

HandyBob's Blog

Making off grid RV electrical systems work

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RV SOLAR QUICK ANSWER ?

RV SOLAR SYSTEM RECOMMENDATIONS AS OF July 2011

By HandyBob

I am writing this in response to requests made by several readers who contacted me and were trying to sift through all of my writings and arrive at a quick answer. There really is no quick answer, but at least if I give a few suggestions here it might help. I am in the process of building an off grid home, something that is going to take years with our lack of savings and being dedicated to never going into debt again. So far the only solar system there is a temporary one being used for construction power. It is a 24V system because that is what will be going on our shop. Currently four very old Trojan T105 batteries wired in series, two Sun 195 watt panels also in series, an old C60 controller that is going to go into the trash soon, and a Magnum MS4024-PAE 120/240V inverter/charger. Still no generator to power the charger though. I had an Aims 3000 watt inverter hooked up for a while. I have had very bad luck with Aims and I will keep this just for back up or running shop tools. The plan for the home is to put big panels on the roof of the shop hooked up in series with over 70 volts going down #6 cables to either two Morningstar MPPT controllers or maybe one Midnight Classic and eight L16 batteries. I cannot yet tell you what brand they will be. Our panels will be tilted to near vertical in the winter so they will shed snow. Light reflected from the snow on the ground will make up for what we lose by being tilted too high. I suppose we may have to buy a generator when we are running electric refrigeration but I am not convinced yet that it is going to be needed. We should get enough energy from this system on cloudy days to run the basic necessities and have over a week of backup power in the batteries.

OUR CURRENT RV SYSTEM:

Solar Panels: 345 watts of all manufactured around 2000 (old). Three are Siemens 75's and one is a Kyocera 120 that was replaced with a rebuilt panel under warranty. They have been through several hail storms and have been very durable. I have them on tilting mounts that go up to better than 45 degrees. They are tilted just a bit during the summer so the rain will wash them. I added about 250 watts of used panels in 2011 so we could buy a DC freezer. My vertical wiring run is #6 about 12ft long. It has served just fine with the 24 amps maximum that the original panels could produce. Now it needs to be replaced with #4 because the voltage drop will be excessive during high amperage summer days. I may have to change it (again), which would be my third rewire. I want to make a point here, so read carefully: I experimented by leaving the TV on all day after using the coffee maker and toaster during sunny but short December days when camped out in Arizona and with only 345 watts. We get charged by 1PM, with the charging amps dropping off because the batteries won't accept any more. Therefore, we do have more panels than we need and we can run appliances that other people will tell you are impossible. These are the same panels that would not charge our batteries originally when connected to a lousy charge controller with too small of wire. The excess comes in handy after a couple of cloudy days, so we can still live while being recharged, but you don't need excess if you already own a generator and are willing to exercise it once in a while.

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Charge controller: Morningstar PWM Tristar 45 amp with remote temperature sensor and **no remote readout panel**. It is mounted in a storage bay that backs up to the batteries and connected through a fused double pole air conditioner disconnect to the batteries with #4 cables about 3ft long. I did not connect a remote voltage sense wire. I recommend using that only if you cannot locate the controller within 6ft of the batteries. I **love** this controller. WARNING: PWM controllers are same volts and amps in as out. **You cannot use high voltage panels unless you pay for MPPT.**

Batteries: Four, five year old Trojan T105's. This is a better balance than six were with the solar charging that we have. These batteries were given to me for some work, already three years old. They came out of a motor home that had no solar for a couple of years and they have been used. We have run them down to 40% a few times. They are working like brand new, at better than 98% charge efficiency. New Interstates, if you can find four that are OK, will never seem to run at better than 95%. Four of the old T105's that we used for 8 years in the rig and that are now ten years old are still running the system I am using for construction. They are weak and running at about 90% charge efficiency, but still able to power the heater on the tractor engine on cool mornings and run power saws. There are no glow plugs in 50 year old Ford 3 cylinder diesels! I have friends & customers with Interstates who have had or are still having a lot of problems. Buying cheap batteries when you need to be able to depend on them is very short sighted. "Outrageously reliable?" Give me a break!

Battery monitor: Trimetrix 2025-RV with 500 amp shunt. This is connected with #22 twisted pairs cable and the hot wire is protected with a 2 amp fuse. It is in the living area so we can glance at it and see the state of charge. I like the 2025 over the 2020 due to the history function that is built in, recording the last five charge cycles. I believe that the Morningstar remote is not needed and just adds confusion for the average RV'er. Even campers should have a real battery monitor. This is the only way to ever be confident that your system is really working. I recently got a great thank you from somebody who said that their Trimetrix showed them that their new and very expensive AGM batteries were not providing the amp hours they were advertised to supply and they were able to use it to convince the supplier (who was arguing) that the batteries needed to be replaced. They told me that the meter paid for itself.

