

LTV 2016-2019 Models Installation of a Lithionics Battery and a 3000W Inverter Rev 2

Written by Sandy Johnson (SSTraveler on the Sprinter Source Forum), a LTV Unity Owner since 2014. You will find all my latest version guides here, <https://sprinter-source.com/forums/index.php?threads/99874/> or in the Files Section of the Leisure Travel Van Enthusiasts, Upgrades, and Help Groups (Browser-Click on the group picture and then click on the Files Section tab or APP-Click on Files tab).

USE THIS GUIDE AT YOUR OWN RISK-This guide is for experienced/skilled Do It Yourselfers or Professionals. It is the responsibility of individuals to verify placement and fit, comply with applicable electrical codes/requirements, and manufacturer installation and operating instructions.

A 3000w inverter performs 2 functions: 1) when on Shore/Generator power (120vAC utility/residential power) the inverter passes through the power to the coach and charges the house battery, 2) When Shore/Generator power (120vAC utility/residential power) isn't available, then the inverter changes (inverts) battery power (12vDC) to 120vAC utility/residential power so you can continue to use all your appliances. Where 120vAC is alternating current type power and 12vDC is direct current type power.

This guide is intended for use by experienced Do It Yourselfers or professionals. It does not give step by step instructions but rather general information and knowledge to guide you through your own project. This guide uses a 2019 Leisure Unity FX, Xantrex Freedom XC Pro 3000w Inverter and Battery Charger, Xantrex Bluetooth Remote Display, and a Lithionics GTX12V315A (315ah) Lithium battery as the subject components for this installation, but the wiring would be very similar if you use a Kisae 3000w Inverter with 100a Battery charger (BIC1230100). I also added sections at the end of this guide to overview the installation of a Kisae.

Since the 2016-2019 Leisure Unity models all use a WFCO 8930/50 Power Distribution Center (120vac Breaker box and 12vdc Fuse panel) and have a separate inverter bay in the exterior compartment next to the door, the use of a 2019 Unity as the example compares to what any 2016-2019 Unity Model year owners will encounter. The actual inverter and battery to inverter cable sizes may differ from year to year, but those have to be removed anyway in order to upgrade to a 3000w inverter so those size differences, and other differences in specifics are inconsequential.

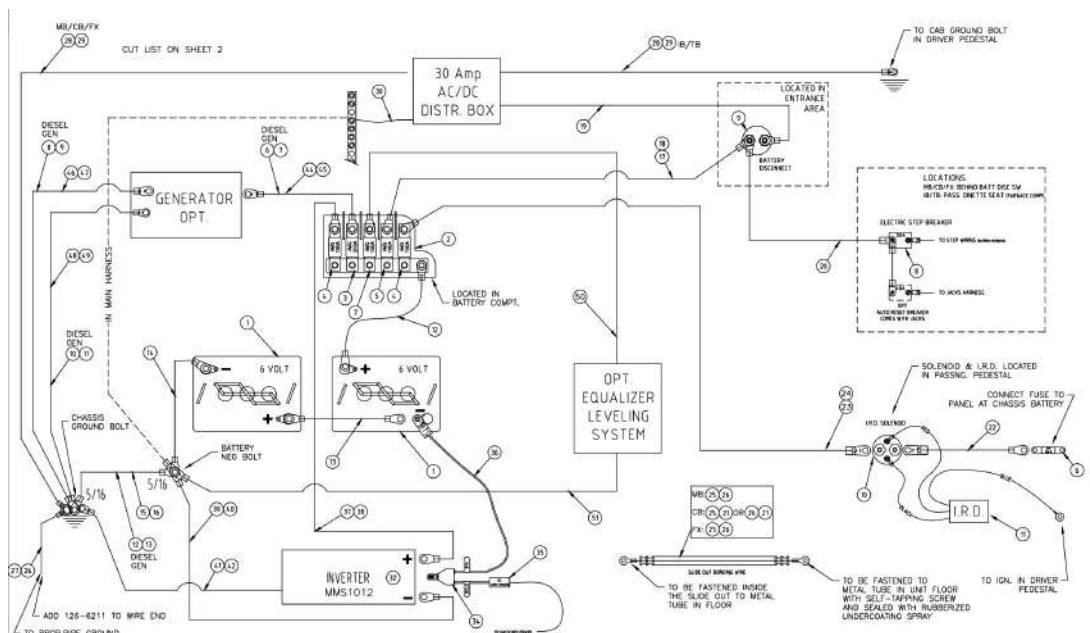
You can also use this guide for a 2000w inverter installation, the installation is exactly the same for a 2000w or a 3000w inverter the only difference is the configuration of the breaker box. A 2000w inverter breaker box configuration is slightly different because it cannot supply power to as many circuits. Particularly it cannot supply the air conditioner, even with an EasyStart. Air conditioner/inverter quickly overloads/ overheats and shuts down, so don't try to run your air conditioner from a 2000w inverter or you might damage it or the inverter. You'll find the 2000w inverter battery box configuration details on page 60.

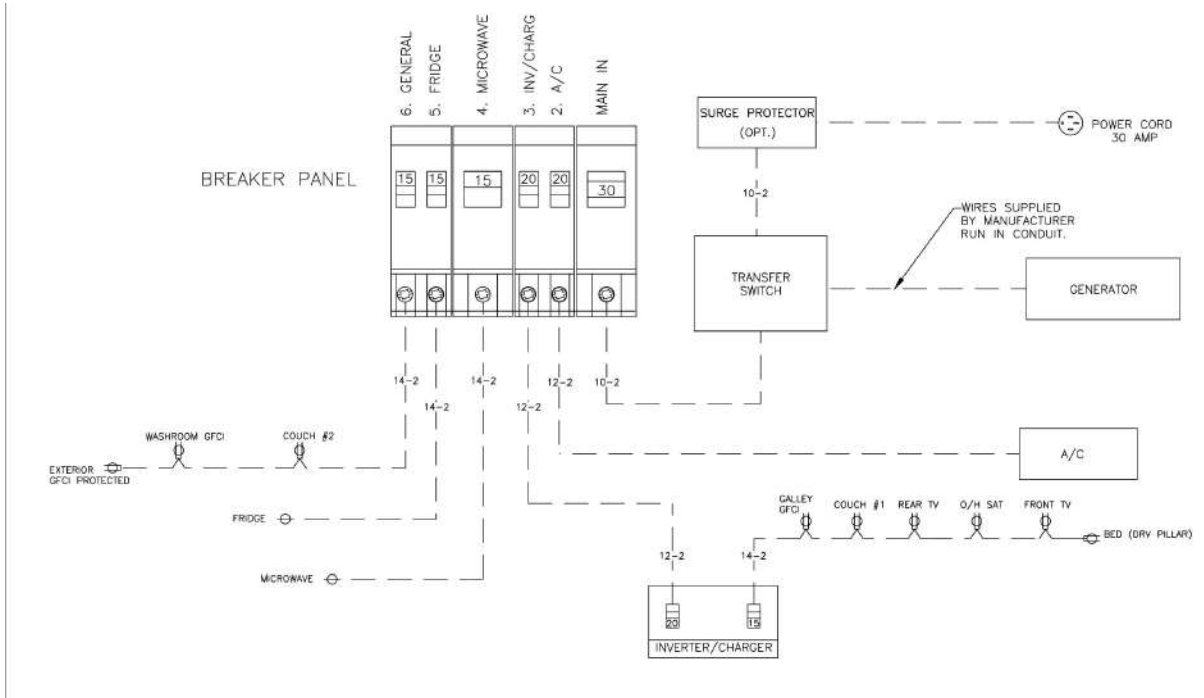
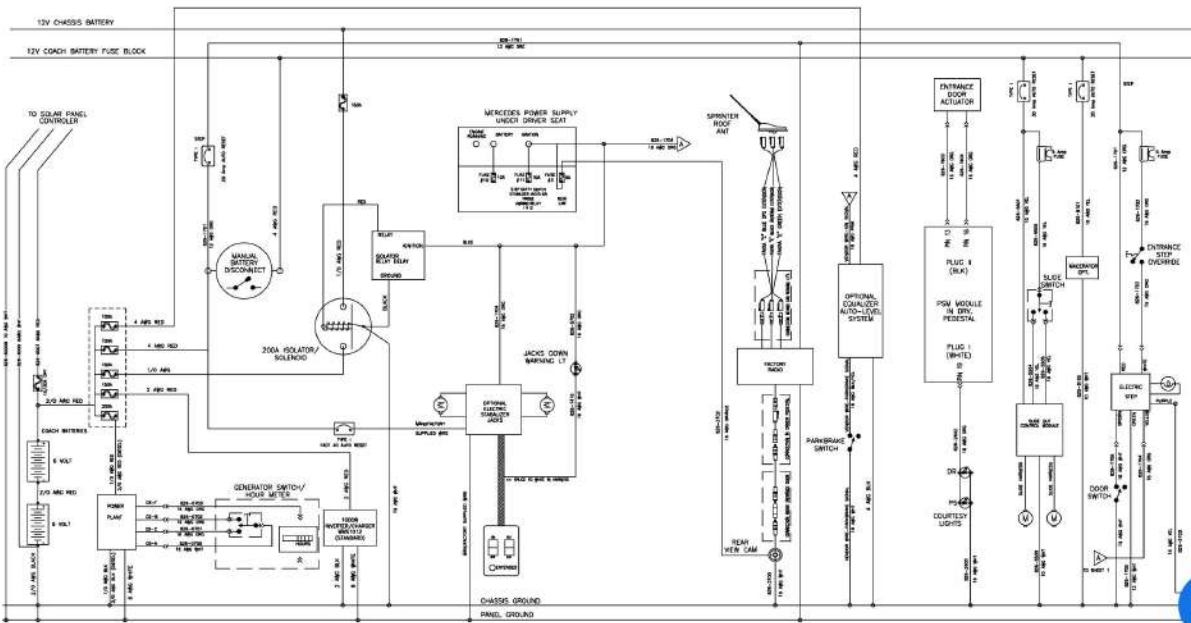
Important: For those wanting to install 3- Lithionics 12V130A-G31-LRBM8 (130ah) batteries (at minimum of 3-130ah Lithionics batteries are required for use with a 3000w inverter) or a Victron Multiplus 3000w inverter, this guide is not to be used for smaller Lithionics battery or Victron inverter installations. Lithionics has specialized instructions for the installation of these and therefore you must consult and follow the latest Lithionics guidance. Download the [Lithionics](#)

12V130A-G31-LRBM8 RV INSTALLATION KIT for 3000 WATT INVERTERS or Lithionics GTX12V315A-E2107-CS200 RV INSTALLATION KIT for VICTRON 3000 WATT INVERTER
document instructions, specifications, and wiring diagrams from the Lithionics support page on their website, <https://lithionicsbattery.com/support/>.

