (Pictured on the right)



Once all the Expansion Nuts were in place I installed the panels using blue threadlocker on all bolts to ensure they don't back out from vibration.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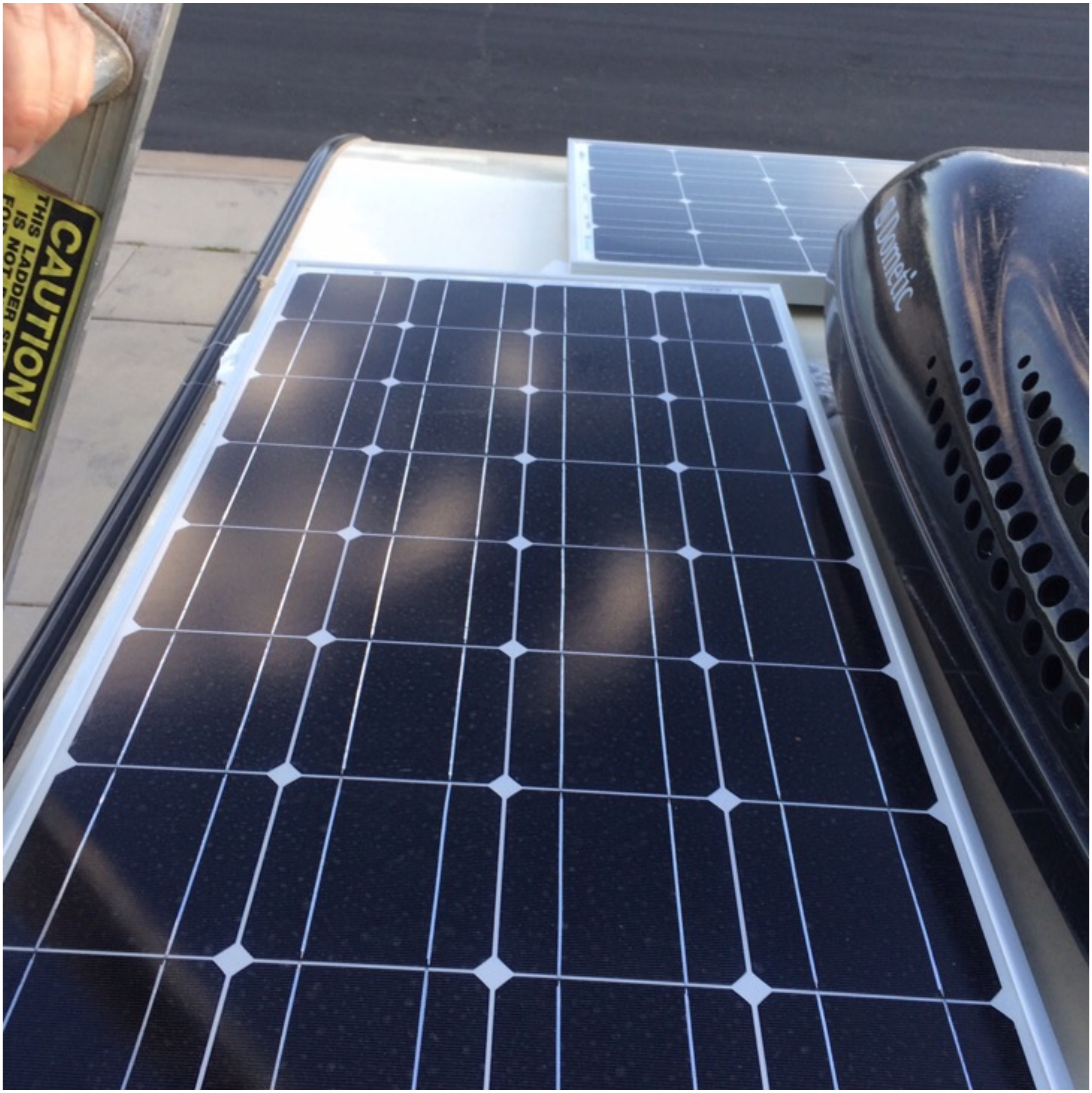
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