

RV 12 and 120 Volt Electrical Systems

Disclaimer

This is another in the series of articles I wrote to help newbies (new to RVing) with questions around popular questions. I am an avid and experienced RVer but am not a professional engineer or professional anything else for that matter. What follows are my opinions and are worth what you paid for them. They are based on my 50 years of RVing. I believe them to be factual. If you disagree, do your own research and act accordingly. Here we go.

12-volt Stuff

I recommend you upgrade your RV battery bank to a pair of 6v "golf cart" deep cycle flooded batteries. You should get at least 5 nights camping out of these without running a generator or plugging in to recharge them unless it is cold and the furnace runs a lot. If you are so inclined, you can also use a solar panel to recharge them and as the price comes down, in my opinion, they are now possibly cost effective over a good inverter style portable generator or a built-in genny.

If you have the space and budget, four 6v golf cart batteries are even better. It is important to use batteries from the same manufacturing batch. Don't mix and match batteries made a long time apart, from different manufacturers or of different capacities. The weak one will discharge the strong one and leave you with less usable power. Generally, two 6v batteries will give you significantly more usable power for longer than will a pair of 12v deep cycle batteries.

The 12v system feeds your interior lights, smoke and propane detectors, the brains in your fridge and hot water heater, and the thermostat and fans in the furnace. The 120v system feeds the roof air, TV, microwave, toaster oven, coffee maker and so on.

Details about properly wiring batteries is below.

Transfer Switch

The transfer switch automatically transfers (hence the clever name) the source of the RV's power between your 12v battery bank, the shore power cable when plugged into the campground, and a running generator. You'll sometimes hear a thunk when it switches. It sends the power from either source to your converter. The converter takes 120v in from the outside world and feeds the 120v systems with a pass through and it feeds the 12v systems, including a battery charger which is built in. .

Converter (120v to 12v)

Most RV manufacturers build in the cheapest components they can find in order to sell at the lowest price. That's why original equipment is usually a single 12v battery instead of two 6v ones. The converter is no different. Chances are you have a low-cost unit with limited battery recharging capability (when plugged into 120v power).

The converter is a rectangular metal box, sometimes with a dark brown cover, door or panel that can be opened or removed. It has circuit breakers for the 120v systems and fuses for the 12v systems. There is a label on the door with the specifications.

You need to determine the total 12-volt DC amperage it can produce (30, 50, etc) and the maximum it can send back to the batteries to recharge them. The original equipment converter in our last motorhome had an output of 55 amps which is lots. The problem was that it could only send 1.5 amps to the batteries! It was useless as a battery charger so I upgraded the internals of it to a 40 amp charger out of a 60 amp system total. Less than a half hour a day of generator time recharges the batteries nicely. That's about the time needed to make coffee and toast. The upgrade is easy enough to do and half the cost of a whole new unit. You can order it on line or through eBay like I did or check around the RV parts stores in town.

Inverter (12v to 120v)

Another toy that you might find useful (or already have) is an inverter. This little box takes 12 volt DC power and magics it into 120v AC power. There are cheap ones called modified sine wave which will run most things like an electric chain saw. For electronics such as computers or televisions, you should use a true sine wave model. This is the type of power that comes out of a generator or a household circuit.

They are also expensive and I think if you need clean 120v power, buy a generator. One other thing about inverters, they are power pigs. Most are in the 70% efficient range and Ohm's law applies. To get 10 amps of 120V AC power (1200 watts), you will draw 100 amps of 12v DC power, plus the 30% loss or about 130 amps out of your battery bank. You'll drain them pretty quickly. Buy a generator.

Generator

Portable generators have a habit of getting stolen so make sure it is welded or chained down. If you can get one with a remote control, it will be worth the extra few dollars. Do you really want to go out in the rain to manually start your portable generator so you can make your morning coffee? Remotes are good!

Also, while I think of it, genny ratings are usually for peak power, not continuous output. The Honda 3000 for example puts out a full 3,000 watts for a few seconds to allow a big roof air to start, then reduces its power output to 2,600. We have a 5,500 watt genny and it cannot start both roof airs at once. The power management system delays starting the second one until the first is running smoothly and drawing less power.

Recharging 12v

The 12v power systems that run your RV and those that run your engine and other automotive systems do not talk to each other. Both are recharged via the alternator on the engine in motorhomes. Some, but not all, trailers are also recharged from the tow vehicle's alternator. If not, you need to connect to shore power or to a battery charger to get them ready for your

next trip. You should recharge them as soon as practical because lead-acid batteries don't like to be stored with only a partial charge and will punish you with a shorter lifespan.

Wiring Batteries

There are two 12v battery systems in motorhomes, one for the engine and one for the house.