The wiring and size of wire used in replacing your current inverter with a 3000w inverter/battery charger is completely independent of the capacity of your battery bank total amp hours. What governs the wire sizing is the maximum draw of the inverter and the components it supplies. Another factor is wire length, the longer the wire the more voltage drop that occurs, that is why Lithionics specifies the minimum wire diameter size, wire length, fuse size, and disconnect switch rating. Lithionics specifies a minimum wire size of 2/0 awg and a minimum total length of wire from the battery to the inverter of 4 feet.

If you are interested in obtaining your model Leisure wiring diagrams you can request those directly from Leisure. The wiring diagrams are the first place to start on electrical upgrade projects because they answer so many questions when you study them. You can do this by calling Leisure's Willie Neufeld, email: WNeufeld@tripleerv.com or phone 877-992-9906, and request this information. What I have found that works the best is if you first email Willie with your VIN# if you have one or Your name and that you have a Leisure on order, email address, and phone number. Requesting him to send you, via email, the PDF versions of your 120vAC and 12vDC electrical systems wiring diagrams for your Leisure year, make, model and any other information you need as referenced above. Then call him (877-992-9906, ask the operator to connect you to him) and leave a message on his voice-mail of what you are asking for and that you sent him an email with all your information. He usually very promptly sends you everything you requested by email. This information will help you as reference documents throughout your Leisure ownership so I recommend requesting this regardless of replacement of your batteries. Here are diagrams that show how the 12vdc (battery) and 120vac (shore/generator power) breaker box and its circuits are wired to the rest of the coach.





In this upgrade from 1200w or less power inverter to a 3000w inverter, the standard Leisure Flooded Wet Cell or AGM Lead Acid batteries will be replaced with a Lithionics 12v315GTX (315ah) Lithium battery. Only the single Lithionics 315ah battery or larger single batteries, or 3 Lithionics 130ah batteries are suited for running a 3000w inverter and the LTV Dometic 13,500 btu or 15,000 btu air conditioners with heat pump (with an EasyStart or SoftStart installed, see my guide, [LTV Air Conditioner Micro-Air EasyStart Installation Guide](#)).

Simply replacing the standard Leisure 6v lead acid batteries (Flooded Wet Cell or AGM) with the more powerful Lithionics GTX315 Lithium battery is definitely something you can do yourself. I get more than 4 hours (time can vary depending on outside temperature and thermostat setting) of air conditioner run time from my single Lithionics GTX315 battery and 3000w inverter. The installation instructions for a Lithionics battery are included in this guide but I have also written separate battery planning and installation guides, [LTV Lithionics Battery Installation Planning Guide](#) and [LTV Lithionics Battery Installation Guide](#) that provide a little more focused information than is contained within this document.

In my opinion, Lithionics batteries are the highest quality Lithium batteries you can buy and they are packed with many advanced features (my favorites are Bluetooth internal Battery monitoring, automatic heater for safe cold weather use and battery charging, convenient on/off switch, and automatic safety and battery shutdown protections (includes low/high temperatures and low/high voltage cutoff).

A Lithionics battery has its own internal temperature sensor and automatic battery heater that requires no extra sensors, wires or switches, it is smart enough to maintain the battery temperature when using or charging the battery above temperatures of -4°F. The Lithionics heater maintains the battery temperature between 35-40°F and requires 1a per hour of battery power to run the heater.

Most importantly they are more compact and powerful than other brands. A Lithionics GTX315 Lithium battery gets you the most power per cubic inch of your Unity battery box and the most output power at a recommended 200a discharge rate. Meaning it can easily power everything in your coach, including the air conditioner (EasyStart or SoftStart installation required). Making a Lithionics 12v315GTX or 3-12V130A-G31-LRBM8 batteries the smarter choice. You'll probably never have to purchase another house battery again, because a Lithionics battery should last longer than 10 years if properly maintained!

Note: For installation of a Micro-Air EasyStart on your air conditioner get my [LTV Air Conditioner Micro-Air EasyStart Installation Guide](#).

You can get Lithionics batteries (<https://lithionicsbattery.com>) through an authorized Lithionics Battery Dealer or recognized Lithionics Battery Installer. You can contact Jackson D'Ettorre, Lithionics Point of Contact for LTV, at jackson@lithionicsbattery.com or 727-726-4204, and he'll direct you to the closest dealer/installer or if you prefer direct online ordering, then visit <https://pagosupply.co/shop/lithionics-products> to place your order today! Remember it takes at least a month to get a Lithionics battery so order well in advance of your project.

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Leisure Models 3000w Inverter Installation Overview

Lithionics recently changed their 3000w inverter installation instructions because they discovered that 3000w inverters have a very large capacitive in-rush current which can damage the internal BMS under certain circumstances. The Lithionics battery is most vulnerable to the high capacitive in-rush current of inverters when it is powering on, using its unique power button. This is why the inverter battery disconnect switch is a vital part of the installation so you can keep the inverter disconnected from the battery until it is fully powered on. Once the battery is fully on there is no risk connecting the inverter to the battery. Since a Lithionics battery has virtually no internal impedance it is important to build in slightly more resistance to the inverter electrical installation to help slow down the high capacitive in-rush current of these 3000w and larger inverters. As such a Lithionics battery is the only Lithium battery that can use 2/0 awg cables (minimum 4 feet of cable from the battery to the inverter), 250a Mega Fuse, and 300a rated Blue Sea battery disconnect switch with a 3000w inverter installation. Here is a video of the complete installation on a 2020 Unity, <https://youtu.be/eZ0nFo0OW0g>. It gives you an idea of what you can expect the installation to entail. There are modifications required on the 2016-2019 models.

Other brands of Lithium batteries choose to build into the battery much greater internal resistance (which creates higher internal cell temperatures, reducing the lithium battery life), similar to what you find in lead acid batteries, therefore you have to use the larger diameter cables because these batteries need to be installed in a system with the least resistance built-in. Another reason why a Lithionics battery is more reliable and will outlive its warranty.

For those interested in installing a Xantrex or Kisae 3000w inverter/charger in their 2016-2019 Unity, here is an overview of what needs to be done. The following information pertains to a 2019 Unity but the same thought process and logic applies to all the 2016-2019 models. So use your wiring diagrams and identify the elements that correlate for your model. You will have to remove your current inverter battery cables and replace them with new larger sized cables (2/0 awg) from the battery to the inverter, replace the inverter Mega Fuse with a new 250a Mega Fuse in the red Silicone covered battery box Mega Fuse bus block, and add an inverter battery disconnect switch to meet electrical safety requirements for the more powerful inverter unit. You'll add the inverter battery disconnect switch in a convenient location close to the inverter. For example, Leisure uses 2 awg battery cables for their Magnum MM1012 (1000w) Inverter/charger installation, so you'll replace those by pulling new larger 2/0 awg cables.

The inverter disconnect switch is an important addition which allows you to always control when you connect the inverter to the Lithionics battery and gives you a way to isolate the inverter from the battery in case issues arise with the inverter operation or if you need to turn off the Lithionics battery with its convenient on/off switch. **When you first install it make sure to leave the switch in the OFF position.**

Additionally you will use it to completely disconnect the inverter while you park/store your Leisure to ensure there are no inverter parasitic draws on the battery. You want to get in the habit of using the inverter battery disconnect switch just like you use the coach battery disconnect switch. So build using it into your normal shutdown and startup routine, using it just like you use the coach battery switch, for your Leisure Travel Van.

For Leisure models with the separate inverter bay within the side exterior compartment, it might be easier if you disconnect 2 sides of the compartment separator wall, the floor and back wall attachment, then you can bend it upward and prop it out the way for more room to maneuver. You may consider completely removing the wall if it seems easier. I will give you some options on this later. On the 2019 models the wall is attached with screws and spot welds or adhesive caulk, which can be broken with a hammer and chisel. An oscillating tool or cutting tool could be helpful as well. You will also have to increase the size of the inverter back wall and front side wall ventilation holes for a 3000w Inverter.

When you remove the AC In and AC Out from the old Magnum Inverter you'll need to add a junction box and splice these wires together to complete the #3 Circuit Breaker circuit (Galley GFCI, couch, TV, SAT, Bedroom outlets). You'll need to run new 10/2 with ground Romex orange casing solid copper wire to the breaker box for the 3000w inverter AC In and AC Out and reconfigure the breaker box to use the inverter to run the whole coach from the Lithionics 315ah battery. A 3000w inverter can run everything, including the air conditioner (with the installation of a Micro-Air EasyStart or SoftStartRV, required). **Note: For installation of a Micro-Air EasyStart on your air conditioner get my [LTV Air Conditioner Micro-Air EasyStart Installation Guide](#).**

In order to reconfigure the coach's breaker box, WFCO 8930/50, to be supplied by the larger inverter, you will have to buy 4 new breakers (two 30a breakers for Inverter In and Out and 2-15a breakers for the Dometic 3 way refrigerator and the old inverter supplied circuit #3, which is now a 15a circuit of outlets. The WFCO 8930/50 power distribution center has a dual bus and single neutral and ground bus bars. In order to rewire the breaker box to use the dual power buses you will need to cut about a 1/2" section (2 screws) out of the middle of the single neutral

bar so you can wire each side of the bus to its associated separate neutral bar. You'll be putting the 30a Main breaker, Inverter AC In 30a breaker, and 15a Refrigerator breaker on one bus and the Inverter AC Out, new 15a breaker for Circuit #3, and all the remaining breakers on the other bus. You must wire the neutral of each of these breakers to the corresponding neutral bar on each power bus bar side.