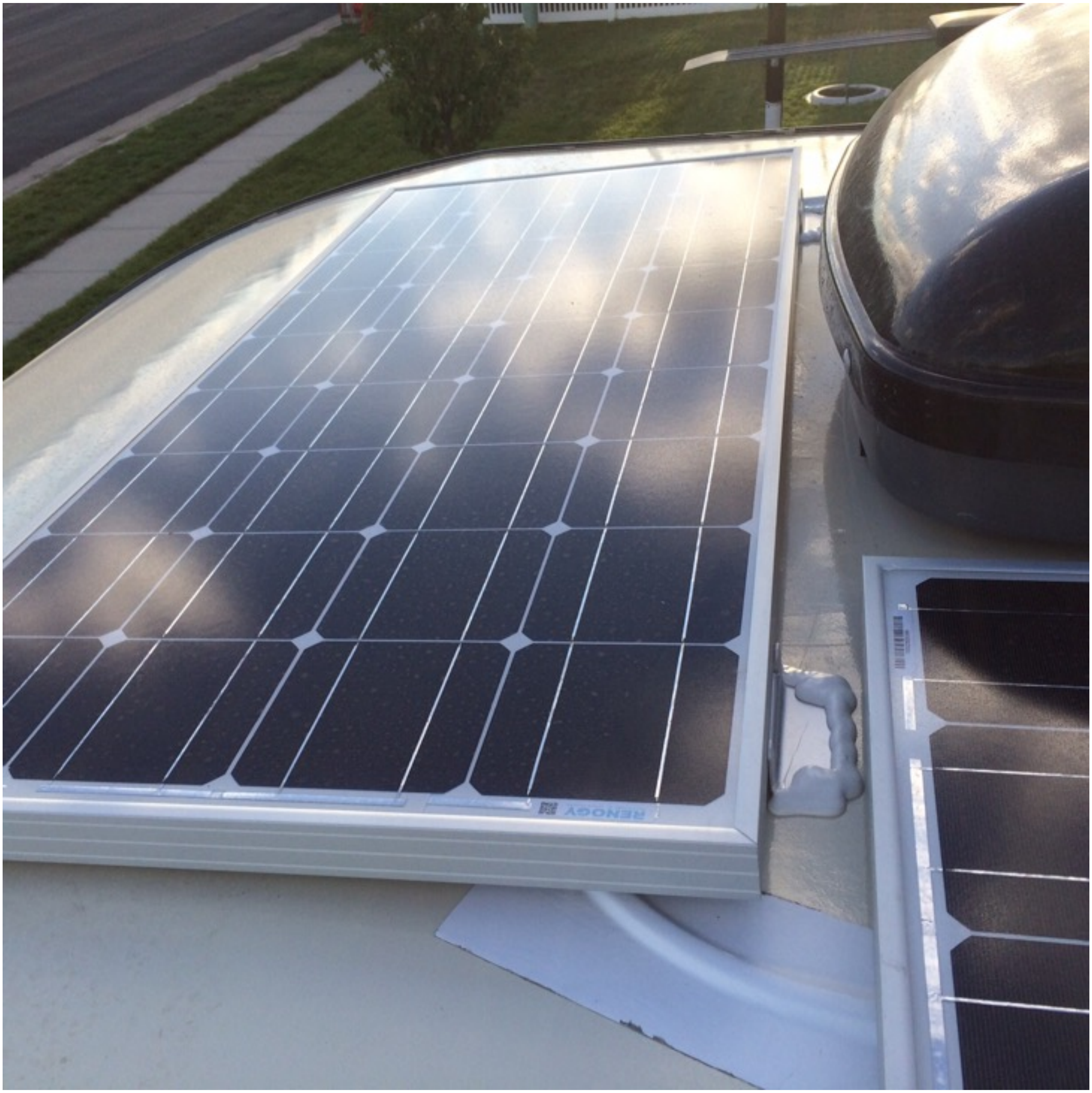
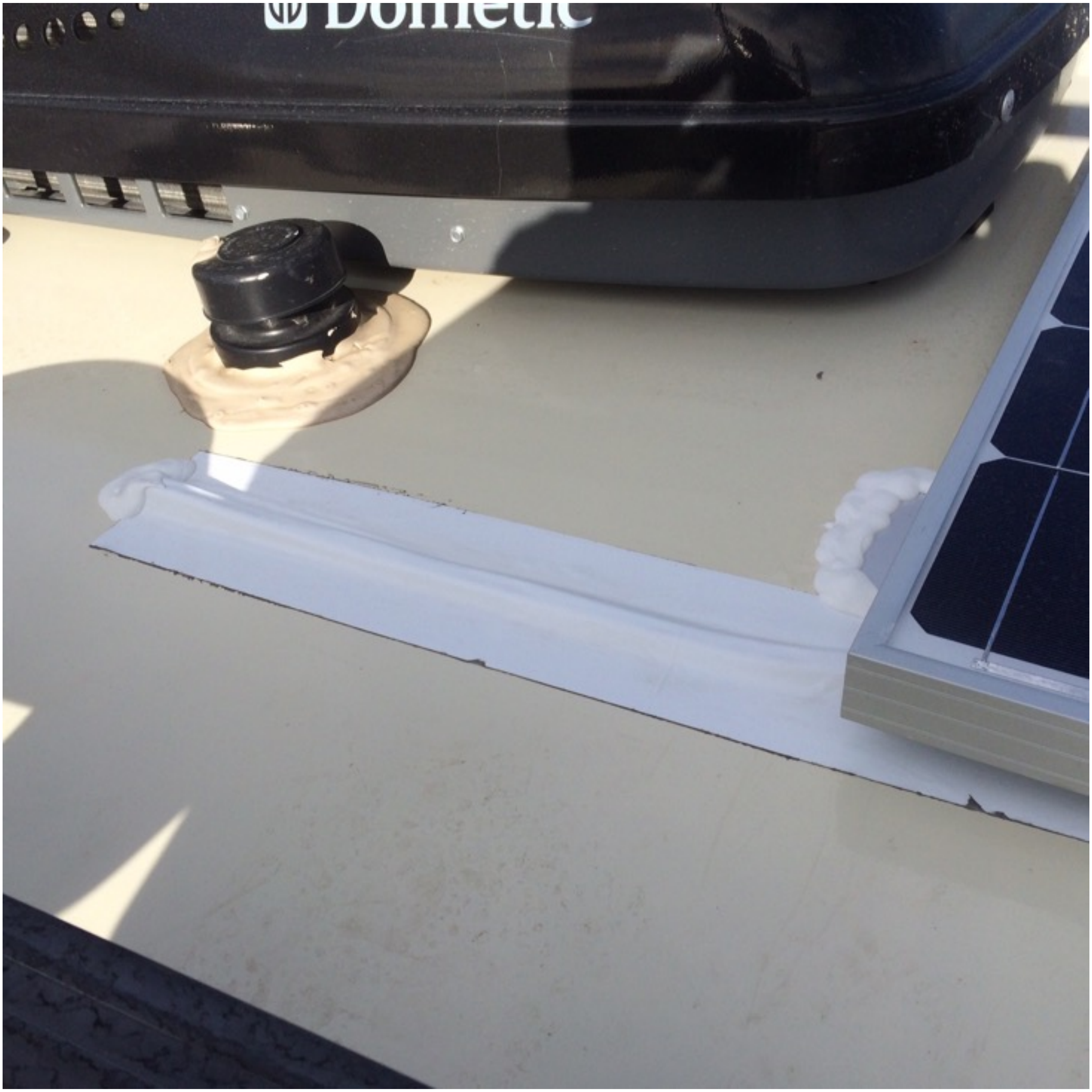
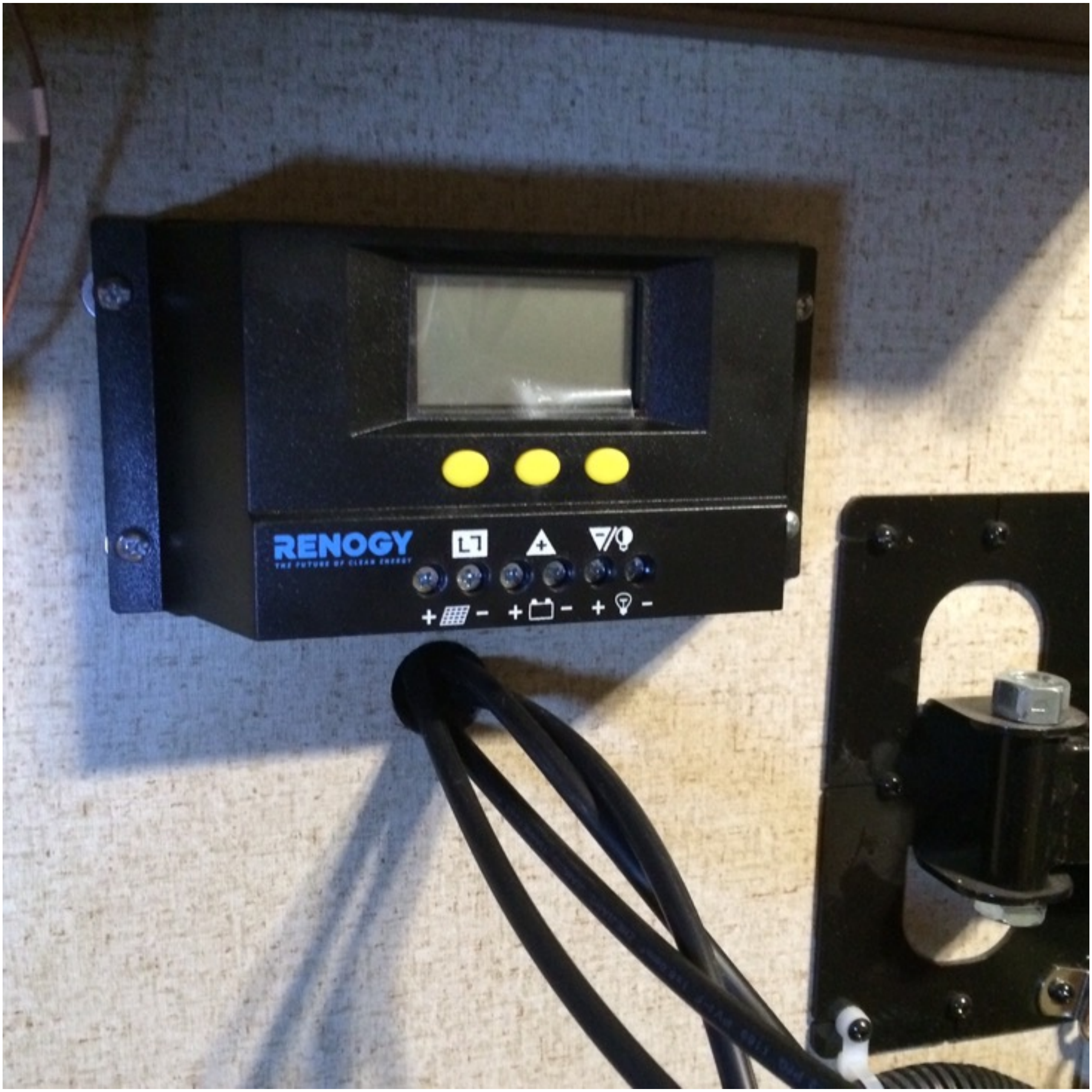


