# RV Solar Made Easy

## A Guide for DIYers & Service Professionals

Thanks to ongoing technological advancement, RV electrical systems are quickly shifting to be more sustainable and self-sufficient. Campers can now enjoy many, if not all of the comforts provided by traditional 30 and 50 amp services, without relying exclusively on shore and generator power. Solar and lithium electrical upgrades can provide much in the way of flexibility for campers looking to get off the beaten path.

This is a manual to help the DIYer, as well as experienced RV service professionals better understand some of the newer components, considerations and best practices associated with off-grid electrical upgrades.

Now it's time for a fun & safe installation! Know that you are not alone in this endeavor. If at any point you have questions about the material contained in this manual, we at RV Solar Connections are just a phone call away. Please read each section thoroughly, the guidance herein has been compiled through review of hundreds of successful installations.

**For more, visit us online at [https://rvsolarconnections.com/](https://rvsolarconnections.com/)**

**Join the RV Solar DIY community at [https://www.facebook.com/groups/rvsolarconnectionsdiy](https://www.facebook.com/groups/rvsolarconnectionsdiy)**

**Presented by:**

RV SOLAR CONNECTIONS

# Resources To Help Get Started

Before you dive into RV Solar Made Easy, there are a few items we'd like to discuss:

**RV Solar Energy Audit -** An energy audit is typically the first step before deciding how much solar or battery capacity you need for your off grid electrical system. The energy audit is simply a means to estimate your expected energy usage on a given day. This is important, as it will ensure your solar system will actually meet your needs and expectations.

We've put together an Energy Audit Calculator to make this step as easy as possible. You can also visit our site to learn more about how to do an RV solar energy audit.

**Inverter Size Calculator -** Similar to the energy audit calculator, our Inverter Size Calculator will help you determine which inverter is right for you.

**Custom Wiring Diagrams -** Throughout this ebook you may see reference to "your diagram". Besides being a free resource available online, we also share this manual with our custom wiring diagram clientele.

While the information contained herein will be valuable through the planning and installation phases of your project, it is not intended to be a tutorial for complete system design. Learn more about our Complete System Design and Custom Wiring Diagram services.

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# General Guidelines & Tips for Success

The following guidelines and tips are meant to save you time and make this project smooth, fun and successful. Please carefully read through each section, do your best not to gloss over, as you could miss some critically important information. Let's get started!

**Safety** - Electricity can be lethal, which is why it's so important to be intentional at every stage of your installation. Whenever possible, avoid working with "live" wire or components. Your power project is essentially like a real-world math formula, and if you follow each step of the formula, you'll achieve the right solution every time. This guide is meant to teach you the formula. Study it, follow it, and you will succeed.

**Beginner's Mind** - In the tradition of Zen Buddhism, "beginner's mind" is the practice of approaching all tasks and endeavors in life with an attitude of curiosity, openness and focused attention, just as a beginner would. Approaching a project with this mindset can help to prevent mistakes or oversights that could occur otherwise. Even though you may have experience in this domain, practicing beginner's mind will help you to achieve an even greater level of expertise.

**Realistic Timeline/Don't Rush** - Oftentimes projects take longer than we anticipate. It's all part of the process, so instead of stressing about the time, do your best to make this project more about the fun of learning and doing. Cutting corners or rushing can lead to costly mistakes, so remember that taking your time during every stage will save you time and money in the long run.

**Thorough Planning** - Before getting started with a task, be sure to read through that section so you know what to expect. Each task will require particular tools and materials, and proper planning up-front will ensure your work goes smoothly.

**Read the Manuals** - This installation guide is not a replacement for reading the product manuals. Before proceeding with planning and installation, carefully read the included manuals, as they contain important installation, operational and safety guidelines. Take notes as you gather relevant information that will assist you throughout installation. Instructions in the user manuals take precedence above all else.

**Mounting Considerations** - There are a couple factors you'll want to consider when mounting each component. An RV is like an earthquake rolling down the road. Bumps and turns can easily send your equipment flying if it isn't properly secured. Before mounting a component to a wall, make sure the wall can support the weight. If needed, you can always add more structure (such as 2x3's or thick plywood) for mounting heavier components.

**Wiring & Fuses** - Caution: Pay particular attention to the wire and fuse sizes of each circuit noted in the accompanying system wiring diagram. Improperly sized fuses or cable can result in electrical fires! Be thorough and follow the diagram and guidelines for a safe and successful installation.

**Wire Routing** - Wire routing should be neat and run in an organized fashion, but keep a small amount of play in the wire so there is no unnecessary tension. In a moving vehicle, a jarring bump could increase the tension in an already tight wire, causing it to pull out of a termination.