As far as the existing GoPower solar controller settings go, you need to change the settings to the AGM battery profile because it is more suitable for a Lithionics battery charging profile. The isolator solenoid and isolator delay relay needs to be replaced with a DC-DC charger for safe alternator charging. I've written 2 different guides on DC-DC charger installation, one for a 50a Kisae DC-DC charger, [Kisae 50a DC-DC Charger Installation \(With Optional Trik-L-Start\) Rev 2](#), and one for a 30a Sterling DC-DC charger, [LTV DC-DC Charger Installation \(with Optional Chassis Battery Trickle Charging\) Rev 4](#). I highly recommend the Kisae 50a DC-DC Charger. I've also written a guide for adding an Amp-L-Start engine chassis battery trickle charger, [Early 2019 and Older Leisure Models \(with Isolator Solenoid\) AMP-L-START Chassis Battery Trickle Charger Installation](#). I highly recommend the Amp-L-Start because it has a Lithium battery mode so it is more compatible for safely maintaining the AGM chassis battery anytime the Lithionics house battery is being charged by solar or the 3000w inverter battery charger.

If you have a solar controller with a Lithium setting then change its setting to that otherwise leave your GoPower solar controller on the AGM battery setting profile. The Xantrex 3000w Inverter settings are near the end of this document, you will use the LifePO4 battery profile setting with it.

ELECTRICAL SAFETY FIRST - Disconnecting All Power

Before you start working, take pictures and label the wires/cables as to what/where each wire is and was connected to so you don't have to remember once it's removed. Take pictures with the wires labeled as well, you never know when you'll need to refer back to them.

Make sure you are disconnected from Shore power. Disconnect the solar panel power if you installed a switch or cover the solar panels with something dark to stop solar power production. You should also pull the solar fuse in the battery box to make completely sure no power is going to the battery connections.



Solar Controller Fuse (colors vary red or black by year or model)

I've written a guide for the installation of a solar disconnect switch, [Adding a Solar Panel Power Disconnect Switch](#), so use that to install one, you'll be surprised how often you need to use it in the future.

Turn the house/coach battery switch to OFF. You want no power to any of the systems whatsoever! **If you are not experienced with electrical work please turn this guide over to a professional electrician to complete the work.**

Next disconnect the house battery(s) and completely remove them. To remove the batteries just disconnect the 2 coach battery cables, starting with the black negative cable first. Save the long red battery cable that connects the 2 batteries, you'll need it later when installing the Lithionics 315ah battery because its positive terminal is in a different place, farther away and you will use it to replace the shorter coach red positive battery cable. You'll reuse the short coach cable for your inverter switch installation.

You won't be reconnecting the Magnum Inverter battery temperature sensor with a Lithionics battery installation so remove it completely. No external temperature sensors are needed with a Lithionics battery. You want just the 2 coach battery cables for connection back to the new Lithionics battery.

Removing the Old Magnum Inverter

Before you remove the Magnum Inverter, write on the wire casing what each wire was hooked to so you don't have to remember once it's removed. I use Blue Painters tape and a black marker for all my labeling or write directly on the items with a label.

You have some options as to how to deal with removing the inverter bay wall. You've got to get it out of the way or remove it so you have space to work. Options; 1) use a cutting tool (grinder with a cutting wheel, rotary cutting tool with cutting wheel) to cut a square out of the wall. I suggest leaving a 1" lip so you can make a new wall from aluminum sheet metal and screw it onto the lip of the old wall frame. 2) Disconnect 2 sides of the inverter bay wall so you can bend the separation wall up between the inverter and the rest of the side exterior storage compartment, using a board to prop it up so you have room to work. 3) completely remove the separation wall and then use 1" aluminum angle stock and aluminum sheeting to make a totally new wall later. I recently did a 2019 Unity FX and found option 1) to be the easiest.

If using option 1 or 3, remove the carpet from the other side of the inverter separation wall. Just pull it back. You can reattach it again later with spray adhesive. If using option 2 then cut around the carpet seam at the separation wall so when you free the 2 sides (back wall and floor) and prop it open, you can later reattach after the new inverter installation is complete using the same screws. You won't have to worry about reattaching the carpet because you left it attached to the wall by just cutting the seams. Remember when you reattached the wall at the end, add a bead of Silicone caulk up around each corner and across the floor seam to prevent water that might get blown through the vents into the inverter area from leaking into the storage side.

Leisure uses SikaFlex Adhesive with screws to secure the wall to the ceiling. If you decide to disconnect the wall from the compartment ceiling then you'll need a sharp snap blade utility knife to cut through the very strong SikaFlex adhesive.



You may need to use a hammer and sharp chisel or large screw driver to cut/pop all the spot welds or rivets. An oscillating tool or cutting tool might be helpful for this as well.



The following pictures are examples of what others have done. Use of 1" angle bar stock to make a new frame to reattach a new aluminum sheet metal wall.



This 2020 person re-used their old wall cutting out the interior square and then making a new aluminum sheet metal wall and angle stock.



Wall completely removed.



2 sides removed and propped out of the way.

You should now be able to completely remove the old Magnum Inverter. You're left with the wires remaining after Magnum Inverter removal



You'll be mounting the Xantrex to the side wall with 4 screws in a similar fashion as the old Magnum, however because the old Magnum was smaller than the new Xantrex 3000w Inverter you are going to have to remove the sheet metal vent box and you will need to elongate the fan vent holes on the back wall and/or cut new holes on the back wall corresponding to the 3000w inverter fans and an opening on the side wall up front so inverter fans can function unimpeded with good airflow back to front. I used my angle grinder with a cutting wheel to just cut 2 big fan holes on the back and one up front so the 3000w inverter would have plenty of opening to exhaust its heat (pictures below). But you could just as easily use the angle grinder or other type rotary cutting tool with a cutting wheel to extend or elongate the existing inverter ventilation holes at the back of the inverter bay and make new slots in the front.

The Xantrex 3000w Inverter has 2 fans on the end that pull cooler air from outside and out the front of the unit. Without at least one large vent (slots, holes, single large opening) up in the front the heat the inverter produces has nowhere to go.

So starting with the increased ventilation modifications is very important. In hindsight, I wish I would have made my front vent opening even taller, the same length as the Xantrex Inverter. Fortunately, I have not had any overheating issues with my installation.

Another option besides mounting the 3000w inverter on the side wall would be to do as I did to sit the inverter on square hollow bar stock away from the wall. I used VHB tape to secure the tubes to the inverter bay floor and then used VHB tape to secure the inverter to them.

I think mounting the inverter on the wall with self tapping screws is probably the easiest option. It easily mounts on the side wall with 4 screws. Just make sure you align the ventilation openings to the Xantrex inverter fans and leave space between the wall and inverter back so you can get your fingers back in there to press the inverter reset button.

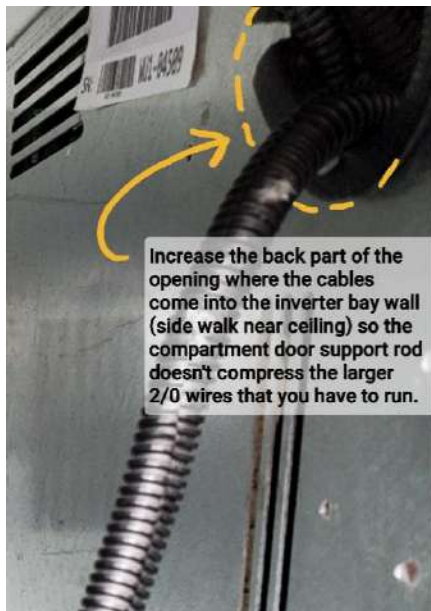
I recommend using the mesh screen I gave you a link to in the **Parts Section** because it finishes the ventilation opening nicely. I also use it in my DC-DC charger installation guides for an increased ventilation modification I recommend with that installation.

My ventilation modification and optional mounting approach with Xantrex 3000w Inverter Installation.



3000w Inverter Upgrade General Preparation

Pull all the wires out of the inverter bay hole on the side wall up near the ceiling so you can enlarge that hole to accommodate the new larger 2/0 awg cables you'll be pulling from the battery box to the inverter battery. Remove the hole edge guard and cut out just the back part of the hole another inch or so for the larger 2/0 awg cables have room to sit back farther so they don't get pinched by the compartment door prop/strut when the door is closed. Put the hole edge guard back on leaving the uncovered hole edge on the front. At the end of the project use the black packing foam from your Lithionics battery to stuff in the hole to keep all your wires sitting back and out of the way of the door strut when the compartment door is closed. Leave the foam longer on the outside part of the compartment wall so you can cable/zip tie the foam to the cables to keep it in place.



You will be reusing the old Magnum Inverter 6awg case ground, because it is larger than what Xantrex recommends for the 3000w inverter installation. Also reuse the old Magnum Inverter ignition control wire after you disconnect it from the dual plug-in port where the Magnum temperature sensor cable is plugged to. Push these 2 wires back through the inverter bay wiring hole.

You will not be using the old 2 awg Magnum Inverter battery cables or the Magnum battery temperature sensor with the new 3000w inverter and Lithionics battery installation so completely remove them from the battery box and inverter compartment. You also will not be reusing the phone cable that connects the Magnum Inverter to the Magnum remote display above the door. The Magnum phone cable is only a 4 wire cable and the Xantrex Remote needs a 6 wire phone cord, which is supplied with the new Xantrex Remote. The Magnum display can be removed and the opening covered with thin wood or plastic. I find some black plastic grocery recyclables make the perfect small hole cover material.

For those interested in installing the Xantrex Remote Display where the old Magnum display was can refer to the section, [**How to Route Remote Display Cord to the Over Door Panel**](#), on page 56 for instructions on how to do that.

Removing the Batteries and Preparing the Battery Box

I've written a [LTV Lithionics Battery Installation Guide](#) that offers more detailed battery installation information. If you want to use it as a companion guide for installing the battery. Otherwise the following tells you pretty much everything you need to do to install a Lithionics battery.

If you are replacing Flooded wet cell or AGM batteries with the Lithionics 315ah battery, you'll recall back in the **ELECTRICAL SAFETY FIRST** section of this guide that I told you to remove and save the long red 2/0 awg battery cable that connected your old batteries together.



Now you'll want to replace the shorter red Leisure coach battery cable with this longer red one. You need a longer red cable to allow you to more easily connect the new Lithionics battery just outside the battery box. The Lithionics positive battery terminal is farther away from the coach's Mega Fuse block connection than the previous Flooded/AGM battery positive terminal was.