I used Eternabond and Lap Sealant to hold down the cables and seal around the brackets.



I wanted to have the charge controller where it would be easily accessible/readable with the shortest run to the batteries, which was behind the television, below the radio and control panel area. (If you're not familiar with the R-Pod 178 layout, it's basically just inside the doorway, immediately on the left)

After I removed the radio I found an already-drilled hole in the wood framing that had wires running through it, presumably for the antennae and outside-speaker wires. So, I determined where that was in the roof, and drilled a hole big enough to fit the wires. It ended up being a straight run down, which was great.



You can see my location for the charge controller by the television mount to the right. I installed it using hollow-wall bolts and drilled a hole for the wiring. I installed the wiring from the panels. Then using the excess, I ran the negative straight down to the ground panel that is directly behind the converter. I ran the positive wire directly to the “hot” side of the battery-cutoff switch (which is installed inside my trailer next to the converter (not pictured)).

By having it on the “hot” side of the cutoff switch it allows termination of all power to the trailer (i.e. anything that draws power) and still have the panels charge the batteries. I installed 30-Amp fuses on both the positive-line to the battery and the positive-line to the panels.

Note: I left the fuse from the solar panels exposed so I can easily remove it should I want to cutoff power. This would be necessary if ever working on the electrical system during sunlit hours because just disconnecting battery-power would still leave a live electrical system from the solar energy.

Controversy #2 – Shortest Path: Placing the controller where I did is not, technically, the shortest possible path to the batteries. Also, the Renogy install manual suggests the controller should be placed within 5 to 10 feet of the batteries. By my calculation I have about 15' of wire between the controller and the batteries.

The Ideal: Run the wiring down the front of the trailer and install the controller just inside the front compartment, potentially reducing the run from the controller to the batteries to under 4'.

Real World: Esthetically this would have been ugly for the wiring down the front and would have put the controller in an awkward place for monitoring.

Just to add to the debate: had I installed the Zamp Solar solution, often touted for the R-Pods, it would have been over 30' of wire between the charge controller, located on the back of the panels, and the batteries. Also, it would have been over much smaller gauge wire.

Controversy #3 – Temperature Compensation: The controller has a temperature sensor (that's what's sticking out of the top that looks like I cutoff a wire connector). It's used to compensate for temperature conditions so it doesn't overcharge, and gas-off, the batteries during hot conditions, or undercharge them, leaving them to potential freeze damage, during cold conditions.

The Ideal: Installing the charge controller in an enclosure, near the batteries, that protects the controller while still allowing it to be subjected to the exact temperature conditions of the batteries, without affect from indoor climate control.

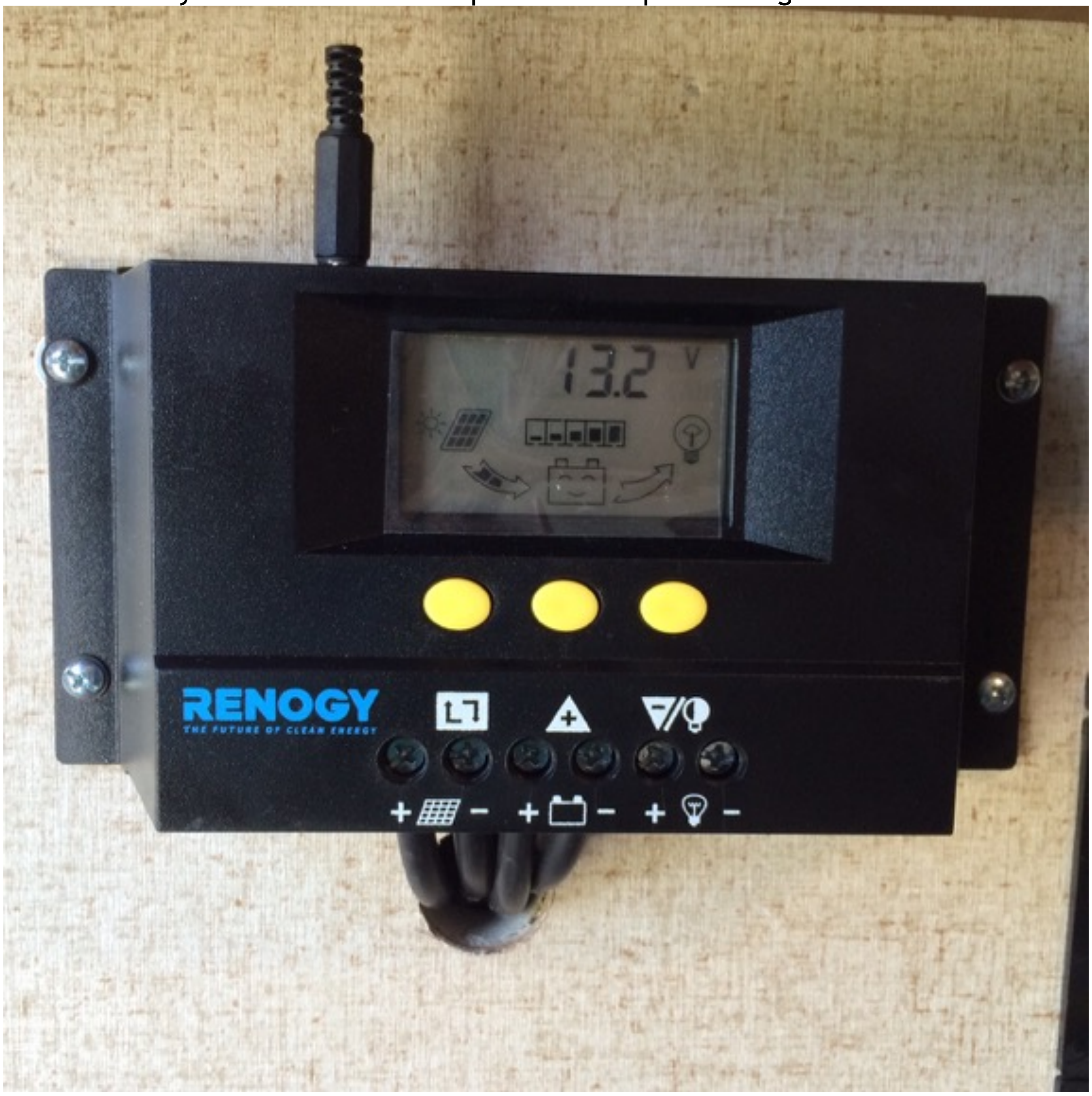
Real World: By installing it in the main living area, the controller isn't getting a perfect reading of the temperate conditions faced by the battery. Since the trailer is sitting in my driveway during most days, without any climate control (air conditioning or heating), I reason the controller is getting a "close enough" temperature reading most of the time. (Likely within 10 degrees tolerance, which, in my research, is the increments used by temperature compensation programmed into charge controllers)