**Crimping** - There will likely be a fair amount of crimping involved throughout installation. The importance of methodical and proper crimping cannot be overstated. Failed crimp connections are the leading cause of issues in electrical systems (especially for mobile applications subject to frequent vibrations). Use the appropriate tool and size when crimping, and always give a firm tug after a crimp has been made in order to test the integrity of the connection. It's better to take a few moments to re-crimp a loose connector than spend hours troubleshooting down the road.

**Torque Specs** - Follow all recommended torque specifications provided in the product manuals. Too tight, and you run the risk of stripping out or breaking a mechanical connection point. Too loose, and you run the risk of added resistance, which will result in inefficiencies, heat, and higher current than a particular circuit was designed for.

**Programming** - Many electronic components require programming via dip switches or software in order to function properly. This is an important step that is sometimes overlooked. Failure to program components with the appropriate settings can compromise the integrity of the entire system. Programming guidelines are noted in this guide, and more details can be found online or through your RV Solar tech representative.

**Have Fun!** - We're building electrical systems that harvest energy from the sun to provide power for many years to come. We're realizing the dream of traveling and camping comfortably off the grid. Take pride in your work and embrace the joy that comes with learning and building self-sufficient systems.

## Tools Needed

- Wire Stripper
- Wire Crimper
- Heavy Duty Wire Crimper
- MC4 Crimper
- Heat Gun
- Multimeter
    - The Best Multimeter
    - Budget Friendly Multimeter
- Diagonal Cutter
- Heavy Duty Cable Cutter (cut up to 4/0 cable)
- Box Cutter (for stripping 6ga-4/0 cable)
- Socket/Wrench set
- Torque wrench
- Torque screwdriver
- Screwdriver
- Level
- Ladder
- Caulk Gun
- Drill/Driver
- Various Drill Bits

# Materials List - Parts Check

Before getting started, check to ensure all the materials have arrived by sorting the various components into piles based on the categories they're listed under on the materials list. This will help us get organized from the start, and make it easy to identify if any parts are missing, so that we don't run into surprises during installation.

## Solar Pt. 1

### Solar Panel Layout

Whether you plan to pack the roof with as much solar as will fit, or you're just adding a couple panels, take some measurements and determine how the solar panels are going to fit on your RV roof.

***Pro tip:*** *Looking for an easy way to experiment with solar panel layout? Cut a piece of cardboard to the dimensions of the solar panel, and use this to determine the most efficient layout.*

### Solar Panel Test

Before mounting the panels on your roof, verify they are all in good working order. Essentially, we're going to use a multimeter to make sure the open circuit voltage matches the manufacturer's specifications. Check out this short video for a step-by-step tutorial.

### Mounting

The two main objectives we want to achieve:

A) mounting the panels in a way that will ensure they never move unless we want to tilt or remove them.

B) preventing leaks by properly sealing any holes created by mounting brackets or wire fed through the roof.

Note that mounting methods will vary based on two factors:

1) *Roof Material*
2) *Roof Shape (Flat vs. Curved)*

**Roof Material**

For metal and fiberglass roofs, a combination of VHB tape and Dicor is typically enough to keep the panels in place. This method is used by professionals, and many successful DIY reports can be found online. If you prefer to add redundancy, metal screws, aluminum closed head blind 3/16 rivets, or stainless steel nuts and bolts can be used as well.

For TPO and EDPM roofs, the VHB tape will stay attached to the rubber, but the rubber might not stay attached to the plywood beneath it. For these roofs, you must use screws or bolts in addition to the VHB tape and Dicor. Not all roofs are created equally though. If your roof has a plywood backing that is less than ½" thick, you'll need to use well-nuts, through-bolt, or possibly locate the studs. When in doubt about roof structure, contact the manufacturer for guidance.

A note on Dicor: Use a liberal amount of sealant when mounting solar panels. If using screws:

1) Pre-drill hole with appropriate sized bit
2) Apply dicor to pre-drilled hole
3) Drive screw into hole (be careful not to strip, consider using a standard screwdriver for this step)
4) Apply a liberal amount of sealant over screw head and around perimeter of mounting bracket

**Roof Shape**

Below are the recommended mounting brackets based on roof shape and optional tilting:

*Flat roof - Standard*

For flat roofs, the most economical choice for mounting is the standard Z brackets. Secure the brackets to the panel using the hardware supplied with brackets. Be sure to use one bracket on each corner of the solar panel, for a total of four brackets per panel. With larger panels (60-72 cell) you'll want to use 6-8 brackets per panel.

