



# CLASS GUIDE



## SOLAR POWER FUNDAMENTALS

With Dave Solberg

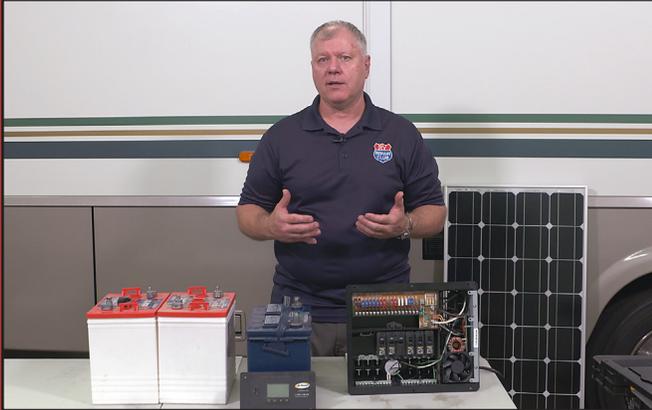
There are many factors to consider when determining the size and type of a solar configuration to purchase for your RV. It's important to understand not only the parts that are needed but how they all operate together.

In this instructional class, we'll walk you through each component and what its function is so that you can better understand how the system works. We will also talk about what things you need to consider that will influence the size and type of solar configuration that will work best for you.



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## Why Solar



There has been a lot of excitement about solar and a lot of people have opted to go down the solar path. However, there are still a lot of people wondering why they should go solar or unsure of where to begin.

The biggest reason to invest in a solar system is to find an alternative source of charging your batteries and the freedom that solar will give you.



When you are using your RV, there are a lot of components inside that run off the 12-volt house batteries and as you use those components, the batteries will need to be recharged.

Traditionally, recharging means plugging into shoreline power and using the onboard converter or starting the generator. Using solar panels allows you the freedom to go just about anywhere.

Without solar, when there is no shoreline power, we rely on our generators to recharge the batteries. Most efficient generators run about 80-100 decibels and because of the noise, many campgrounds will not allow you to run them or have restricted hours for them. There is also a fuel cost associated with running the generator.



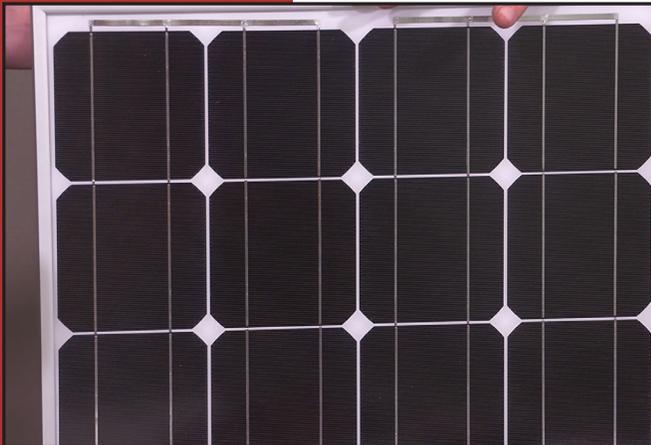
The solar controller will also help keep the batteries conditioned. The multi-stage controllers help prevent sulfation which leads to longer battery life. This is particularly helpful in systems that have lead-acid batteries in the RV but will also help AGM's and Lithium-Ion batteries charged.

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## How Solar Works



The solar panel takes energy from the sun and transfers it into DC power to charge the batteries. A good analogy of a solar system is to compare it to a fuel system on a car. The solar panel is the fuel station, the controller is the shut-off valve, the cables are the fuel lines and the batteries are the fuel tank.



The solar panel is made up of cells. Each cell takes the sunlight and turns radiant energy into DC power. The solar panel specifications are very important to understand when setting up the system.

Amps, watts, and voltage are the three specifications that you will need to know. The 100-watt panel we used in this session has an output of 18.4 Volts. If this panel was run directly to the battery, the voltage would overcharge and ultimately boil the battery.



The solar controller is one of the most important items in the system. The best style is a three-phase controller which will not only control the amount of charge to the batteries but will also help to maintain the batteries. The controller limits the voltage going to the batteries so that they do not overcharge and boil over.

