RV Inverters 101 by: Mark J. Polk

If you own an RV, or have been around RVs you're probably familiar with a converter. When you're plugged into electricity or using a generator the RV converters job is to reduce 120-volts AC down to 12-volt DC to supply power to all of the 12-volt appliances and accessories in the RV. If you weren't plugged into an electrical source your RV battery(s) would supply the power to all of the 12-volt appliances and accessories in the RV. The converter basically prevents your RV battery(s) from draining when you're plugged into electricity or when you run the generator. The converter also acts as a battery charger, providing a trickle charge to keep the batteries topped off.

Now, what about an inverter? Your RV batteries produce power in Direct Current (DC) that run at low voltages. Power companies and AC generators produce sine wave Alternating Current (AC), which is used to operate 120-volt appliances and electronic equipment. An inverter takes 12-volt DC power from your RV batteries and electronically changes it to 120-volt AC.

If you've been RVing for awhile you have probably been in a situation where you needed an inverter at one time or another. Maybe it was when you were dry camping and didn't have access to electricity, or even when you have a generator but it's after quiet hours and you still want to watch a TV program. You don't want to buy a bigger inverter than you need, but you also don't want one that's too small for how you plan to use it.

Inverters are available in small portable units that plug directly into a cigarette lighter or 12-volt outlet to larger high power hardwired units that can provide electricity for the entire RV electrical system and are permanently installed in the RV. Many of the inverters found in RVs today are inverter/chargers. What this means basically is that they are inverters, battery chargers and a transfer switch all in one. They act as a battery charger when you're plugged into an electrical source or using the generator, and they invert stored DC battery power when no electrical source or generator power is available. They are capable of transferring from inverter to battery charger automatically.

Inverters are rated in watts and come in a variety of sizes and power ranges from 75 watts to 3000 watts. The size of the inverter you will need depends on several factors. If the majority of your camping is done at campgrounds where electricity is plentiful you may not even need an inverter. On the other hand you might enjoy boon docking where all of your 120-volt requirements depend on batteries and an inverter.

When you purchase an inverter the output capacity must be capable of operating the loads that will be placed on it. Inverters have two different capacity ratings, the continuous output rating and surge capacity rating. Continuous output is the maximum wattage the inverter can output for a long time period. Surge capacity is the maximum wattage the inverter can output during initial start up. All appliances require more

power when they initially start, compared to what they use when they are running. They can use as much as two or three times the amount to start that they use to run, so the starting power required for any appliance that you plan to use with the inverter must be within the surge capacity rating.

Let's say you only plan to use an inverter to run one or two small appliances. You might want to use a 19-inch TV, a VCR, and an overhead light all at one time. You total all the wattages, about 80 watts for the TV, 25 watts for the VCR, and 20 watts for a fluorescent light. This is a total of 125 watts. In this case you can probably get by with about a 300 watt inverter. Other RVers use inverters to operate microwaves, coffee pots and other larger appliances which will require a larger more sophisticated inverter.

Another consideration is the type of AC power being produced. There are modified sine wave inverters and true or pure sine wave inverters. Modified sine wave inverters are less expensive and will power most types of appliances. The down side to modified sine wave inverters is that some electronic equipment will not run on this waveform and because it's not true or pure sine wave you may get some electrical noise or a snowy picture on your TV screen. True or pure sine wave inverters are more expensive, but they are capable of producing power as good as a power company and all appliances and electronic equipment will run the way they are intended to. Microwaves, motors and other inductive loads will run quieter and will not overheat and electrical noise will be reduced. If you plan to use a computer or other sensitive electronic equipment you may want to consider a true sine wave inverter.

Another very important consideration when using an inverter is your RV battery(s). The more electricity you plan to use not only requires a larger inverter, but a larger battery bank too. Batteries are rated in amp hours. The amp hour rating is basically how many amps the battery can deliver for how many hours before the battery is discharged and needs to be recharged. Amps times hours. In other words a battery that can deliver 5 amps for 20 hours before it is discharged would have a 100 amp hour rating. 5 Amps X 20 Hours = 100Amp Hours. This same battery can deliver 20 amps for 5 hours. 20 Amps X 5 Hours = 100 Amp Hours.