Note, you will not be able to remove the solar panel from the bracket once it's mounted. This deters theft, but it also means you'll need to remove the solar panel and bracket from the roof if your panel is ever damaged or needs to be replaced.

*Flat roof - Tilting*

Tilting your panels towards the sun will allow you to harvest a higher percentage of energy, especially during the winter months. To learn more about how tilting solar panels can increase their power output, check out this article. For tilting panels on a flat roof, use the standard tilt brackets.

*Curved Roof - Standard*

If you are working with a curved roof, you'll want to opt for specially designed curved z-brackets.

*Roof Racks*

Many options are available when it comes to roof racks. For common vans used in conversions (such as Sprinters or Promasters), you can find roof rack kits made specifically for your applications. For more custom projects, you might consider 80-20 aluminum or unistrut.

## Configuration

### Series vs. Parallel

Series configuration = total voltage increases, current remains constant
Parallel configuration = total current increases, voltage remains constant
Series/Parallel configuration = total current & total voltage increases

If you've purchased an RV Solar complete system design package, the ideal configuration for your particular application is outlined in the accompanying wiring diagram. Different factors determine the most appropriate configuration, such as:

1) Overall size of system
2) Panel specifications
3) Different aspects feeding multiple charge controllers
4) Shading

Choosing the right configuration is important, as this will reduce potential voltage drop and allow the solar array to deliver the maximum amount of charge and efficiency.

### Wiring

Solar wire (aka PV wire) is used when wiring solar panels because of its UV and weather resistant properties. Once the solar panels are in their approximate position, measure the length from the panel to its next connection point (another solar panel, “Solar-Ready” port, or combiner).

At this point, you’ll also need to determine the best place to bring the wire through the roof. Think about the most direct path you can take from the panels to the charge controller (typically located in the electrical box with the rest of your components). All RVs have wires hidden behind trim or inside empty wall cavities. Consult with your RV manufacturer or check online for where these access points may be in your RV.

Once you have the wire run planned out, cut wire to appropriate length and splice MC4 connectors to each side of the wire that is to be connected to another solar connector or MC4 port.

### MC4 connectors

MC4 connectors come standard on most solar panels. These connectors will need to be installed onto any extension wires that run from your solar panels to the combiner or cable entry housing.

Check out this short tutorial for splicing MC4 connectors. Most importantly, make sure to test the crimp connection by giving a firm tug on the metal crimp connector before inserting it into the plastic connector. There are a lot of vibrations on the road, and a single loose connection could compromise the entire system.

### Combiner

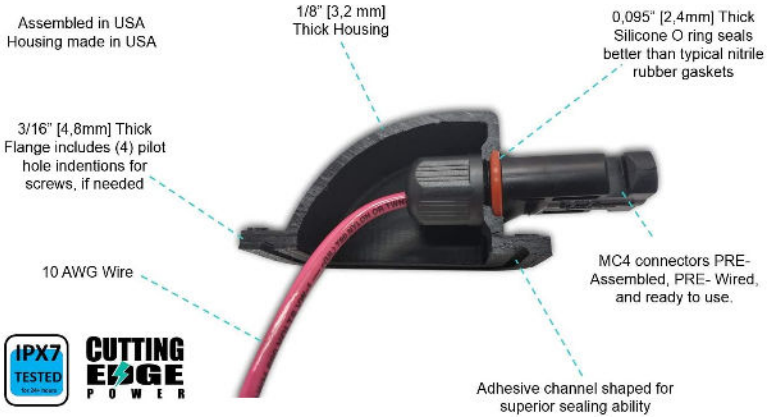
The purpose of a combiner is to bring the output of multiple solar panels together, prior to terminating the wires at the charge controller. The most commonly used combiner in mobile applications is the MC4 Branch Connector. With these, you can easily parallel up to (4) strings, simply choose the option that meets your needs.

If your combined strings exceed 30 amps, you'll want to consider a more robust combiner box. These come in wall mounted and roof mounted options. In most cases, it's easy to keep total amperage of RV solar arrays below 30 amps by using a series or series/parallel configuration.

### Roof pass through/Cable entry housing

Once the panels are mounted and the wires have been run into a combiner (if applicable), it's time to pass them through the roof down to the PV disconnect.

Once wires have been run to the combiner,, it's time to install the cable entry housing. There are different types of housings, so you may be running the cable through watertight cable glands, or connecting into MC4 ports. Regardless of the housing type, make sure to seal this with a liberal amount of Dicor. If mounting the housing to a TPO or EDPM roof, be sure to use screws in addition to sealant.



# Electrical Box

The electrical box is where the heart of your system will live. Batteries, Inverter, Chargers, Distribution, it all happens here. The following is a series of considerations we'll want to make before diving into installation.