Orientation of Mega Fuse bus may vary by year and model but the connections are the same for the coach positive battery cable and solar controller fuse on the main input bus bar of the Mega Fuse block

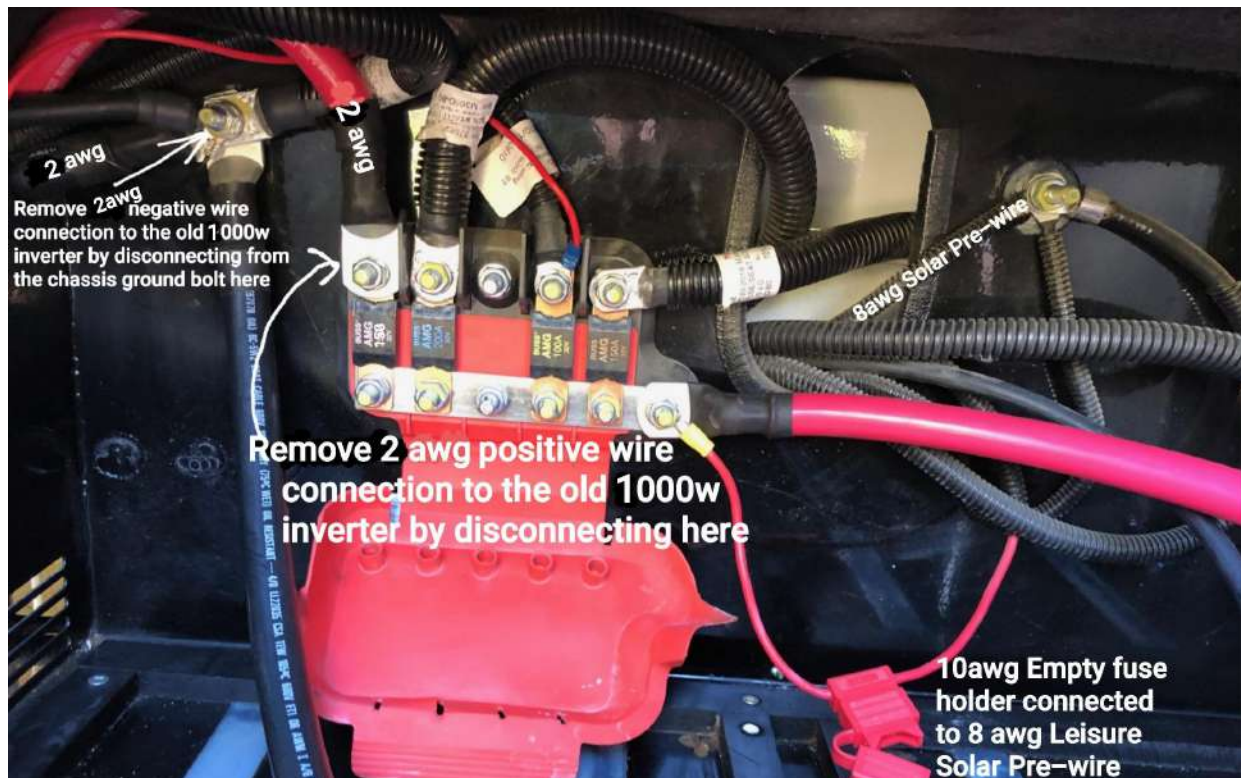
You will simply remove the 1/2" nut from the Mega fuse block terminal that holds the coach positive battery cable and solar controller output ring terminal (if you didn't order the solar option, then the fuse holder will be empty). You may find a second fuse holder (5a fuse) for the Automatic Start Generator (AGS) Option connected, if that option wasn't ordered, the fuse holder will be empty. Leisure installs these as a pre-wire regardless of purchasing the option.

Replace the battery cable with the longer one, add the solar controller and AGS (if applicable) ring terminals back on, and tighten the terminal nut down tight. You'll want to position the cable connection pointing more toward the ceiling since the Lithionics battery is taller and the connection is made on the top of the battery.

NOTE: If you had any extra power feed wires on your old battery's positive battery terminal, then move and stack them on the main Mega fuse bar input terminal with the new longer battery cable and the solar controller/AGS fuse holder ring connectors. Same thing applies to the negative battery cables, any extra grounds should be added to the left side battery box ground bolt. You want only the 2 coach battery cables (positive and negative) for connection back to the new Lithionics battery.

Tip: The way I tighten is to snug down the Nut or bolt until you think it is tight and then give it a last 1/4-1/2 turn just to give it that last teak of tightness. Once tight, the lug/connector should not be able to be moved by pushing or pulling on it. Use this for everything you tighten in the battery box, in the inverter, or on the battery. You never want to over tighten, this method helps you keep from doing that.

In order to install a new 3000w Inverter, you will need to disconnect and remove the Leisure 2 awg battery cables to the Magnum 1000w Inverter and then pull 2 new larger 2/0 awg cables. You'll also need to replace the 150a Mega fuse with the new 250a Blue Sea Mega fuse.

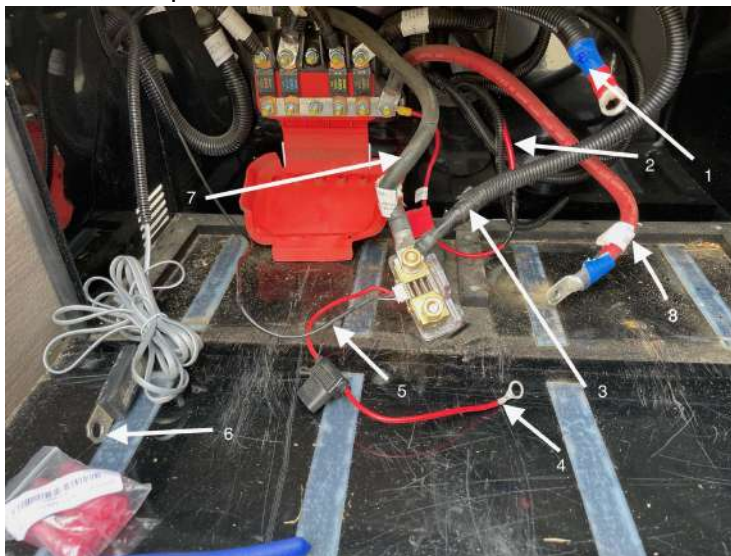




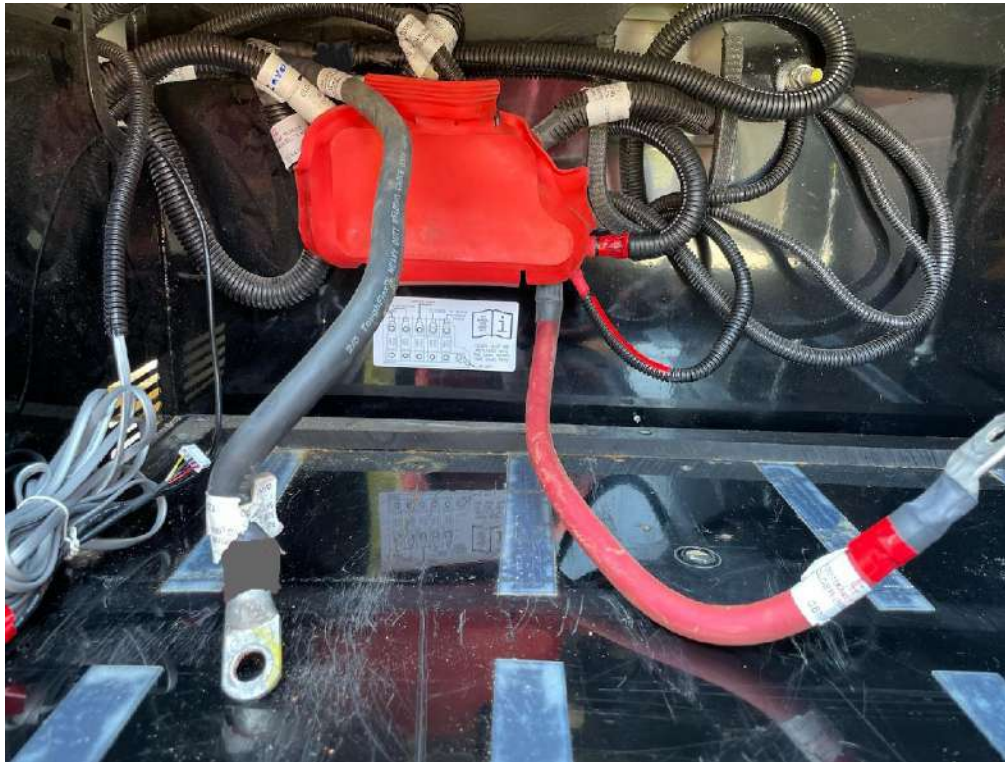
You disconnect the inverter positive and negative 2 awg battery cables from the Mega Fuse holder and left side ground bolt (as pictured above). Then you disconnect them from the inverter and pull them out. Pull the new 4' 2/0 awg positive and negative battery cables for the inverter and reattach the ends to the ground bolt and inverter new 250a Mega Fuse. On the red positive 2/0 awg cable make sure you are attaching the 5/16" hole lug end to the Mega Fuse Terminal. The 3/8" diameter lug on the other end will connect to the new Blue Sea 300a battery switch.

TIPS TO TIDY UP THE BATTERY BOX

The goal is to only attach the 2 battery box battery cables to your new Lithionics battery. So that means connecting any extra positive or negative wires to their respective terminals in the battery box, Mega Fuse block main coach positive terminal or the left or right side ground bolt. Understanding where all the extra wires go can take a bit of detective work, particularly if you bought a used Leisure and the previous owner did some undocumented wiring. Here is an example: someone sent me this picture and asked me to tell them what to remove, keep and/or move.



Here was my response, 1) is a positive wire for the Equalizer Levelers added aftermarket. This power wire needs to be connected to the same terminal as the positive coach battery cable and the positive battery wire to the solar controller (on the input terminal of the red covered Mega Busbar). 2) Is the Solar 8 awg positive wire that is spliced into the 10 awg red fused wire and connected to the same terminal as the positive coach battery cable. 3) Is the negative wire used with the aftermarket Equalizer Levelers installation and can be moved to the same battery box ground bolt that the coach negative battery cable is attached to (top back left). 4) Is the fused power wire for a battery monitor shunt (center picture), it and the shunt can be permanently removed. 5) Is the battery monitor display cable and that can also be removed permanently. 6) Magnum Inverter Temperature Sensor should not be reattached to a Lithionics battery, just remove it permanently from the battery box and keep with the Magnum Inverter for when you remove it. 7) This is the coach negative battery cable connected to the battery box ground bolt upper left corner, and it stays connected as is. 8) Coach Positive battery cable and it stays connected as is. You must account for all the extra wires and disposition them like this. They did a great job of getting the battery connections to just the original coach connections so when they pull the new 4/0 awg wires from the battery box to the Inverter there will only be 2 cables connected to each battery terminal. This is important because the space is so tight and there is no headroom for more cable lugs stacked on the Lithionics battery top terminals. Notice how they got all the wires behind the black battery bumper and even with the red Silicone cover so no wires keep the battery from sitting back against the bump stop. This is important because the space is very tight and you need the battery to push into place unimpeded.