Batteries generally come in 6v and 12v but your RV requires 12v. It is easy to connect two 6v batteries in series to make 12v. It is similarly easy to connect two or more 12v batteries (or pairs of 6v batteries) in parallel to still make 12v but have much more available power. Details below.

Cranking batteries to start the engine are of very different design and construction than are Deep Cycle batteries designed to run 12v RV systems. Both types come in assorted shapes, sizes, and capacities. Think of a cranking battery as a fire hose producing a lot of water for a short period and a deep cycle battery as a garden hose producing a useable amount of water for a much longer period.

Engine Side

Typically, motorhomes with gas engines use one 12v cranking battery and diesel engines use two 12v cranking batteries wired in parallel. Cranking batteries are recharged quickly as soon as the engine is started. They are designed to supply a lot of power for a relatively short time. They also accept high amperage recharging from the alternator.

Cranking batteries are typically very reliable right up until they fail at which point they must be replaced. Most of us are familiar with cranking batteries and dread that click-click sound telling you it is time for a new one.

House Side

There are lots of excellent in-depth technical articles about RV or deep cycle battery construction at the various manufacturers' websites. Check out:

- <https://www.trojanbattery.com/applications/recreational-vehicle-batteries>
- <https://www.interstatebatteries.com/recreation-vehicles/rv-batteries/deep-cycle>
- <https://www.batteriesplus.com/battery/rv/deep-cycle#product-listing>

The bottom line is that two 6v batteries in series to make 12v produce more usable power than two 12v batteries in parallel to make 12v.

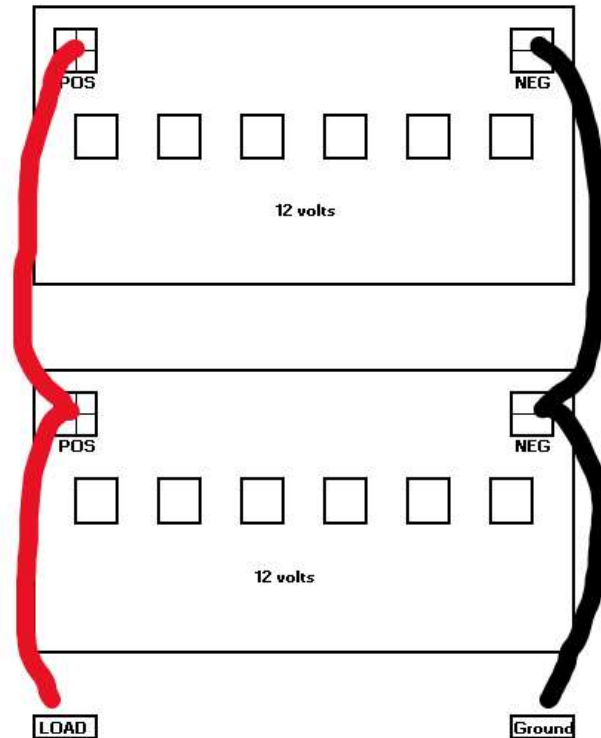
A quick word about lithium batteries. I don't know enough to write about them confidently. I understand they have higher storage capacity than flooded lead-acid batteries and weigh much less; both attractive qualities. The downside is they do not handle cold temperatures well, cannot be recharged by the motorhome's engine or the built in converter most of us have. And they are at least twice as expensive as old-fashioned flooded lead-acid or AGM batteries.

Where To Buy Batteries

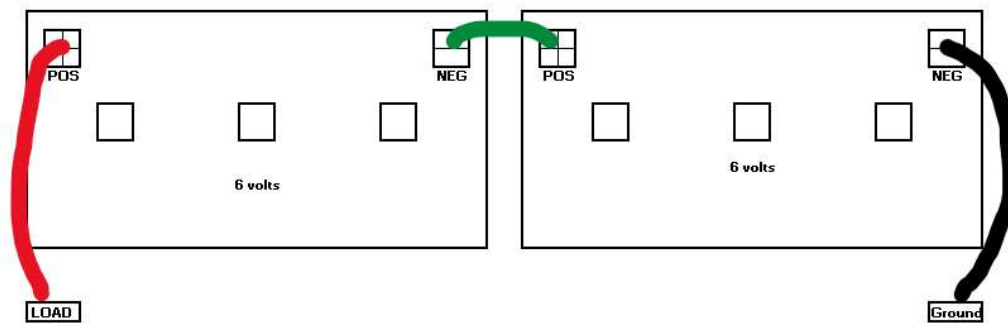
Shop around is the best advice I can offer. Make sure you are comparing apples to apples and buy the best value for your needs. I like Costco but other retailers may be a better choice for you. It is worth checking at your local golf cart supplier for GC-2 batteries.

How to Wire Batteries

Two 12v batteries in parallel



Two 6v batteries in series to make 12v



Two pairs of 6v batteries in series to make 12v with 2x higher capacity