Camping is when there's an issue and I've convinced myself that since I won't be in extremes most of the time, it really won't put that much stress on the batteries. When I camp in extremes I'll have to do some manual compensation. For example:

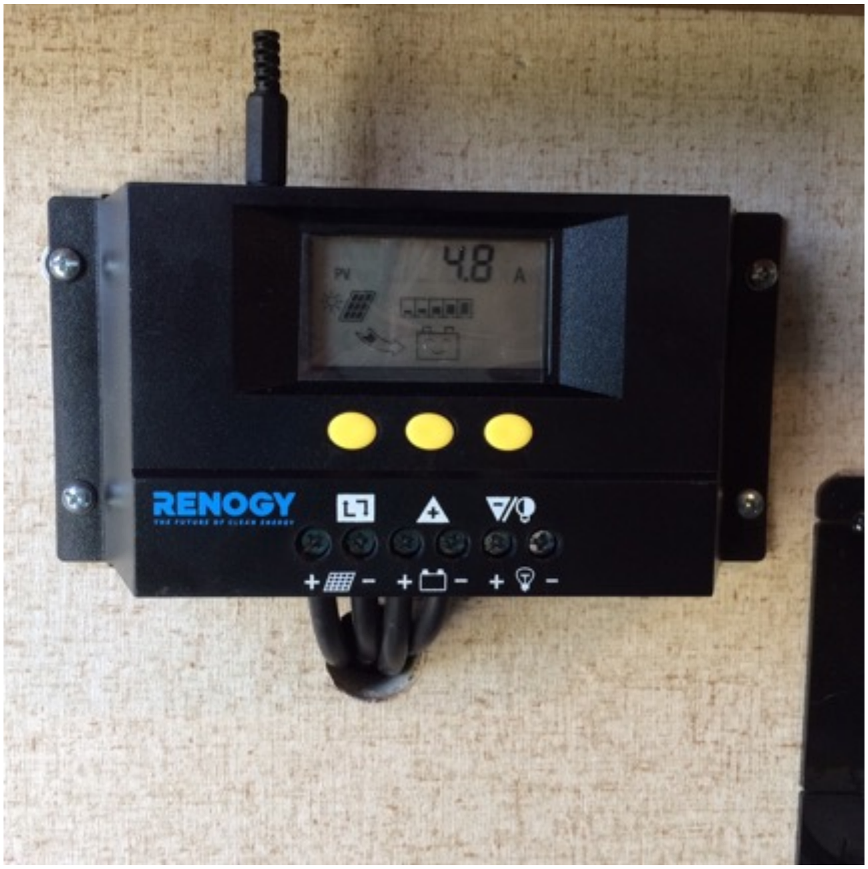
- **Hot:** Camping in a hot environment, likely where I have hookups to run the A/C, I run the risk of the charge controller boiling off the batteries that may be subjected to 100+ degrees outside, while the controller thinks it's in the 70's. Disconnecting the fuse from the solar panels will eliminate this risk and the converter will keep the batteries charged.
- **Cold:** Freezing temperatures are harder to compensate. Keeping the inside temperature in the 60's or 70's will make the charge controller not output all the voltage/amperage available from the sun into the batteries, which may already be drawn down by the longer nights, interior lights, and furnace load. Augmenting the power source is the viable option.