Final prep step, remove the center battery bumpers that used to keep the old batteries in place and the center battery box bolt.



You will find a carriage or hex head bolt in the middle of your battery box. It holds the step frame underneath the battery box. If not replaced it makes the Lithionics battery sit too high, not flat in the batterybox. This reduces the clearance needed to get the battery to slide in under the step and fit properly. As such, this bolt needs to be replaced with a stainless steel or zinc 5/16"x 1" or 3/8" x 1" taper head/flat head machine screw and matching nut. You'll probably find a 5/16" flat head bolt easier than the 3/8" but I give you links to both sizes because they are hard to find. My Lowes store offered these in their Specialty Hardware section over any of the other hardware stores in my area. You need the flat tapered head so it will sit flatter in the hole while still making contact with the hole to secure the step frame under the coach. You are just replacing the Leisure carriage bolt and nut setup with the new 5/16" x 1" or 3/8" x 1" machine screw, and matching nut * with a Silicone locking insert, tension nut or you can use a free spinning locking nut (as pictured right). You won't use any part of the old bolt/nut set. Now with the flat head screw the battery box floor is essentially flat in the center and the battery will slide in nicely with the clearance it needs. Below are Pictures and information on the 3/8" flat head screw, but I found the 5/16" flat head screw works just as well and might be easier to find.



Lowes Specialty Hardware Section,
Grade 8- 3/8" Flat Head Machine Screw,
<https://www.lowes.com/pd/Hillman-3-8-in-16-x-1-in-Allen-Drive-Cap-Screws-2-Count/50088914>

Lowes Specialty Hardware Section,
Grade 8- 3/8" Free Spinning Washered Nut,
<https://www.lowes.com/pd/Hillman-3-8-in-x-16-Black-Phosphate-Steel-Hex-Nut-2-Count/3012485>



Cold weather protection suggestion: if your battery will typically be exposed to temperatures below freezing temperatures while in winter storage. With battery box wiring preparation completed, use Eternabond Tape, spray foam, foam sheets, etc. to seal off the battery box vents, screw holes, and cable openings. This will seal off the battery box and decrease the Lithionics Lithium battery from greater exposure to outside temperatures. The Lithionics battery needs no ventilation because it is vacuum sealed and UL Tested and Certified not to off gas. A Lithionics battery has its own internal temperature sensor and automatic battery heater that requires no extra sensors, wires or switches, it is smart enough to maintain the battery temperature when using or charging the battery above temperatures of -4°F. The Lithionics heater maintains the battery temperature between 35-40°F and requires 1a per hour of battery power to run the heater.



Lithionics Battery Preparation

Before trying to put the battery in place, make sure and get all the wires sticking off the back wall are even with the red Silicone cover and behind the black plastic battery bumper. You don't want any wires pinched between the bumper and battery. This could damage a wire and keep the battery from sitting completely back against the back bump stop. Make sure the wires being connected to the battery are placed in such a way that when you slide the battery in they don't become an impediment to keep the battery from sliding fully back into place against the bumper. You don't want to pinch any wires or cables between the battery and bumper. This is very important because the space is very tight and you need the battery to slide completely back into place unimpeded.

Your new Lithionics 315 battery may or may not come with the things I'm going to discuss in this section so follow these instructions as applicable. Remove the felt pads from the bottom of the battery. Disregard the straps and white plastic guards in the picture, that is how Lithionics used to ship batteries, the new battery should only have felt feet on the bottom that need to be removed.



The Lithionics 315ah battery weighs 68 lbs so it may take 2 people to lift it onto the coach step in front of the battery box opening. Then put the red and black terminal cover caps over the ends of each coach battery cable. Pull the lugs through the terminal covers and push the cover down the cable a bit so you have adequate room to put the lugs on the battery terminals.

Lithionics Battery Installation

All you need to do is simply hook up a Lithionics battery like any other battery, using the 2 coach battery cable lugs, black cable to the negative battery terminal and red cable to the positive. Before you start making connections make sure the **battery is off**, **NO blue light is on** around the battery button. Be careful when handling the battery or pushing it into the battery box because it is very easy to accidentally turn ON the battery by touching the on/off button. You don't want to turn the battery on accidentally until it is in place and you are ready to do so later (process described later).

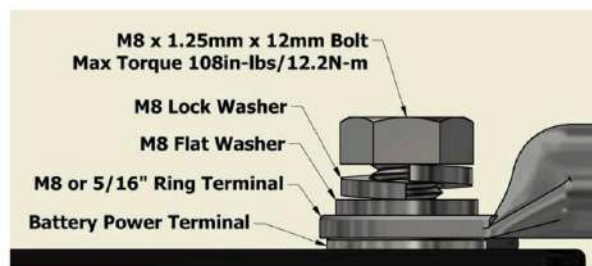
If you pulled the solar fuse, reinstall it now but recognize the positive battery cable will be energized if the solar panels aren't covered and getting sun. If you still have voltage coming from the solar panels then skip this section until you put the inverter battery disconnect switch (leave it in the OFF position) on the positive 2/0 awg cable going to the inverter. This way you

can be assured that no power is going to the inverter and you are safe making all the connections to it.

Keep the positive battery cable covered with painters tape or the red battery terminal cover that came with your Lithionics battery so the lug which may have voltage on it from the solar panels can't come in contact with a metal ground. Put the positive cable on first and the negative cable on last. Then add a washer, lock washer, and bolt onto the lug (see picture below). A 13mm wrench is required to tighten the battery bolts. You don't need to torque the bolts if you don't have a torque wrench, just make sure they are tightened down well. Be careful not to over do it. The way I tighten is to snug down the bolt until you think it is tight and then give it a last ¼ -1/2 turn just to give it that last teak of tightness. Once tight, the lug/connector should not be able to be moved by pushing or pulling on it. You never want to over tighten, this method helps you keep from doing that.

Note: Remember you never want to add any washers between the lugs or Battery Power Terminal, nor do you want heat shrink to get between the lugs or Battery Power Terminal. You want clean metal to metal lug and Battery Power Terminal contact.

The battery is equipped with two flat threaded terminals designed for a 5/16" or M8 size ring terminal lug and secured by included M8 bolts, flat washers and lock washers. When using flat washers, it is critical to place the ring terminal lug in direct contact with the top surface of the power terminal and then place the washers on top of the lug. Connect the positive and negative battery cables with correct polarity and double check the polarity of battery circuit to avoid potential equipment and battery damage.



DO NOT place any washers between the battery power terminal and the ring terminal lug, as this could create a high resistance path and cause excessive heating of the connection which could then lead to permanent battery damage or fire.

If you must attach more than one lug to each terminal, make sure at least 1/4" or 6mm of thread is available to secure the connection. Additionally, the ring terminal lugs need to be "clocked" in such a way that they do not interfere with their flat conducting surfaces. Acquire and use longer M8x1.25mm bolts if necessary.

Tighten both M8 power terminal bolts to a maximum of 108in-lbs/12.2Nm to ensure there is good contact with the ring terminal lug.

CAUTION: Over-tightening the terminal bolts can damage the terminal. Loose terminal bolts can result in a high resistance connection which could then lead to permanent battery damage and/or fire.

Now the battery cables are connected and you can pull the battery terminal covers into place and push them down into place over the lugs so that the whole terminal and the connections are covered. You'll feel them snap into place.



If you forget to put the terminal covers over the cables before you connect the cables to the battery. Take the red and black terminal covers that Lithionics provides and cut the tube portion straight down the bottom center so you can easily slip them over the 2/0 cable and push/snap them into place over the battery terminal bolts.



Before you slide the battery under the step make sure the **battery is off, NO blue light is on** around the battery button. Be careful when handling the battery in the battery box because it is very easy to accidentally turn ON the battery by touching the on/off button. You don't want to turn the battery on accidentally until it is in place and you are ready to do so later (process described later).

Now the Lithionics battery should slide into its place under the step. The vertical clearance of the battery box is very tight, you may have to lift and tilt the front of the battery up so you can get the battery terminal/covers under the lip of the battery box first. Use your fingertips to try and keep the terminal caps on but they may get pushed off somewhat by the opening lip. After you get the covers past the opening lip then realign the caps and make sure they are snapped down on the terminal before you completely push the battery into place. Once past the opening lip there is room to work on the caps to get them securely back in place if need be.



Note: Straps no longer shipped on a Lithionics battery

You may have to move the battery around a bit and push it a little forcefully to get it to sit all the way back against the back wall battery stop/bumper, but you need it to sit just a bit back behind the opening so it is in the correct position to get the battery box cover back into place.

Before you can put the battery box cover back in its place, you need to add some black Lithionics packing foam to keep the battery from sliding around. Just cut pieces and stuff them in the sides around the battery to keep it snugly in place. You don't want it sliding around when traveling. Re-purposing the black shipping foam that came with your Lithionics battery to fill in some of the spaces is an easy way to keep your battery securely in place. Use as much as you like!