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## Choosing the right system



In order to choose the right solar system for your rig, you really need to take some time and look at how you are going to be RV'ing. The main reason for this is you will be using solar to charge the batteries when you are not able to plug into the grid. It boils down to using your batteries to run electronics inside the coach and how long you're going to need to run them.



Common items that will run off 12-volt power in an RV are:

- Water Pump
- 12-volt Lighting: Halogen, Florescent and LED
- Refrigerator
- Clocks
- Monitor Panel
- Hood Fan
- Furnace
- Inverter to run 120 Volt appliances



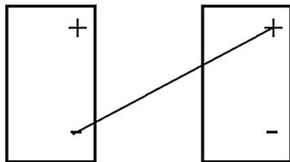
Another important factor to consider is the type of solar panel you will be using. A solar panel needs to have direct sunlight to operate. Are you mounting it to the roof? Is weight a consideration? Will you need to frequently change their position to point towards the sun?

All of this will determine if you need a mounted or portable solution or maybe a combination of both.

## Battery 101



### 6-Volt Batteries Connected in Series



One of the most important components in a solar system is the batteries because after all, that's what you're trying to charge and to use as a fuel source to run the electronics on the inside.

In an RV, you have a house battery that's going to be a deep cycle battery. That means it's designed to be drawn down to 10.6-volts, recharged to 12.6-volts and that cycle continues as you use electrical devices. There are two different types of batteries that are typically used in RV's. The first type is the 6-volt batteries, and the second is 12-volt batteries.

The 6-volt batteries are very similar to what you would see in golf carts and some farm implements. An RV will have two 6-volt batteries each having three cells. Each one of these cells is going to have 2.1 volts per cell.

The 6-volt batteries need to be connected in series, meaning connected from the positive post of one battery to the negative post of another. This series connection creates a 12-volt bank just like a regular 12-volt system.

The acid level needs to be checked periodically in a lead-acid battery. This is due to the gassing that occurs during the charging cycles. When the acid level drops below the top of the plates inside the battery, the battery loses efficiency which leads to fewer amp hours available.

There are a couple of easy ways you can check the level inside; either pop the caps off and just look inside or, if you have an awkward position way back inside a compartment, you can use a mirror to look at it.

There are some watering systems that are available on the market that are handy. US Battery has one where you replace the caps with their kit that stays on permanently. Watering kits make it simple to ensure the acid level is at the appropriate level.



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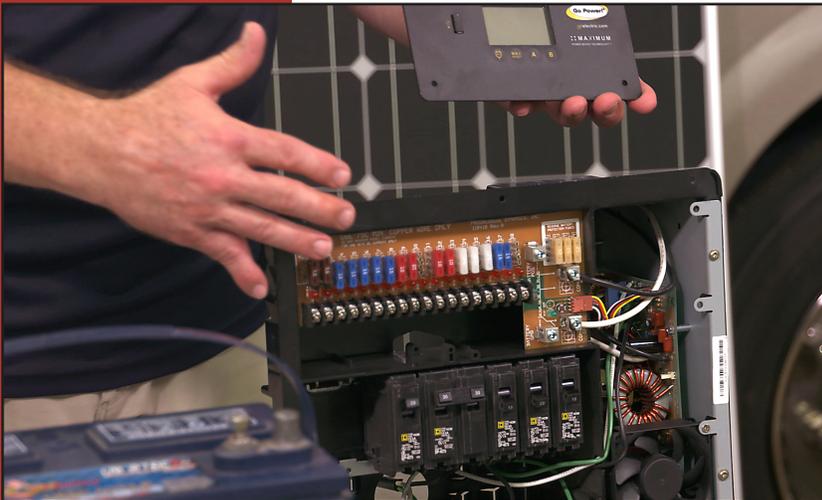
## Inverters



If you're going to put a solar system in to charge your batteries and use them to run things inside, you're going to be limited to just those 12-volt appliances that we talked about in the previous sessions. You will only be able to use the interior lights the appliances that run on LP with a 12-volt system and you won't be able to run a TV or any other 120-volt appliance with batteries. That's why a lot of people will put an inverter into their system.