## Standard vs. Stealth

Standard refers to an upfit in which you use easily accessible space, such as a large, empty storage cabinet, as the dedicated electrical box. A stealth build, on the other hand, takes a little more creativity to pull off. By cleaning up or rearranging spaces that RV manufacturers reserved for plumbing, wiring, and heating duct, it's possible to add a large electrical upgrade without losing any storage space.

## Layout

Once the location is determined, electrical box layout is the next stage of planning. It's best to work from large to small, so start with battery bank placement, then inverter/charger, and so on. Before sketching the layout for your electrical box, read through the remaining sections, as each component comes with particular mounting and wiring guidelines, which will ultimately inform the most safe and efficient layout.

## Framing

It may be necessary to add studs, plywood, or other structural improvements in order to mount the components included in your electrical upgrade. When choosing to mount a device to a particular surface, with a particular fastener, ask yourself “will this hold over hundreds of thousands of miles driving over bumpy roads?”. Leave no room for doubt. These electronics are expensive, and it’s better to do a little more work up front than having to come back and redo or replace down the road.

## A Professional Touch

Instead of mounting components on a rough piece of plywood, take the time to staple on some carpet, or add a couple coats of paint to match the interior. Keep wires organized and neat. Use a level. The components used in these upgrades are top of the line, and when you show your system off to your friends or the RV Solar community, you’ll be glad you went the extra mile.

## Ventilation

High temperatures can reduce the efficiency of your system, and over time this can lead to premature wear and failure of electronics. If there is limited space in the electrical box, it’s a good idea to incorporate passive or active ventilation.

Heat rises, so it’s best to place vents high and low in the electrical box. High vents allow hot air to escape, while low vents pull in cool, fresh air.

For optimal ventilation, incorporate small 12v fans and a digital thermostat to effectively and reliably lower the temperature on the hottest summer days.

*Note: active ventilation is only necessary in particularly tight installations, where component spacing can't fully conform to recommended guidelines in their respective installation manuals.*

# Batteries

Since the majority of off-grid upgrades will utilize lithium technology, the following guidelines apply specifically to lithium batteries.

## Mounting

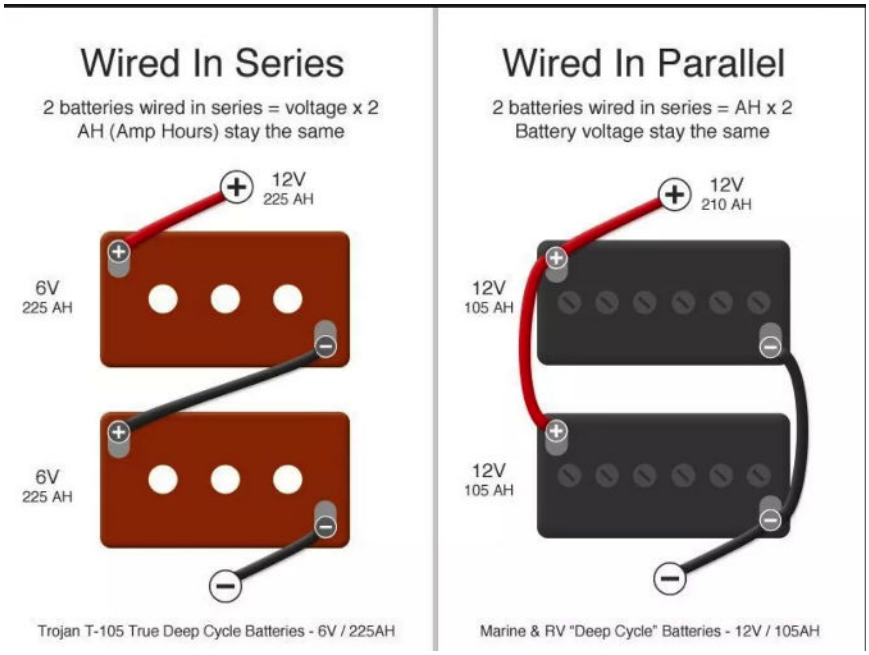
While some battery manufacturers claim you can mount their batteries in any orientation, it's a good idea to keep batteries right side up whenever possible.

So long as you have clear access to the terminals, feel free to mount these batteries in whatever way best utilizes the space.