You need to compute the amperages you plan to use and the amount of time you plan to use it to determine if your battery(s) are capable of providing enough stored power. Keep in mind when you make your calculations that when a battery is discharged to 50% of its capacity it is basically dead. What this means is a 100 amp hour battery can really only provide 50 amp hours of service before it needs to be recharged. The power, in watts, drawn from the batteries by your inverter is the same as the power, in watts, drawn by the 120-VAC items, plus about 15% for losses in the inverter. Since Watts = Volts times Amps, and the 120-volts is 10 times the 12 volts of the batteries, then about 10 times the amperage is required from the batteries than the amperage drawn by the 120 volt loads (ignoring for the moment the inverter losses). For instance, a TV might draw 480 watts from the 120-volt AC supply, which is 4 amps of current. To supply this 4 amps at 120 volts, the inverter must draw 40 amps at 12 volts from the batteries, plus about another 6 amps for the inefficiency of the inverter.

You can estimate your total battery capacity requirements by starting with the tables below. In the first table, you will find estimated requirements for 120-volt items. Note that you need to use the column "Amps at 12 V". To compute required amp-hours, multiply each entry by the number of hours you estimate you will use the item during the time between battery recharging sessions. Similarly find your 12-volt loads from the second table and multiply each of them by their estimated use time in hours. After adding up all the required amp-hours, add about 15% for inverter losses. This gives you an estimate of the amp-hours actually required from your batteries.

Last but definitely not least you need to consider that any battery power used has to be put back in through some type of effective charging system. Batteries need to be charged in three stages. The first stage is a bulk charge that replaces 80% of the battery capacity very quickly. The second stage is the absorption stage that replaces the remaining 20% and the last stage is the float stage which is a lower voltage designed to keep the battery(s) topped off, but not overcharge them. Many RV converter/chargers charge battery(s) at a fixed voltage in the range of 13.5 volts. This will not recharge batteries that are discharged to 50% and it can be too much for a float charge for fully charged batteries. Once you determine how much battery power you will be using you can decide on an effective charging system. It may be that you only need to keep the batteries topped off with the converter charger, or you might need a complete set of solar panels to put back into your batteries what you are taking out. Again, this is a whole other topic. I am including some typical amperage draws for appliances and accessories commonly used in RV's and some simple formulas to convert some common electrical terms.

Wattage % Volts = Amps
Amps X Volts = Wattage

Amp Requirements for 120 Volt Items

Appliance or Electronic Equipment	Est. Amps @ 120 V	Est. Amps @ 12 V
Air Conditioner (X number of A/C)	12-16 Amps	120-160 Amps
Blender	5-6 Amps	50-60 Amps
Coffee Maker	5-8 Amps	50-80 Amps
Compact Disc Player	1 Amp	10 Amps
Computer (Laptop)	2-3 Amps	20-30 Amps
Converter	1-6 Amps	10-60 Amps
Crock Pot	1-2 Amps	10-20 Amps
Curling Iron	<1 Amp	<10 Amps
Drill	2-6 Amps	20-60 Amps
Electric Blanket	0.5-1.5 Amps	5-15 Amps
Electric Fan	1 Amp	10 Amps
Electric Water Heater	9-13 Amps	90-130 Amps
Electric Skillet	6-12 Amps	60-120 Amps
Hair Dryer	5-12 Amps	50-120 Amps
Iron	5-10 Amps	50-100 Amps

Light (60 watt % 120V)	<1 Amp	<10 Amps
Microwave	8-13 Amps	80-130 Amps
Microwave (Convection Oven)	13 Amps	130 Amps
Refrigerator in AC mode	5-8 Amps	50-80 Amps
Space Heater	8-13 Amps	80-130 Amps
Television	1.5-4 Amps	15-40 Amps
Toaster	7-10 Amps	70-100 Amps
Vacuum (handheld)	2-6 Amps	20-60 Amps
VCR	1-2 Amps	10-20 Amps
Washer/Dryer	14-16Amps	140-160 Amps

12 Volt DC Amp Ratings

Appliance or Accessory	Estimated Amps
Aisle Light	1 Amp
CO Detector	1 Amp
Fluorescent Light	1-2 Amps
Furnace	10-12 Amps
LP Gas Leak Detector	1 Amp
Overhead lights (Per Bulb)	1 Amp
Porch Light	1 Amp
Power Roof Vent	1.5 Amps
Radio/Stereo	4 Amps
Range Hood (Fan & Light)	2-3 Amps
Refrigerator (LP Gas Mode)	1.5- 2 Amps
Security System	1 Amp
Television (12 volt)	4-5 Amps
TV Antenna Booster	<1 Amp
Variable Speed Ceiling / Vent Fan	4 Amps
VCR Recorder / Player	2 Amps
Water Pump	4 Amp

I hope this helps to answer some questions you may have had about inverters.

Happy Camping,
Mark

Mark Polk is the owner of RV Education 101. RV Education 101 is a North Carolina based company that produces professional training videos, DVDs and e-books on how to use and maintain your RV. Our goal is to make all of your RV experiences safe, fun and stress free.
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