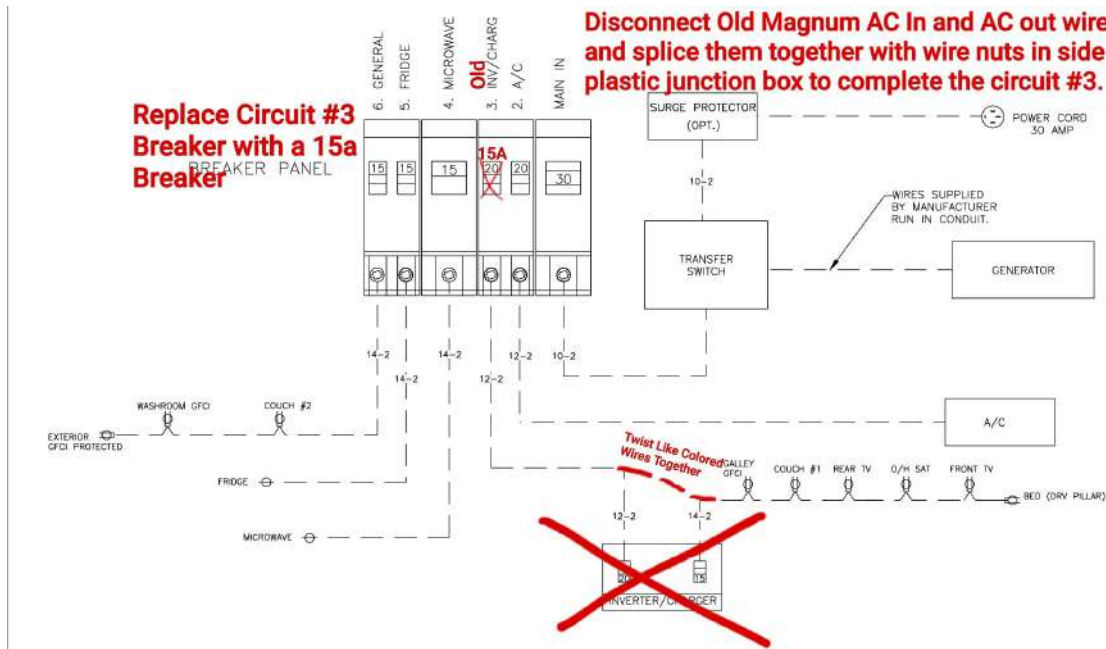
Don't put the battery box cover on until after you turn the Lithionics battery on and check for a firmware update as described on the next page. I wouldn't button up the battery box until you verify everything is working properly. In order to get the battery box cover back on you need to remove the 2 metal angle pieces and possibly the black carpeted bumpers off the step cover face in order for it to go back into place. Just remove the metal pieces and try to make it fit that way first.



When ready, the step cover should go back in place and the latch secured. The final step floor cover will keep the step opening cover snugly in place. You may need to give the step floor cover a good push to get it to fit down in the floor, it needs to be snugly in place.

Inverter Installation Preparation!

Completing the Old Inverter Breaker Box Circuit- Now before you can start test fitting the new Xantrex 3000w Inverter in place, you want to make sure the wires all reach. You'll be running New 10/2 w/ground Romex wires from the breaker box to the new inverter but you do need to splice the old 120vac Romex 12/2 w/ground and 14/2 w/ground wires together to complete that circuit #3 from the old inverter wiring.



When you disconnect the old Magnum Inverter AC In (12/2 w/ground) and AC out (14/2 w/ground) Romex solid wire, you can either pull them back up into the floor area under the kitchen drawers or behind the WFCO Power Distribution Center/Breaker box and cut them off to make a nice junction and reconnect like wire colors together inside a plastic junction box using yellow wire nuts or red wing nuts (always wrap wire nuts with black electrical tape to protect/secure them from road vibration). You'll see a blob of gray black spray foam just below the back of the Leisure battery disconnect switch, clear out the foam and you'll see where the wires go through the floor to the inverter bay. You have nice open areas of floor space in which to add a junction box.





Figure 6 - Ceiling of inverter bay. Note the plastic junction box that ties the original inverted string to the PDU.

Or you can just install a junction box, as above, in the inverter bay, out of the way of the new inverter, and use wire/wing nuts to connect like wire colors together. See the gray junction box on the ceiling in the picture above. Remember to always wrap the wire nuts with electrical tape to make sure they stay secure. You can use screws or double sided tape to mount the junction box in the location you select to bring the wires together and complete the circuit. Joining the wires together completes the Old Inverter Circuit #3 and returns the Galley GFCI, couch, TV, SAT, and Bedroom outlets to standard 120vAC breaker box powered receptacles. Then when you connect the 3000w inverter to the breaker box all the circuits will be powered by Shore/Generator power passing through the inverter or by the Lithionics battery when using the 3000w inverter (when not connected to shore/generator power).

Now the old Magnum Inverter should be removed, the inverter bay vents enlarged or created new ones, and all the old cables and wires should either be removed, replaced, reconfigured, and/or disconnected and waiting to be connected to the new Xantrex 3000w Inverter. New larger 2/0 awg wires should have been run from the battery box to the new inverter location. The old inverter 120vAC AC IN and AC OUT wires have been connected together to complete the old inverter circuit of outlets to a single 15a breaker into the breaker box.

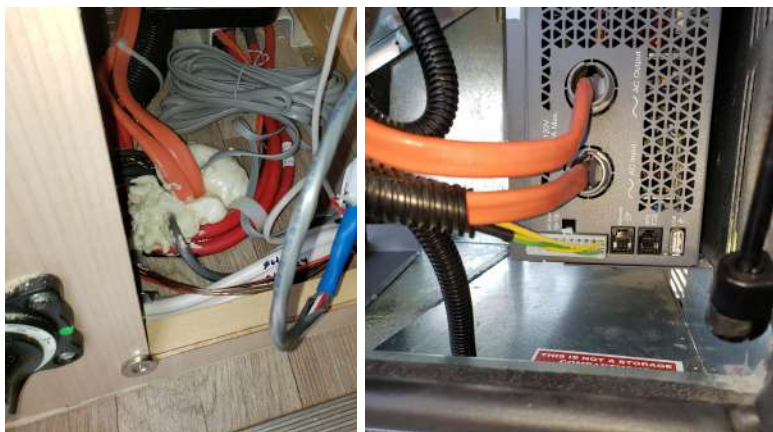
At this point the Xantrex 3000w Inverter can be dry fitted in place and to make sure there is room for everything to connect properly and decide if you can use an existing hole for the new 120vac wires or you have drill a new hole in the inverter bay ceiling to run those new 10/2 with ground Romex wires from the WFCO breaker box for the new Inverter AC IN and AC OUT breakers. Then remove the Xantrex inverter so you can pull the 2 new 10/2 w/ground Romex wires (orange casing) from the breaker box to the new Xantrex 3000w Inverter space.

Running New Romex Wires and Preparing to Reconfigure the WFCO breaker box to the New 3000w Inverter

Running New Romex Wires and Reconfiguring the WFCO breaker box to the New 3000w Inverter requires running 2 new 10/2 w/ground Romex solid copper wires (orange casing) from the WFCO breaker box to the new Xantrex inverter space. These 10 awg wires will ultimately be connected to the 3000w inverter AC IN and AC Out wire ports. You want to pull the 2 new 10/2 wires out through the front of the WFCO breaker box so you know you have enough wire to wire the breakers and then through the floor straight down to the 3000w Inverter, leaving enough length to make the necessary connections at the inverter. Make sure you label the wires at both ends so you remember which one is for AC In and AC Out. As you can see by the design of the WFCO8930/50 there are a number of push through slots in the center of the box to push the 2 new orange casing 10/2 w/ground Romex wire through so you can make the necessary breaker, AC ground and appropriate side neutral bar connections. You push the new wires through cut outs in the back of the box.



Below you can see how the orange Romex wires come from behind the WFCO breaker box area and run straight down through the floor to the new 3000w Inverter in the inverter bay. Use spray foam or Eternabond tape to seal the holes.





Reconfiguring the 120vAC Residential Power Breaker Box

Now the final thing you need to do is reconfigure your breaker box so the 3000w inverter can supply the coach appliances and outlets with 120vAC residential power. People find the breaker box reconfiguration a little intimidating, so take it slow and label everything you touch and take pictures of the breaker box connections before you start. Here is what it looks like at the start.

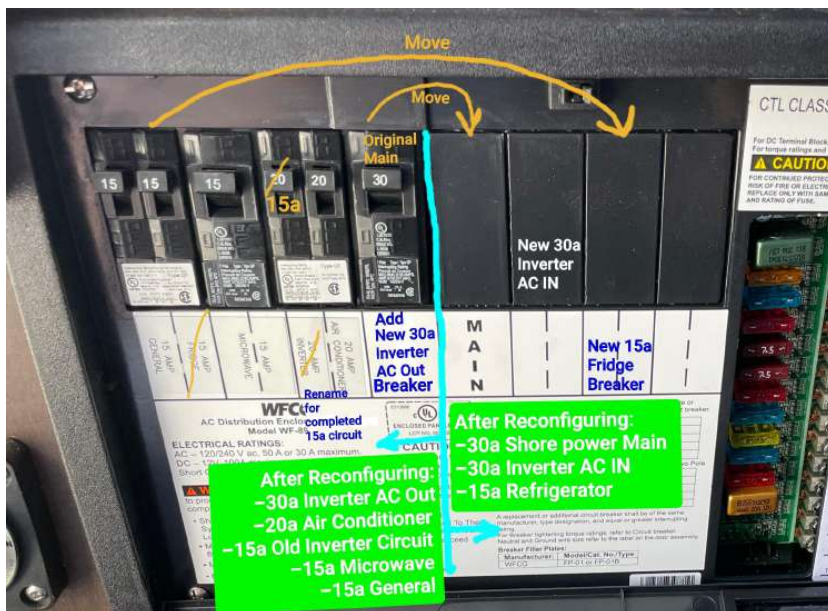


Note: Screw and metal tab above the Main Breaker holds the first breaker in place of the left side bus. You'll be moving the Main breaker one place to the right to become the first breaker on the right side bus. A new 30a breaker (takes the position the main breaker used to be in) for the Inverter AC Output will become the first breaker on the left bus for this breaker box reconfiguration.

Here is an overview of what you'll be doing. You will cut a half inch section (2 screws) out of the neutral bar. Use a hacksaw or electric cutting tool to cut out the 2 screw section. This gives you the separate neutral bars you need to create 2 distinct power buses.