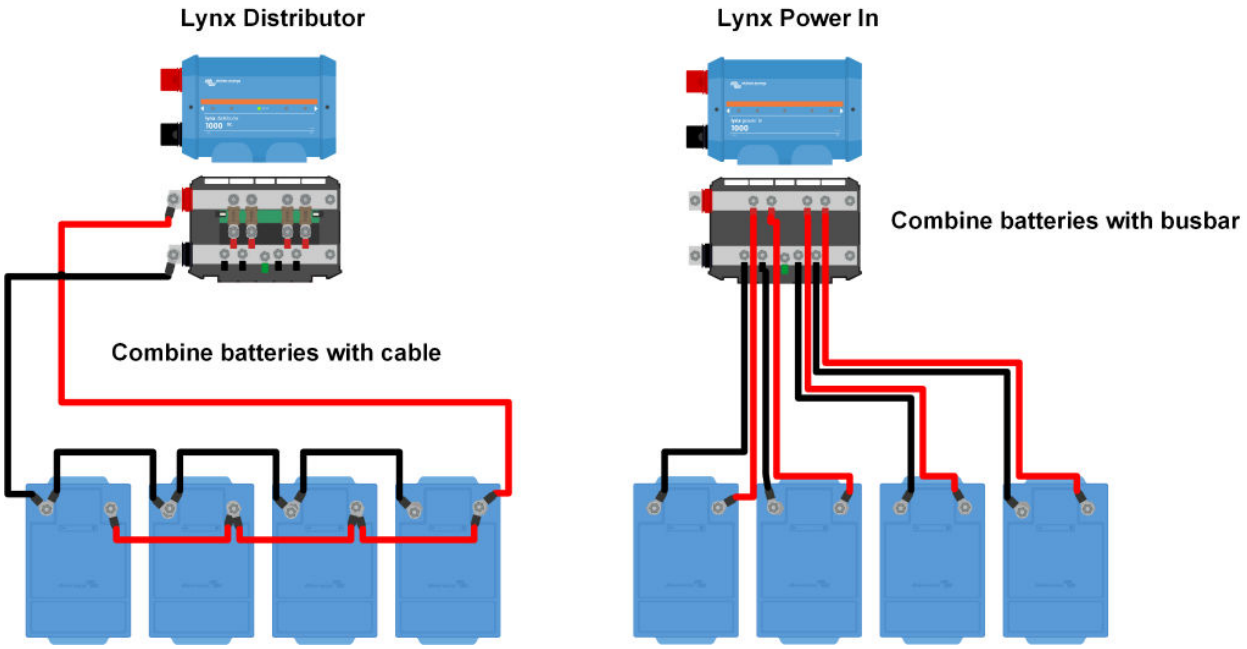
Always ensure batteries are placed in an area that will stay dry, and if you can mount them in a climate controlled space, even better. Check with the manufacturer for most up to date mounting guidelines.

## Wiring

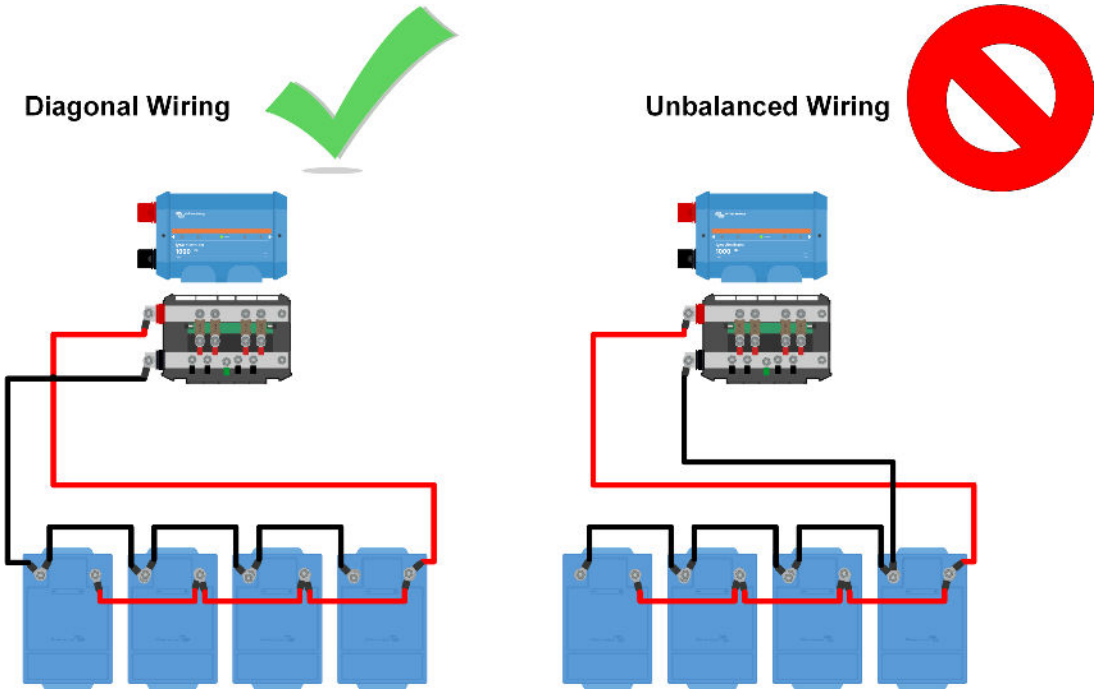
As with solar panels, batteries can be wired in a series, parallel, or series/parallel configuration. For the ideal configuration that will work best with your specific system, reference your wiring diagram.



