RV Solar = Freedom

DICK & BECKY MARTIN

BRN 2753

Overview

- Why Solar Panels?
- How much Solar do I need?
- Components of a Solar System
- Batteries-Lead Acid vs Lithium?
- How do I know how much energy is left?
- Do you want to run 120 VAC appliances?
- Monitoring/Trouble Shooting
- Self Install or Turnkey?
- Q&A?

Why Solar Panels?

You want to camp in places that don't have hook-ups

- BLM (Bureau of Land Management) camping
- Primitive National Park camping
- Harvest Hosts/Boondockers Welcome camping
- Friends Driveways/Streets
- Small town city parks w/o hookups
- Business Parking lots (Cracker Barrell, Walmart, etc)
- Others?

How much Solar do you need?

How do you want to use your camper/motorhome?

RV Solar & Safety

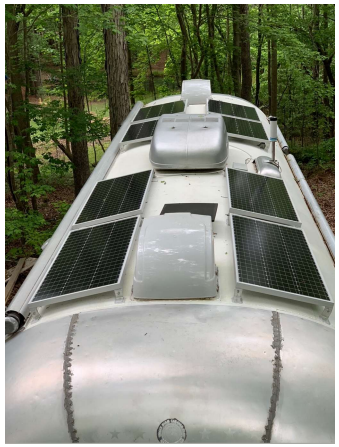
1. Extended dry camping v.s. Keep your batteries charged during storage
2. If dry camping, make a list of your appliances, you want to use:
   - Type of appliance
   - Amps @ 120v from nameplate on each appliance
   - Amount of time you use it daily <u>in hours</u>
   - Then make a chart of amps @ 120 vac for each device
   - Multiply #amps by # of hours used for each device
     - (example: coffee pot >8 amps x .1 hrs = .8 amphrs
   - Total the number of amphrs at 120 vac
   - To get to amphrs at 12 vdc, multiply by 11
3. Rule of Thumb is 200-250 watts of Solar for every 100 Amphr of Battery

Typical Loads in an RV

Appliance	Watts	Volts	Amps	Time Used in Min	Time Used in Hrs	AmpHrs @ 120 V	AmpHrs @ 12 vdc
DC Loads	Served Directly by the Batteries						
LED Lights (20)	20	12	1.67		4.00		6.67
Bathroom Fan	2	12	0.17		1.00		0.17
Fantastic/Max Fans (2)	24	12	4.00		6.00		24.00
Outdoor LED Lights	2	12	0.17		4.00		0.67
Kitchen Cooktop Fan	2.5	12	0.21		1.00		0.21
Water Pump	6	12	0.50		1.00		0.50
Water Heater	12	12	1.00		6.00		6.00
Furnace Fan (runs 1/3)	108	12	9.00		20		18.00
Refrigerator on DC (Using LP)	12	12	1.00		24.00		24.00
Total							80.21
AC Loads	Served by an Inverter						
Coffee Pot	600	120	7.10	10	0.17	1.18	11.83
MicroWave	1050	120	8.75	15	0.25	2.19	21.88
Hair Dryer	1200	120	10.00	10	0.17	1.67	16.67
TV LED/LCD	60	120	0.50		4.00	2.00	20.00
Laptop (Charging)	65	120	0.54		3.00	1.63	16.25
Stereo/Music System	100	120	0.83		4.00	3.33	33.33
Small Fan	60	120	0.50		6.00	3.00	30.00
Total						15.00	149.96

Solutions:

1. Hook up to Utility Power
    a. May not be Available in Remote Areas
2. Run a Generator
    a. You need to carry the Genset
    b. You need fuel, either LP, Gas or Diesel
    c. Noisy
3. Add Solar Panels and Batteries



Solar System Components

Solar Panels

Solar Controller

Panel Mounting/Combiner Boxes

Inverter/Converter

Battery Monitor

Fuse/Breaker Protection

Storage Batteries

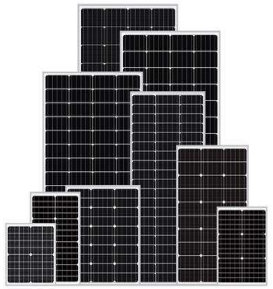
Solar Panel Options

Flexible Panels

- Good for curved or uneven surfaces
- Good for lower profile
- Lighter than fixed panels
- Get really hot in summer when directly on roof aluminum