You will need to replace the 20a old inverter circuit breaker (#3) with a 15a circuit breaker and re-label the breaker description to reflect the outlets it supplies. You must replace the old inverter 20a breaker with a 15a breaker because you connected 12 awg wires and 14 awg wires together to complete the circuit and 14 awg is the smallest wire and therefore the limiting power capacity wire size. The 14 awg wire only supports a maximum of 15a. So a 15a circuit breaker is protective of this rating limit. You need to put the refrigerator on its own unique single 15a breaker if it is connected to a tandem breaker because it is staying on the shore power bus of the breaker box, you'll be wiring the new 10 awg AC In and AC Out wires to their own unique 30a breakers so the Inverter AC In breaker can be put on the Shore power bus (right side) and the 30a Inverter AC Out Breaker can be the main input breaker to the other bus (left side) in the dual bus breaker box. This new Inverter bus will supply all the coach appliances and outlets by letting shore or generator power pass through the inverter to supply the inverter bus or when wanting to use just the Lithionics battery power, the inverter will supply the 120vAC power to the inverter bus to supply the coach appliances and outlets. A 2000w inverter breaker box configuration is slightly different because it cannot supply power to as many circuits. Particularly it cannot supply the air conditioner, even with an EasyStart. Air conditioner/inverter quickly overloads/ overheats and shuts down, so don't try to run your air conditioner from a 2000w inverter or you might damage it or the inverter. You'll find the 2000w inverter battery box configuration details on page 60.



I use blue Painters tape and a marker to label each breaker right on the front of the actual breaker, because when you start disconnecting them and moving them around it is very easy to lose track of which breaker goes to what circuit. I also put blue painters on the black and white neutral wires of the Refrigerator 15a breaker, Inverter AC In and Out 30a breakers, and Main 30a breaker (Shore and Generator Power), old inverter circuit wires, and any other breakers and wires that I touch so I know what is what every step of the way. Putting blue tape on the 3 neutral wires of the breakers that remain on the shore power bus (right side) makes it easy to recognize that those go on the right side bus and right side neutral bar of the breaker box. All the other white neutral wires will be moved to the left side neutral bar. If you have to disconnect any black wires from the other breakers to detangle the wires, then label that black wire as well so you get it back on the correct breaker. It is very easy to get confused about what goes where if you don't label things well. Take pictures, you might need to refer back to them.

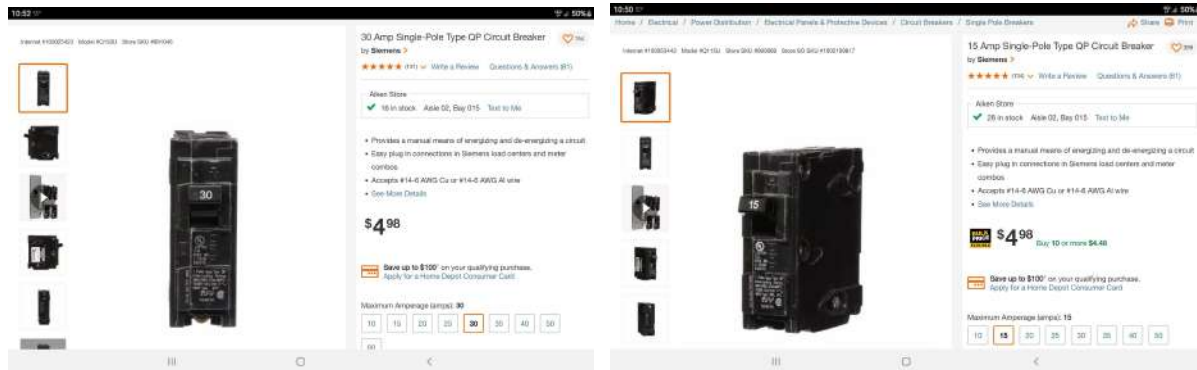
The 2016-2019 Unity's come with a WFCO8930/50 Power Distribution Center (PDC) (120vac breaker and 12vdc fuse panels), I believe in 2016 Leisure started using a WFCO8930/50 which has split busses or 2 power busses that can be used for a single 30a service or using both to create a 50a service. If you want to use the dual buses for a split/dual 30a service, you must perform a modification and separate the neutral bus bar into 2 neutral bars. Before the WFCO 8930/50 can support its use as a split 30a power bus system, you must remove a small section, 1/2" or 2 screws from the center of the neutral bus bar (see pictures below). It doesn't have to be perfectly from the center since only 3 wires go on the right side bar, just make sure you have enough screw terminals for all the wires going to the left bar (5 white wires). Since the inverter (grounded to the chassis) must not share a neutral bus with a differently grounded power supply, such as you have with shore power (grounded to earth), you must split the WFCO 8930/50 neutral bar to create 2 separate neutral bus bars. Then you must carefully wire the left breaker and right breaker bus to their respective left and right side neutral bars.

Note: The National Electrical Code doesn't allow co-mingling of neutral wires/conductors on the same neutral bus bar in all cases. If there are several power sources, be it from shore power, generator power, and/or single or multiple inverters, the National Electrical Code (NEC) requires that separately derived AC sources (such as inverters and generators) have their neutral conductors tied to ground in the same way that the neutral conductor from the utility is tied to ground, each in only one place. Given this requirement to keep shore power (true earth ground), and inverter and generator (chassis frame ground) neutrals separated, because each power source has a different ground type (true Earth vs Metal Chassis Frame) and therefore is considered a different neutral bonding source. For Inverters with an automatic transfer switch that actually lifts leads to maintain the same source neutral origins the NEC requirement is met when direct wiring shore power into the inverter AC In. However, in the case of the WFCO8930/50 PDC with dual power buses but only a single neutral, this doesn't support the NEC requirement for AC power sources with differently derived neutrals. Differently grounded power source neutrals cannot be on the same neutral bar. In order to make the WFCO8930/50 NEC compliant you must cut a 2 screw (~1/2") section out of the single neutral bar. By creating 2 separate neutral bars you can now use the dual bus WFCO8930/50 and keep the power source neutral separated as the NEC code specifies. Shore power in on one bus and inverter power out on the other bus. The automatic transfer switch for the shore and generator power also maintains the neutrals for these power sources as separate.

When dealing with the breakers, in order to remove one, just pull the breaker straight out from the top and lift it out at the bottom to release it from the bus bar and reverse to reinstall it. I will be referring to the left bus or inverter bus and right bus or shore power bus for purposes of this

breaker box re-configuration exercise. Strip off 5/8" of black and white wire casing to make new breaker connections.

If your refrigerator is connected to a tandem style breaker, double single pole breakers in one unit then you'll need to put it on a separate 15a breaker so you can separate the refrigerator from the tandem breaker set. I typically see the Refrigerator and Microwave or the Refrigerator and General Outlets on Tandem breakers. I'll use the refrigerator and microwave tandem breaker as the example for my discussion. You'll need to buy 2-15a Single-Pole and 2-30a Siemen's Type QP, or Square D Type HOM, or Eaton Type BR Circuit Breakers to reconfigure the breaker box to the 3000w inverter.



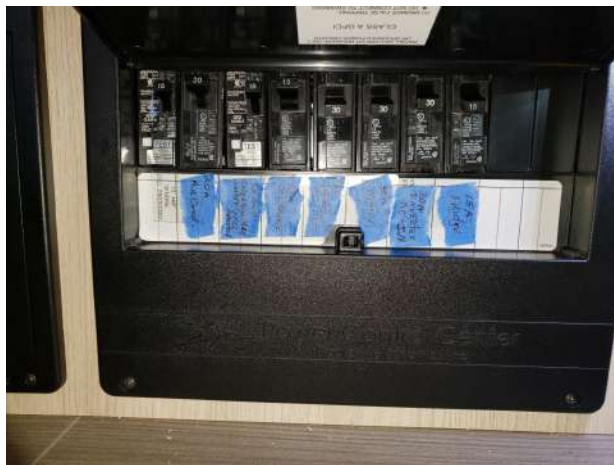
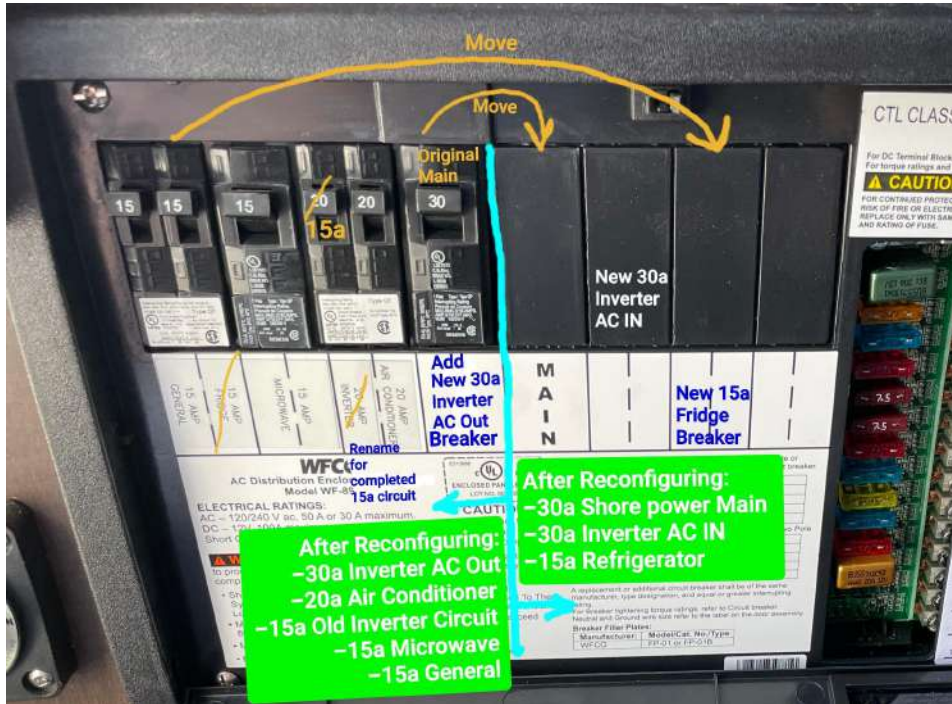
Take a 15a breaker and move the refrigerator black wire to it so it is on a new separate breaker. The refrigerator needs to be on its own breaker so it can stay on the right side bus (shore power) bus. Then you can leave the Tandem breaker for the Microwave/Vacant tandem breaker on the left side bus so the inverter can power it. Remember to leave the vacant 15a position switch flipped off/down.

I recommend leaving the refrigerator breaker on the right bus (shore power bus) so you retain the automatic power source select feature of the Dometic refrigerator.

