

Going Solar in your RV

We test a solar kit in a full size RV

BY MARK A. ROLLAND

In the year 2009, we are at a time where technology has become an increasing part of our lives. As a society we are more dependent on electricity than we ever have been. When we go camping in the dunes, that doesn't change one bit. Most of us take the same items with us to the dunes as we'd use at home. Whether they be power tools, video games, or things used in the kitchen, we have become dependent on items powered by AC or DC electricity.

In a quest to find a solution to the noise created by and extra fuel required for a generator, I wanted to find out what would be involved when it comes to converting an RV to use solar power. In the first hours of investigating I became overwhelmed with the questions people were asking me, as I tried to interview them. As it turns out, before making any inquiries about installing solar equipment into an RV, you must first determine how much electricity you will burn and for how long you expect to use it. And from there, you base those requirements on the system that will supply your needs. Read on to find out what we learned from our testing and to better understand what you'll need to know in order to convert your RV to using solar power.

CALCULATING POWER NEEDS

As I said, in order to buy the right system, you must first know how much power you'll use on a daily basis while camping. Our test unit was based on approximately 1500-1800 watts per hour for normal daily use. Adding up the amounts of amps, or watts of the devices that is used will determine the system you'll need. One example is, how much electricity a microwave uses. First, find out how many amps it uses. To do this, look for a sticker with this on the back panel and that should tell you how many. Most microwaves pull between eight and 13 amps when they are in use. Let's say it pulls 10 amps, so all you do is multiple the amps by the volts and you'll come up with how many watts. In this case, 10 (amps) x 120 (volts) = 1200 (watts). Do that with all the appliances you'll use and then add about 500 watts to the total daily number be safe. (During our testing we found many small things using power that we didn't think of.)

THE SYSTEM

There are three basic parts to any solar powered system; the panels, batteries and a power inverter. There are a lot of misconceptions when it comes to solar panels. I found panels that say they were rated up to 280 watts, which is a lot of power for a single panel. So people are lead to believe that in one day of sunshine a single panel will generate well over a thousand watts of power. Not so. In perfect conditions, when the panel is facing directly into the sun and the ambient temperature is just right, it will generate that much power. Otherwise it's likely to only generate a percentage of the full rating. So, depending on your weather and light conditions, a 200-watt panel may only produce the full 200 watts an hour for no more than four hours a day. In the hours before and after the sun is directly overhead, it may only produce 150 watts per hour (or less). The key is finding panels that produce as much power overall, starting at sunrise and ending at dusk. Here lies the difference in panels. There are a few different designs on the market, with constant research being done to improve existing models. The most common panels that people see are the Crystalline Silicon Photovoltaic panels (PV panel for short). These are the ones you see on a lot of rooftops and are generally about four feet long and about two feet wide. They are typically about an inch thick and weigh roughly 40 pounds per panel. A newer design is the thin film amorphous silicon panel. It uses about one percent of the silicon that a PV panel uses and will work in full and ambient sunlight. They are much thinner, only a few millimeters thick, and can be rolled up and weigh only about four pounds. The thin film amorphous silicon panels have other benefits as well; they aren't subject to damage near as easily. You could walk on one and not hurt it. Also, natural enemies to solar panels have been bird droppings. With a crystal panel, if a pigeon bombs a panel, the entire panel no longer produces power. With a thin film amorphous silicon panel, only the individual cells covered in poo don't generate power. Heat is another natural problem for solar panels. Thin film amorphous silicon panels generate much less heat than PV panels. Thin film panels can produce efficient percentages of power in a very wide range of ambient temperatures (from -67 to +185 degrees), whereas PV panels have less range and do their best work at around 77 degrees. We obviously went with the thin film amorphous silicon

design, made by an American company called PowerFilm. They are offered in a few sizes, but because of the many layouts of RV roof designs, we went with the smaller panels for our testing. We chose to try the R15-600 10-watt panels that produced a total of 1.2 amps at 30.8 volts DC with all four panels connected. PowerFilm and Green Duck (the design and install company for this test) offer other panels that produce much more power, but just make sure your roof has a layout wide enough to support it.

When it comes to batteries, almost anyone you ask will agree that a bank of deep cycle 6-volt batteries (golf cart batteries) is the way to go. Lead-acid or Absorbed glass mat (AGM) will work fine, but lead-acid will save you money, however the AGM are maintenance free and the fluid level in the lead-acids should be checked every three months. The key is getting a battery with as many amp hours (AH) as you can afford. Our test included using a bank of four, 6-volt 232 AH wired together in series to come up with a 24 volt DC current with 232 amp hours of power. If you're a family that uses a lot of electricity, a big bank of batteries will be needed to last all day. In our testing, the bank of four lasted most of the day, but not through the night into the next day of sunshine. Keep in mind these batteries are heavy, weighing about 63 pounds each. As much as I'd like to have tried an eight-battery bank to last possibly 48 hours straight, I didn't have the space to fit them, and didn't really think any of you wanted to tow an extra 250 pounds of batteries around. So for our testing, we went with the most batteries we thought were worth carrying around, and would still provide ample time of power.