Note: By the way, I did most of the electrical work after sundown, for obvious reasons. The install manual says to cover the panels, but it was easier to work in the cool of the evening.

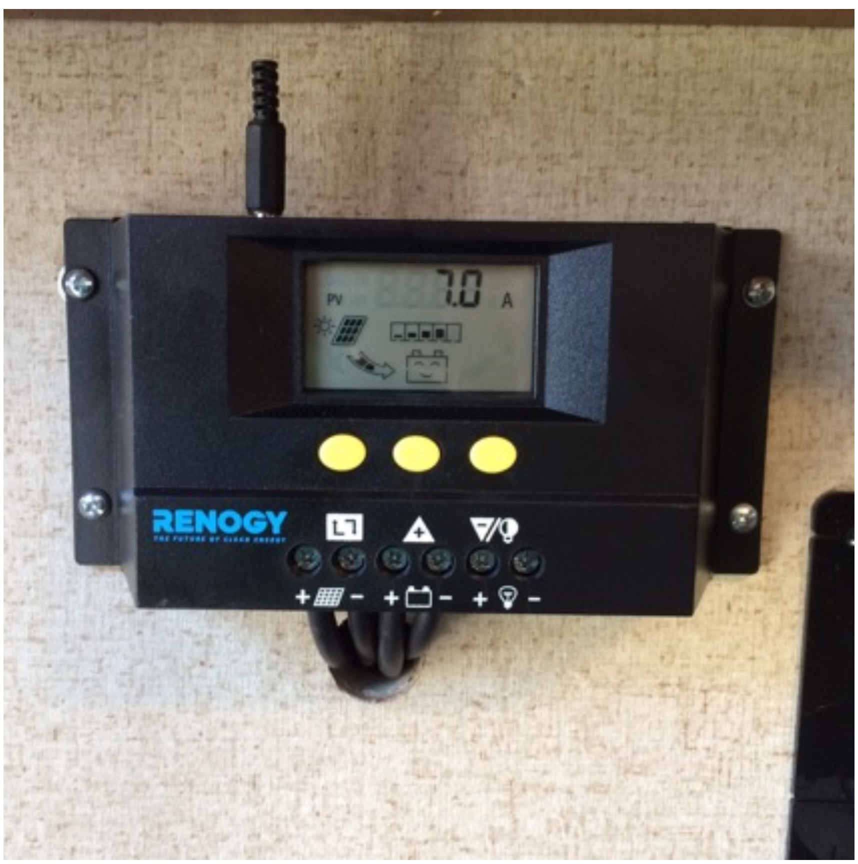
Testing:
After installation, comes the testing. Since the batteries were fully charged I had to create a lot of draw to really determine how the panels were performing.



13.2 volts, fully charged. Looks good so far.