Inverters come in a variety of sizes. The small inverters such as the 100-watt ones will run a small TV or DVD player and are typically installed in a cabinet area. Those are very limited to what they will run. The larger inverters go up to 2000-watts and usually combine an inverter and a charger. These units are typically installed in an outer bay due to the amount of heat they create.



Remember, even with an inverter installed, not all the 120-volt circuits can be energized. Most inverter systems only allow a select few outlets to be energized and on some of the more powerful inverter systems, a residential style refrigerator can be run. The air conditioner is almost never run to an inverter due to its energy demands.



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## Installation



The first thing you should do when getting ready to install the solar panel kit is to lay the kit out and make sure you have all the components.

The next thing you will want to do is to walk around the areas of the RV and look for different issues you might encounter and make sure there isn't anything in the way of your mounting locations or wire chases.

Look through the installation instructions and adhere to the do's and don'ts. You need to plan on how to get the wiring from panel to battery and controller.

Lastly, assemble everything you can on the ground first rather than fuss with fasteners and small parts up on the roof.



When installing the panel on the roof, you want to start by cleaning the area well. Then, if you are installing the rigid style panels, you want to be sure that you will be screwing down into a solid surface.

Since you will be making holes in the roof, you will want to take steps to prevent water intrusion. Adding a butyl tape to the bottom of the brackets as well as using the correct sealants will go a long way to keep water out of the anchor points.

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## Installation (continued)



The next step in your installation will involve fishing the wires from the solar panel on the roof down to the batteries and controller. It is important to avoid areas where the wires can be damaged by chaffing or heat.

You also want to try to run the wiring in the shortest route possible to minimize the voltage drop on the circuit. Make sure to follow the directions and connect to the correct locations on the controller.

The battery and solar panel should remain disconnected until you have finished the wiring and are ready to test the system.

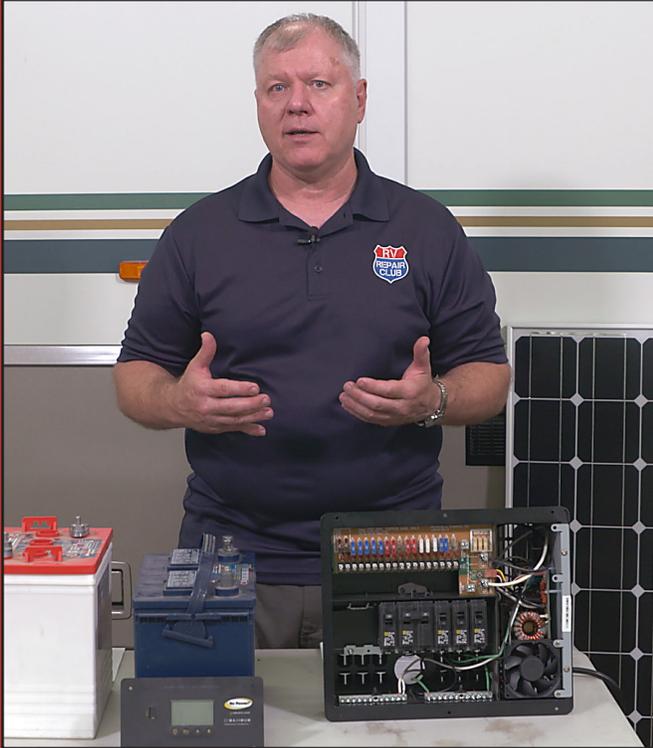


The last step of the installation is to test – to make sure the system is functioning. To do this, you need to connect the solar panel and reconnect the battery. If you are inside, you should read some voltage on the display of the controller if it is an efficient panel, but you should have the panel located in direct sunlight to make sure it is working as designed. In full sunlight, you should read close to the maximum voltage on the panel.



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## Class Wrap Up



Now that the system is installed and working, there are a few more things to consider.

- You will want to check into any potential tax credits or rebates for the renewable energy that you have installed.
- You will want to consider how the unit is stored when not in use. If it is stored inside or under a cover, especially in the winter, you may want to consider removing the batteries and putting them in the garage until you are ready to use them.
- If you get large amounts of snow and ice, you may want to invest in a cover for the RV.

### Thank You!

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