Note, in order to keep the batteries balanced, it's important to follow the recommended wiring procedure. There are several ways to achieve this, but most commonly we recommend combining batteries with a busbar, such as the Lynx Power In or using cable to parallel batteries.




If you're using cable, make sure to use the diagonal wiring method (see below). Failure to wire the batteries to DC distribution in this manner will result in unbalanced battery cells, premature wear, and overall reduced lifespan of the battery bank.



## Battery Management System

Lithium batteries require a BMS in order to protect against certain conditions that can result in damage to the cells. A good BMS should protect against over charge and discharge, as well as high and low temperatures. The BMS can be internal (built-in to each battery) or external (an additional component included in your system design). Ensure a BMS is present before connecting any charger or load to lithium batteries.

## Battery Tie Down

Use a ratchet strap and cargo tie down anchors to keep the batteries from moving around. You may need multiple straps if you have multiple rows of batteries. For additional security, a piece of aluminum angle or similar material should be used in conjunction with the straps.


## Monitor & Control

### Battery Isolator Switch

Located on the positive line between the battery bank and DC distribution to all other DC circuits, the battery isolator switch is the main disconnect to cut off power. You may need to service or replace a device, in which case having the ability to shut off the incoming power will prove convenient. This switch can also be used to isolate the batteries from all loads and chargers when storing for extended periods of time.

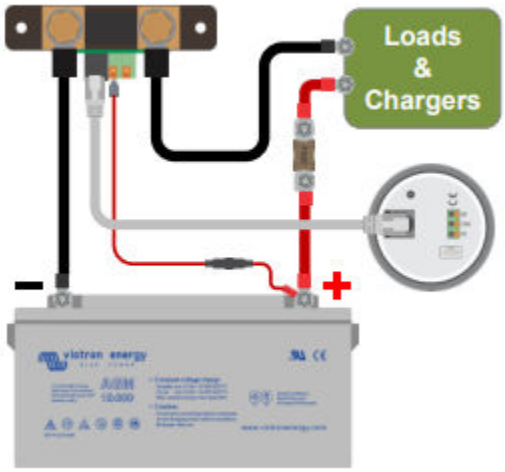
### Shunt

The shunt measures all DC current coming in and out of the batteries. This provides three important functions:

1) an accurate SOC (state-of-charge) readout, where your battery level stands between 0%-100%
2) monitor how much energy on average you are consuming and producing.
3) monitor real-time power draw and supply. In other words, see exactly how much current particular electronics or appliances use, and how much power your system is receiving via solar and other charge sources.

**Wiring**

On the negative (black) side, place the shunt in between the batteries and DC distribution. Pay attention to the orientation of the shunt, as one side is for batteries, and the other is for all other DC loads and chargers. Additionally, a small power lead included with the shunt will be wired to the positive DC distribution.




BMV-712

If using the BMV-712/shunt combo, an RJ12 cable (included with BMV-712) will run between the shunt and 712 battery monitor.

Victron SmartShunt

The SmartShunt has BlueTooth included, so an external battery monitor is not needed. This shunt is typically preferred over the BMV-712 if using the Cerbo GX or other GX device.

Lynx Smart BMS

The Lynx Smart BMS (to be used exclusively with Victron Smart Lithium batteries) has a built-in shunt and disconnect switch.

Shunt to GX Device

If using a GX device, such as the Cerbo GX, run a VE direct cable between the shunt and GX. More on GX devices later.

**Programming**

First, you'll want to download the VictronConnect app from the app store on your smartphone. From here, you'll change a few settings based on the particular type and brand of batteries used. For programming recommendations based on your particular system, check out the Victron Community, reach out to your battery manufacturer, or contact RV Solar tech support.

# Inverter/Charger

The inverter/charger has two primary functions in your off-grid electrical system

1) The inverter function takes direct current (DC) from your battery or solar array and converts this to power 120v or 240v AC household appliances, such as TVs, air conditioners, toasters, etc.
2) The charger (or converter) function takes alternating current (AC) from shore or generator power, and converts this to DC power to charge your batteries.