Large Inverter: Old Vector 2200 watt fed with #2/0 cable through a 400 amp fuse with the output going to a Hubbell 30 amp double pole, double throw manual transfer switch so that the AC electrical panel in the rig is all powered. The circuit breaker feeding the air conditioner is off and the water heater does not have an electrical element. A switch was added in the line that feeds the battery charger (converter) and it is also off. I do not recommend Vector today. Read my warnings concerning inverters in the Puzzle. I can currently only recommend Samlex PSE series power inverters or Magnum inverter chargers. I would use a Powermax PMTS 30 automatic transfer switch today with a Samlex inverter, because it costs about the same as the Hubbell manual switch and the box for it. I have been dealing with DonRowe.com for a couple of years for inverters, transfer switches, fuses & cables and find them to be very competitive, with great service.

Small Inverter: Morningstar Sure Sine 300 fed with #4 cables through a 100 amp fuse with the output going to receptacles at the entertainment center, in the bedroom for the Select Comfort air compressor & mattress pad warmer and two more in the living area for the sewing machine, lap top and 120V reading lights. These receptacles are used only for low wattage devices and are never connected directly to the original AC panel. This gives us a substantial improvement in efficiency when using low wattage appliances versus what the loss of having a large inverter on would be. People who have already paid for a generator probably won't want to spend the money for this, but I have installed the same type of system for folks who have generators and who hate to run them just as much as we do. This inverter I recommend highly.

SOLAR PANELS:

The main thing to realize is that shopping can find you bargains. Currently the best deals I have found are at Sunelectronics (sunelec.com). They have warehouses in Miami and Phoenix where they will let you pick up small quantities. Their service is lousy and the web site inventory is NEVER current, but they have good prices. If you can make them fit, they have unbelievable prices on big, beautiful blemished panels that have a good warranty. The freight for shipping the big 185 and 195 watt panels is killer, but with the price it is looking more and more like the correct solution today is to buy more panels than you need and mount them nearly flat. Tilting mounts are expensive and three good ones will pay for another panel. The cheap mounts sold in Quartzsite are not what I would call good. If you can tilt them just enough so the rain can wash them and not collect dirt in the corners you won't have to climb up on the roof as often. You can make your own mounts using overlapping "L" angles bolted together at any height. When I make mounts I use three screws and caulk to fasten a three inch long foot to the roof, so it can be trusted. This gives you the ability to remove a panel without taking the screws out of the roof, just in case. Remember that you want panels that are rated about 17Vmp if you don't want to be forced into buying an expensive MPPT controller. If you want to spend the extra \$\$ for MPPT, you can use higher voltage down from the roof and thus reduce your voltage drop.

CHARGE CONTROLLERS:

All full timers should use either what I have (Tristar PWM) or spring for the Tristar MPPT. I personally only recommend MPPT if the system is approaching 600 watts, if the solar panels are those high voltage 44 cell units so that MPPT is needed to use the excess voltage, or if the existing wiring is too small and series wiring the panels can be done to improve voltage drop. I will not do this unless the panels wired in series are identical and will absolutely never have shadowing issues. I will never series more than two panels on RV's. Doing so with the whole roof is asking for shadow problems because a shadow that shuts one panel off will also shut off all panels wired in series with that one. I also would prefer rewiring with larger cables if less expensive than the extra \$\$ that the MPPT costs. I do not believe that MPPT, even Morningstar's (which I believe to be superior to the others) nets enough extra energy over time to justify the cost. I know it works during perfect conditions, but just how much of the time does that happen? People that talk about 25 & 30% boost are just like those that report their fuel mileage when looking at a one time measurement reported by their truck's computer. Spend the money on another solar panel and get more energy all of the time, even when cloudy. I set controllers in motor homes slightly conservatively (14.6V) due to the chassis battery interconnection and over voltage alarm problems. I don't like it, but there doesn't seem to be much choice.

Campers should use a Morningstar SunSaver or if you can afford it, a Prostar (three stage). These are limited to 14.4V when set for flooded batteries, but the standard temperature compensation does a lot to improve performance during cold conditions. Realize that the temperature compensation will not work if the controller is located where it will not see the same temperature as the batteries and a remote sensor may be needed. The Prostar has remote voltage sensing, so it can be located some distance from the batteries and still be made to work. Be careful with this, the voltage loss in that wire translates to loss of charging amp hours.

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I will say it one more time; I know there are many charge controllers available and new ones come along. I am so happy with Morningstar's quality, warranty and service that I am not looking. I will no longer touch anything from companies who have demonstrated to me that they do not listen to the battery manufacturers or who use little pots for adjustments. As far as I am concerned, they have demonstrated that they don't know what they are doing and their stuff belongs in a dumpster. All of the hype & marketing by the Blue Sky & Outback people I view as just that, hype. I know they make big expensive controllers that do work and I have read the glowing reviews by people who have spent the money and bought them. Download their instructions & see if YOU can figure out how to program them. They are not user friendly. When programming a Morningstar Tristar you select one of several standard charge algorithms by flipping a few switches and walk away, confident that it will do what it is supposed to. Plus, their MPPT unit actually is as efficient as claimed. If you are the gadget type that just has to fool around with the programming you can buy the computer interface & change it to your heart's content but there is absolutely no reason to do so. If it ain't broke, don't fix it! I keep telling Morningstar I would be even happier if they would turn the voltage up on their smaller controllers and if they would expand their inverter offering, but so far they are not listening.

SUMMARY:

You should read the entire RV Battery Charging Puzzle.

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