Rigid Panels

- Available in many sizes –small to large
- Lower cost per watt
- Extremely durable
- Tolerate heat better when mounted a few inches off the roof
- Provide shade for the Airstream roof
- Available in 24 vdc and 12 vdc
- Produced in the millions so lower prices



Solar Controllers

Solar Controllers regulate the flow of Energy from the Panels to the Battery

Two Types of Solar Controllers:

- Maximum Power Point Tracking (MPPT)
- Pulse Width Modulation (PWM)

MPPT Controllers increase the effectiveness of an given array by up to 30%

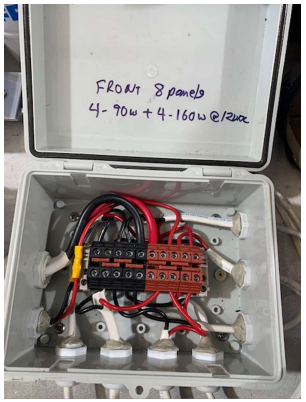
MPPT Controllers support higher voltages, keeping wire size smaller for longer runs

Getting Power from the Panels to the Batteries

Combiner Boxes
- Series or Parallel panels together
- Reduces # of wires through the roof
- Cleaner Installations

Panel Mounting
- Fixed or Tilting
- Flat or Curved Roofs

Protection/Switching
- Protect solar panel wires with a Breaker
- Protect Solar controller output with a Breaker
- Breakers can be opened manually to disconnect



RV Battery Technologies

Lead Acid-Flooded, AGM or Gel Cell

- Lowest Cost
- Only allows 50% of rating to be used and need equalization
- AGMs offer a spill-proof design, lower internal resistance, faster charging times and a longer life
- Gel cells contain no liquid. The sulfuric acid is mixed with a thickening agent to form a gel-like substance

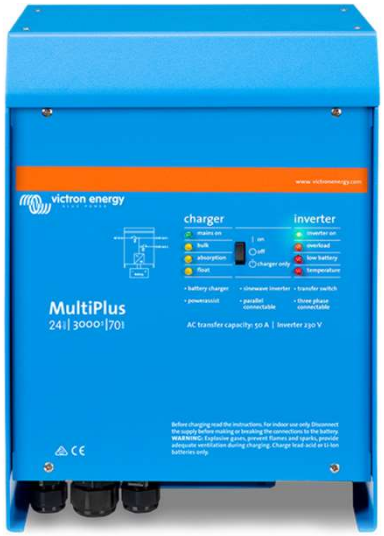
RV Battery Technology

Lithium Iron Phosphate Batteries

- **They are SAFE** -LiFePO4 RV batteries are designed with a built-in safety measures
- **They Go Further** -With highly sustainable voltage levels, lithium RV batteries offer 95-99% usable capacity
- **They weigh less** -Lithium batteries are typically half the size and a third of the weight of traditional lead-acid batteries
- **They live longer -**Lithium batteries have up to 10X longer cycle life than lead-acid equivalent. 3500 to 6000 cycles,
- **They're maintenance-free -**Lithium-ion batteries require zero maintenance in their decade-long battery life
- **They are Self Protecting with Battery Management Systems**

Do you want to use 120 vac Appliances?

- Inverter changes DC (battery) into AC (outlet)
- Some include a Transfer Switch
- Rated in VA, short term current and continuous current
- Connects to the battery bank with heavy copper cables
- Through a Fuse for protection
- Many include a battery charger function
- Size to accommodate AC loads running simultaneously



Everyone ASKS:

Can I run my A/C on my lithium batteries?

Answer: Well, maybe!

A typical 15,000 BTU A/C runs 13-14 amps at 120 vac

To get A/C from DC in your batteries, you need an inverter!