*Note: There are many inverter/charger manufacturers out there. We typically recommend Victron in this arena, so some of the steps in the following instructions will be specific to Victron inverter/chargers.*

If you need a hand deciding which inverter is right for you, check out our Inverter Size Calculator.

## Mounting

Depending on the model, the inverter/charger can be mounted in various orientations. If mounting on a wall, ensure it can handle the weight. Leave appropriate space around the inverter for ventilation. Mount the inverter as close to the battery bank as possible, but not directly above it. Read through the installation instructions in the manual that came with your inverter prior to mounting.

## Wiring

### Shore inlet to junction box

The cable attached to the interior side of your shore power inlet is where we begin. This cable runs all the way from the inlet to your AC breaker panel. Depending on the location of the AC breaker panel and its proximity to the inverter/charger, the cable may be long enough to reach the inverter/charger input.

1) unplug any cords from the shore power inlet.
2) verify with the multimeter that there is no power feeding the AC distribution panel. If there is an existing inverter on board, you may need to turn this off.
3) Disconnect the line, neutral, and ground coming into the AC distribution panel.Typically, these wires will be larger than the rest. Line will be terminated at the main breaker, and neutral and ground will be terminated in independent bus bars. If working with a 50a service, disconnect line 2 as well.

From here, determine if the cable is long enough to reach the new inverter location. If not, we'll need to install a junction box (J-box).

Note: If installing a hardwired surge protector, this can be used in place of a J-box. Simply mount the surge protector in a location where the shore inlet cable can reach the input, and run wire from the output to the inverter/charger.

### J-box to Inverter

If a J-box is needed,

1) Determine a location to mount based on the length of the shore power inlet cable.
2) Mount J-box
3) Run cable from J-box to inverter/charger location (run a little extra just in case)
4) Remove (2) knockouts from the J-box, and insert (2) romex connectors to protect cable.
5) Insert shore power inlet cable and inverter cable
6) Use appropriately sized wire nuts to splice each individual wire together. Perform tug tests to ensure proper connections.
7) Wrap each wire nut and wire with electrical tape to firmly secure the wire nut.

### Existing Automatic Transfer Switch (On-board Generator)

Some RV's come equipped with an ATS (automatic transfer switch) for automated switching between shore power and an onboard generator. If there is an existing ATS in the system, simply re-route the ATS output cable to the inverter/charger input.

### Inverter to AC Panel

Now run a cable from the inverter/charger output back to the AC distribution panel. Ensure the wires are out of the way and secured with zip ties or clamps.

### Lynx Distributor to Inverter

The Lynx distributor is the bridge between the inverter/charger and battery bank. A positive and negative cable will run between the Lynx and the inverter. Be sure to use a proper sized fuse.

## A Note on Surge Protection

Surge protectors can be hardwired or portable. This ultimately comes down to user preference. We recommend always using a surge protector with your system, as this is a small price to pay for the insurance that your system will be protected.

30 amp Surge Protector
50 amp Surge Protector

## Monitor & Control

### Bluetooth Dongle

The VE.Bus Smart Dongle is an optional accessory to Victron inverter/charger units, and has the following functions:

1) Monitor activity via Bluetooth on the VictronConnect app.

2) Switch inverter from on/off or to charger mode through VictronConnect.
3) Change current input limit through VictronConnect.
4) Mounted directly to the battery, the Smart Dongle can collect and transmit temperature and voltage data to the inverter/charger via RJ45 cable. If using the Smart Dongle for temp sensing, the temperature cable included with the inverter/charger is not needed.

### Inverter Control Switch

An optional remote control switch is available. This is recommended if you would prefer to switch the inverter on/off via a manual switch instead of the VictronConnect app. *Note: This is not needed if a Cerbo GX is incorporated in the system.*

## Programming

**Note: Ensure the negative battery cable is connected to the inverter/charger before connecting an RJ45 communication cable between the inverter and a GX Device. Failure to follow this sequence will result in damage to the communication chip on the inverter/charger.**
Before using the inverter/charger, the firmware will need to be updated, followed by programming.

Firmware update:
It's critical that the firmware is updated prior to programming. If firmware is updated after programming, all settings will be wiped, and you will need to reprogram the inverter/charger. There are two methods for updating firmware/programming.

1) MK3-USB on-site. Reference the VE.Bus Configuration guide for more info. Before programming can take place, the inverter/charger firmware must be updated. Use the VictronConnect app on your Mac or PC. After updating, you can proceed to program the settings, or follow step 2 for remote programming assistance.
2) Remote configuration via Cerbo GX. Follow the steps outlined in the document we shared titled, "Basic Programming and GX Device Setup". From here, you'll be able to push firmware updates and complete programming remotely via VRM.