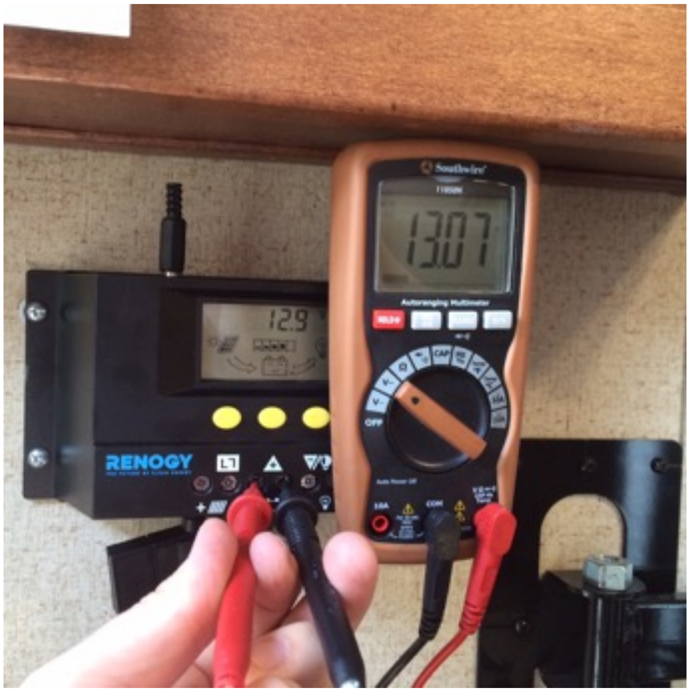
At about 10AM, the panels are putting out 4.8 Amps

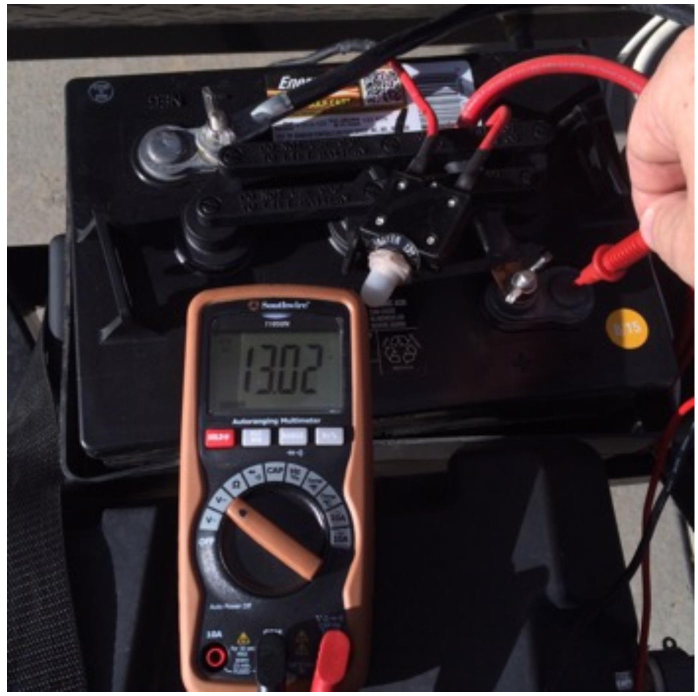


Full sun at around 12PM, noon, the panels are putting out 7.0 Amps, the max that can be expected.

Note: The panels are rated at 100W and 5.29A, but that's ideal world. The PWM controller is only about 67% efficient at converting the available solar power (MPPT controllers are around 97%). With the two panels, both producing 5.29A at high noon, and a PWM controller, 7A is spot-on for my optimal conditions.

I did several voltmeter tests, represented by the images below, and had similar and consistent readings. Basically the charge controller is putting out .05V, at the controller, that are not showing up at the battery, which is my Voltage lost over the approximate 15' of wire.





Controversy #4 - Float Voltage: I set the float-voltage-point on the controller to 13.9 Volts.

The Ideal: The batteries should be float charged to somewhere between 13.6 and 13.8.

Real World: With the resistance of 15' of electrical wire between the charge controller and the batteries, the controller "thinks" it's volted the batteries to 13.9, they are actually somewhere around the 13.8+ mark due to this resistance.

The maker of the charge controller has to make the safest, most stable, product possible. Since the charge controller could be installed just inches from the batteries, they have to program the charge controller to not compensate and assume that if it reads 13.8V, then the batteries are at 13.8V.

Since my conditions are different I'm making my own calculated change. I'll keep an eye on the battery water level to ensure they're not off-gassing, but it shouldn't be a problem since that usually isn't a problem unless the batteries get really hot or voltage is kept above 14.4 Volts for extended periods.

Appendix

* This write-up was done by R-Pod Owners Forum user "M0tl3y" and is for the sole purpose of helping others research their own fixed solar installation. No warrantee is given in the information and the reader must perform their own extensive research before installing solar panels or modifying any RV or trailer.

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