In rough terms, to find the DC current required to operate the A/C, multiply the current by 11

Lets assume you have 2-100 Ahr lithium batteries in your rig, so you have about 200 Ahr max available

So, 200 Ahrs/(14ax11) = = 1.3 hours, then batteries are dead

So, Yes, but not for very long without a large battery bank

And More

Electric motors require a surge of energy to establish the magnetic field that operates the motor

For A/Cs this may be up to 5100 watts to start and then 1600 watts to run.

This translates to ~42 amps to start and 13.5 amps to run.

Since the 42 amps are for a very short time, the A/C starts when on a 30 amp campground hookup.

What about operating with a small generator? NO GO!

Solution: Add a device to reduce the startup surge: like SoftSartRV or EasyStart

This also allows running two A/Cs on a 30 A service and reduces the thump when the compressor starts

Or run with a large inverter and lots of batteries

Battery Monitors
How do you know how much energy is left?

Victron BMV-712 Battery Monitor

- Bluetooth inside
- Easy to install
- Very low current draw from the battery
- Battery capacity: 20 to 9,999 Amp-hours (Ah)
- 500A / 50mV shunt included
- Supply voltage: 6.5 to 70 Volts DC
- Displays Battery voltage, current, power, ampere-hours consumed and state of charge
- Remaining time at the current rate of discharge
- Programmable visual and audible alarm
- Measures energy, not just voltage

Self Install or Turnkey?

Many handy campers can install themselves

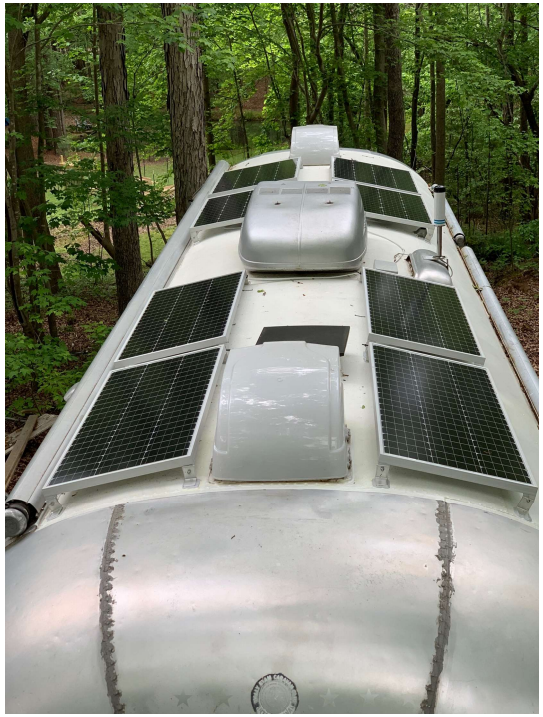
Saves money, not necessarily saves time

System Design is very IMPORTANT

Advise using Products from established Companies

- Warranty Coverage does no good without a company behind it
- Products in service for a time, have been through most early failures
- Web-connected products can be easily updated with new firmware/software
- Less problems with obsolescence and bugs

RV Solar Installs



Q&A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RV Solar & Safety Products Available

NOMAD Portable Grill/Smoker

ProOne Water Filters

Element Fire Extinguishers

FireFight Gas Extinguisher

ReLion LiFePO4 Batteries

PowerMax Converters

Odorcon Purogene

Victron SmartSolar

Victron BMV-712

Victron Orion DC to DC

RV Solar & Safety Products

Truma AquaGO

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ProOne Water Filters

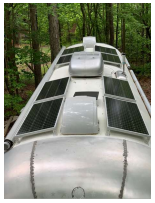
Element Fire Extinguishers

FireFight Gas Extinguisher

Micro-Air EasyStart

Micro-Air Thermostats

Solar Panels



RV Solar & Safety Products

Victron MultiPlus MultiPlus

Victron SmartSolar

Victron BMV-712

Victron Orion DC to DC

Battle Born LiFePO4 Batteries

Renogy LiFePO4 Lithium Batteries

PowerMax Converters

Odorcon Purogene