## A Note on Existing Battery Chargers (aka. Converters)

If you're adding an inverter/charger, and there's an existing converter, it's important that this converter is disabled or removed. If left as is, this converter will constantly draw power from the inverter/charger system, which will be inefficient at best, and leave you with completely drained batteries at worst.

# Solar Pt. 2

In Solar Pt. 1 we covered mounting/wiring the panels, combing the solar wires, and passing the wire through the roof by means of the cable entry housing. In Pt. 2, we move from the roof into the electrical box, starting with the importance of a PV disconnect switch, and then on to the solar charge controller.

## PV Disconnect

The PV Disconnect is positioned in between the combiner and solar charge controller, and is important to ensure you have a safe and easy means to disconnect incoming power from solar if needed. There are many options out there, but most importantly, you'll want to ensure the disconnect is rated for the combined max voltage and amperage of your solar array.

We frequently recommend this DIN mounted breaker to be used as a PV disconnect. In addition to the breaker, you would need the PV disconnect housing.

## Solar Charge Controller

The solar charge controller takes the high output voltage from a solar array, and converts this to an appropriate voltage to match the battery bank.

### Mounting

Mount the solar charge controller as close to the main distribution block (Lynx or busbar equivalent, not to be confused with the secondary DC distribution fuse panel) as possible.

### Wiring

Post-combiner, you should have two conductors (PV positive and PV negative) leading to the charge controller. Double check polarity with a multimeter, and terminate conductors accordingly.

### Programming

The charge controllers need to be programmed so they will provide the appropriate charge parameters for your particular system. Typically you can find these settings readily available online.

# Main DC Distribution (Lynx Distributor)

The main DC distribution block is where all the primary charge & load conductors come together. This component allows for a safe and efficient means to distribute power from the battery bank to the loads, and from the chargers to the battery bank. If using the Lynx Distributor, mega fuses can easily be integrated within the case. Multiple units can be linked together to support larger systems.

### Mounting

Mount the main DC distribution block between the battery bank and inverter/charger, solar charge controller and any other DC chargers.

## Grounding the System

On mobile applications, the DC system needs to be grounded to the chassis. A few things to keep in mind when grounding the system:

1) Grounding conductor size should be as large as the largest conductor in the system.
2) Only one grounding conductor is needed, and this should come from the main DC distribution block.
3) The ring terminal can be riveted, bolted, or screwed into the chassis. The grounding point on the chassis should be sanded/grinded to bare metal before terminating the grounding conductor, to ensure proper ground connection. Spray paint can be applied after ground has been secured to chassis.

## Alternator Charging

Many RVs are wired to charge through the 7 pin while driving. This is standard protocol when the house batteries are AGM or Lead Acid, because they share the same chemistry as the vehicle battery. However, when dealing with Lithium house batteries, extra steps must be taken to ensure safe charging via the alternator.

### Lithium Upgrade without Alternator Charging

When upgrading an RV to lithium, alternator charging must be reexamined.

If deciding to forego this option, it's important to determine whether the RV is already wired for alternator charging, via the 7 pin or another means. If the RV is set up for alternator charging, this must be disabled by disconnecting and removing or capping off the wire with a wire nut or closed end crimp.

Failure to do so will likely result in a steady parasitic draw from the lithium house battery bank to the vehicle start battery, as lithium batteries have a higher resting voltage relative to lead acid batteries (commonly used for vehicle start).

#### *DC-DC Charger*

A DC-DC charger takes an input voltage/amperage and converts it to a specified output voltage/amperage. These chargers are the most popular option for combining lead-acid vehicle batteries with LiFePO4 house battery banks.

### Dual Alternator Charging

This option is for RVers who want to get the absolute most out of their electrical system. To offer a bit of context, a standard DC-DC charger can supply around 360 watts of charge per hour,

whereas a secondary alternator can supply 3,000+ watts per hour. For more information about this option, please reach out to your RV Solar tech representative.

## Cerbo GX - Complete Monitoring & Control

The Cerbo GX takes monitoring and control to the next level. Here's a list of features ordered from most relevant.

-Monitor battery state-of-charge, solar output, AC loads, shore/generator charging, temp sensors & tank levels

    -Remote monitoring via internet through VRM Portal

    -Local monitoring through optional Touch 50 display

-Maximize system performance and efficiency through connectivity of all components.

-Access to professional remote monitoring, programming & troubleshooting via VRM

-Automate generator start/stop through set parameters

-Integrate GPS for added security

Check out this short video to learn more about the Cerbo GX.