If you read the Sunday paper, you'll often find inverters on sale at many automotive stores and sometimes tool and equipment stores like Harbor Freight, Camping World and Northern Tool. Believe it or not, even big truck stops carry them up to 3000-watts. However, they have limits as to how they would work when it came to supplying power to an RV. Typically a common 1500-watt inverter will cost no more than \$200. They can hook up to any 12-volt source and turn DC power into AC. One problem is, they will normally only have two and sometimes three 110 outlets to plug into. So, we had to step it up and find a converter that would allow us to have one massive outlet, to directly feed a 30-amp power supply (or RV in this case). We actually had to use a 30-50 amp piggy back plug to step up, because the unit used for testing was a 37-foot 5th wheel that was wired for 50 amp service. The technical difference between these types of inverters is true-sine wave and modified-sine wave. We went with 4000 watt true-sine, made by Magnum Energy for a few reasons. First off, if you'll be using electronics with variable speed motors, (drills, electric shavers, etc.) or a plasma TV, you'll want a true-sine. They are made from a more industrial frame of mind and worked best for our RV application. Features we liked included; lightweight, remote control capability, two-year warranty and they are made in America.

GET THE RIGHT HELP

This story was one of the most in-depth, tech-research features I've ever attempted. A total of about two days on the phone, a dozen e-mails to various companies, who passed on some good information, like Mohr Power, but most of these companies weren't set up to supply an RV with solar electricity. After three weeks of searching I spoke with Richard Lehmann, President and CLO of Green Duck Energy Solutions from Minnesota. In the initial thirty minutes we spent on the phone, I was relieved to find out they could accommodate our request and best of all; I found out that Richard was also a former Army vet (he was a Military Police Officer). Long story short, Richard and his crew came through for us in every way. Not only flying down to install the equipment, but to help explain each piece of the solar pie in great detail. In conversation I told Richard that our readers are used to having custom designed products to meet their specific needs. He smiled and said that solar solutions can be done just as easily in a custom fashion as long as they know what the users power needs will be. He explained that many of their jobs are done for clients with non-normal requirements. So whatever your needs may be, the Green Duck team can come up with a solution... just remember the batteries are heavy.

OUR RESULTS

After coming up with our daily power needs and keeping in mind the cost of this application, we started with a two panel, four-battery system with a 4000-watt 240-volt inverter (remember that we were hooking up directly to the 240-volt 50-amp service on the trailer). The two 12-volt panels were placed in series to make them 24-volts. Before testing was over, we added two more panels, hooking the two sets of panels up in parallel so that

we could increase the amps that were going into the battery bank from the solar panels. We did this because we weren't able to get the maximum charge (level of voltage) to the batteries as we'd like to have. According to the (very) handy remote panel that we installed inside the RV, the batteries were supposed to be able to reach a level of 29.2 volts. In the several weeks of testing, we never got them above 26.4. After reviewing all the information with the Green Duck gang, we came to the conclusion that the power being drawn from the inverter itself and the trailer's DC systems weren't going to allow us to ever reach the maximum of 29.2. By adding the two extra solar panels, we did increase from the low 25s, to 26.4, but didn't get as high as we had hoped. This particular kit we tested retails for about \$5,000.

If you're confused about the terms parallel and serial, it's very easy to understand. Think of serial as four 1.5-Volt "AA" batteries in a flashlight, one in front of the other with the (+) positive all facing the same direction. They increase to six volts, to make the bulb brighter, but they won't last any longer. In a handheld GPS, the same four batteries are side by side, with the + and - opposite of each other. They are running in parallel, still at 1.5 Volts but creating more amps and saving battery life to transmit and receive that signal to satellites in space.

To give you an idea of other RV solar kits we found locally at Mike Thompson's RV. They were single panel kits that came with a modified sine inverter and all the wiring and framing needed. Prices started around \$2,700 for a 110-Watt panel with a 1,500-Watt inverter to \$4,700 with a 220-Watt panel and a 2000-Watt inverter. If you wanted them to install it, add another \$1,000 for a neat job. You can decide which way is better for your own needs. But wouldn't it be cool if in a year from now, when the environmentalists fly over Glamis to see what we're doing wrong, and they see RV after RV with solar panels on the roofs. It would make me wonder how many of them are driving gas-guzzlers and don't have solar panels on their golf carts. (Oh yea, the Green Duck guys can convert your electric golf cart too).

SOURCES

Green Duck Energy Solutions
(952) 224-9090
www.greenduckenergy.com

PowerFilm
www.powerfilmsolar.com

Magnum Energy
(425) 353-8833
www.magnumenergy.com