Note: DOMETIC REFRIGERATOR AUTO OPERATION: my understanding is that if you set the refrigerator mode to AUTO, it will run on 120vAC if plugged in to shore power, then will automatically switch to propane if there's no shore power and you're stationary, then it will automatically switch to 12vDC when you start the engine and are driving. You can manually take the refrigerator off AUTO and set it to propane, 120vAC or 12vDC at any time. However, if you set it to propane while driving, you'll notice that when you stop and turn the ignition off, the refrigerator will still automatically switch to a 12vDC battery for about 10 minutes. That's a safety feature - it assumes you're at a service station and turns off the burner so there's no risk of igniting gasoline fumes. There are a few reasons you might drive with the refrigerator on propane. Typically it is related to the battery or that people find that the refrigerator cools better on propane than on battery. Also, if your batteries are low and you want to recharge while driving, you want the fridge to be on propane - it draws about 16-20a when it's running off battery, and that means the current coming from the solar or alternator is no longer available to charge your batteries. So instead of charging your batteries at around 25 amps (DC-DC Charger or 400w solar), you're only charging them at around 5-8 amps and at that rate it will take forever to charge the battery.

Moving some of the breakers from the left to the right can be challenging because the wire might not be long enough so you'll have to unseat some breakers and move them or detangle

them to use the full length of the wire. This is why labels on the black and neutral wires are so important before you do anything to a breaker. I also found that there is a little slack in the wiring if you pull on the 3 wire set casing/wires poking through the back you can get an extra 1/2" - 1" of length. This is just enough extra to get the breaker to fit on the right side bus on the right side of the 30a Inverter AC In breaker.



2021 Unity Breaker Box

Basically all you need to do is move breakers around. The left side bus is fed by the 3000w inverter through the Inverter AC Out 30a breaker, so you put all the appliances (except the refrigerator) and outlet breakers on this side. The right side bus, starting with the 30a Main breaker, for the shore/generator power input, which feeds the 30a Inverter AC In breaker and Dometic Refrigerator breaker. Moving the breakers is only a part of the job, you must also align the breaker's black wire corresponding white neutral wire to the correct side neutral bar as well.

Once you've reconfigured the breaker box remember to correct the descriptions on the panel face plate. Make sure all the breakers are flipped ON or up. You can also move the breakers on the left side closer together against the Main breaker so your blank spaces are at the far left end. Take your time and be very focused on moving the breaker and aligning the neutrals to the respective side its black wire/breaker is on. You'll also need to remove blank panels from the right side of your face plate to accommodate the new breakers you've added to the right side bus. There is no need to touch the bare ground wires, they can all stay together on their own unique grounding bus bar.

How Does it all work?

Here is a description of how it all works. When on shore/generator power, the power enters the breaker box through the 30a Main breaker which supplies the breakers on the right side with power, the 30a InverterAC In, and Dometic Refrigerator. The 30a Inverter AC In breaker takes the shore/generator power and passes it through the inverter, which comes out and goes to the first breaker on the left side bus, the 30a Inverter AC Out Breaker. This breaker supplies the entire right side bus with power, powering your appliances and outlets with 120vAC residential power. The Shore/Generator power passing through the inverter also supplies the inverter unit's battery charger to charge the house battery when on shore/generator power.

When there is no shore/generator power, the inverter senses that and starts inverting the 12vdc battery power to 120vAC residential power and feeds it to the breaker box through the 30a Inverter AC Out Breaker on the left side bus, which supplies all of the left side breakers (appliances and outlets). With the refrigerator breaker located on the right side bus, if shore power is lost, then the refrigerator breaker loses 120vac power, so it automatically switches to propane when no shore/generator power is being supplied to the breaker box's 30a Main breaker. You must manually change the refrigerator power to battery if that is the power source you want it to run on, but remember it takes a surprisingly high number of amps to run the refrigerator off battery so always consider the significant drain the refrigerator may have on the battery before you choose battery as the refrigerator power source.

Alternatively, if you had left the refrigerator breaker on the left side, if shore/generator power was lost, the inverter would immediately start providing 120vac power so the refrigerator would continue to be powered as if it were on shore power, triggering no automatic refrigerator action. In this way the Dometic refrigerator automatic power selection feature is disabled if you leave the breaker on the left side bus. The refrigerator essentially only runs off shore power or the inverter; all other power supply choices must be manually selected.

I highly recommend putting the refrigerator breaker on the shore/generator power fed main bus (right side) because you retain the automatic switching feature of the Dometic refrigerator. Since the refrigerator can be run directly from the battery there is no reason to have it on the inverted bus, it is a waste of battery power to run the inverter to run the refrigerator. It's not a huge difference, but if you run the refrigerator off the inverter it is another 20-25a from the battery versus 10-14a directly from the battery. It does make a difference when you are boondocking and trying to conserve power. Also having the refrigerator on the shore power bus means its power doesn't have to pass-through the inverter to get to the refrigerator breaker. Keep the refrigerator operation automatic and simplest by putting its breaker on the right side bus, shore/generator power direct.

3000w Inverter Mounting

At this point you should have created adequate ventilation for the 3000w inverter, cut out a larger hole so the new 2/0 cables down get pinched by the compartment door strut when closed, installed the new 2/0 awg inverter battery cables, installed a new 250a Mega Fuse, and installed the inverter battery disconnect switch on the red positive 2/0 awg battery cable.

Now it's time to install the 3000w inverter. You will reuse the Leisure provided white wire (6 awg) for the inverter case ground since it is more than adequate for the new 3000w Inverter. Attach the 6awg white inverter case ground wire before you mount the Xantrex Freedom XC Pro 3000w Inverter. You can't get to its connection point after the inverter is installed, there just isn't enough room. You can mount the inverter in the same place as the old Magnum by one of these 2 methods, 1) screw it to the wall or mount it on something. If screwing it to the wall, use some pieces of wood for supports under the inverter to keep it in the right position while you mark new mounting holes, then drill the holes for screws, then mount the inverter. You could also use #8 self tapping screws. 2) Use aluminum or steel tube stock (and VHB tape to stick the tube stock in place and VHB to stick the inverter to the tube stock).

I think mounting the inverter on the wall with self tapping screws is probably the easiest option. It easily mounts on the side wall with 4 screws. Just make sure you align the ventilation openings to the Xantrex inverter fans and leave space between the wall and inverter back so you can get your fingers back in there to press the inverter reset button in case you ever need to in the future.

Inverter 120vAC Orange Casing Romex Wire Connections

Add the 3/8" wire holder/strain relief connectors you purchased. Install these and then put the orange wire through and into the lever connectors inside. Make sure you put the AC in and Out (that you marked on the wire) in the corresponding AC In and Out connection ports.

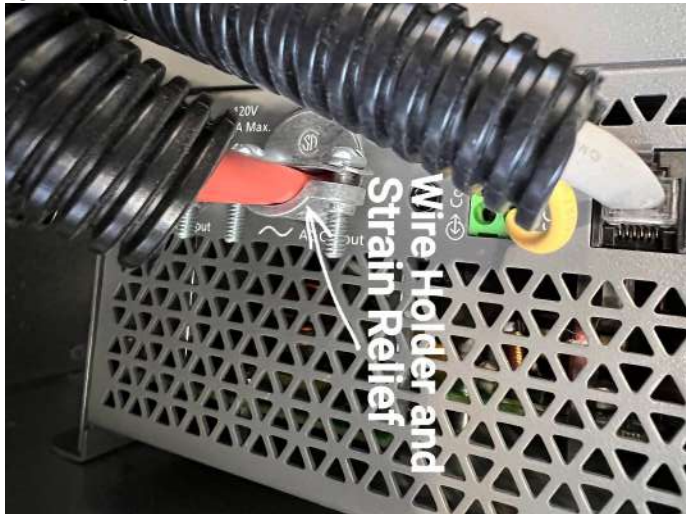


On the Xantrex 3000w inverter, strip off about 5/8" - 3/4" of casing from the white and black wires and feed the Romex wires into the orange tab lever connectors (lift up to open) inside the Inverter, being very careful to put them in as labeled. Make very sure you put the wires in the right order, N-white neutral wire, G-bare copper wire, L-black wire. Make sure only the bare wire goes inside the actual connector, you don't want any casing in-between the connection device

and the wire. Then push each tab down to lock the wire into the connector. Do this for both AC wire ports (Inverter AC IN [bottom] and AC OUT [top]).



Tighten the screws on the $\frac{3}{8}$ " wire holder/strain relief. Don't tighten down the wire holder too tight, it is just supposed to hold the wire, not compress or deform it.



Attaching The Battery Cables

Connect the black battery cable to the inverter battery negative terminal. Before you attach the red 2/0 awg battery cable to the 3000w inverter, one important addition needs to be made. You must add the 300a rated Blue Sea battery disconnect switch between the battery and 3000w inverter. It will probably be easiest to install this switch near the inverter. Refer to the **Removing the Batteries and Preparing the Battery Box** section on page 13 and retrieve the short coach positive battery cable left over after you replaced it with the longer cable used with AGM batteries. You will have to drill out the old short red 2/0 awg battery cable to a 3/8" diameter hole. Or if you purchased the optional short 2/0 awg cable with the 5/16" and 3/8" lugs, make sure you connect the 3/8" end to the battery switch terminal.

NOTE: The way I tighten is to snug down the Nut or bolt until you think it is tight and then give it a last 1/4" of turn just to give it that last teak of tightness. Once tight, the lug/connector should not be able to be moved by pushing or pulling on it. Use this for

everything you tighten in the battery box, in the inverter, or on the battery. You never want to over tighten, this method helps you keep from doing that.

On the red 2/0 cable from the battery box, make sure you are using the end of the red battery cable with the $\frac{3}{8}$ " hole lug connector so it will fit on the battery switch terminal (9/16" nut) and then add the new short piece of 2/0 awg cable with a $\frac{3}{8}$ " lug on one end to fit the other switch terminal and a 5/16" lug on the other end to fit the 3000w inverter positive terminal. **Make sure to leave the switch in the OFF position.**

Then cable/zip tie the switch to the other cables to secure it in place. Here are examples of the switch installation. You can cover your cables with a split loom cover if you want a finished look like Leisure does with their cables.



While the Lithionics battery has a convenient power button located on the battery, it can be used to completely disconnect the battery from the entire draw of power from the several coach components (connected through the Mega Fuses in the battery box), including the inverter if you ever need to work on the complete coach electrical system. However, you must always disconnect the inverter first using the inverter battery disconnect switch before you use the Lithionics battery power button. Always turn the Inverter battery switch OFF, disconnecting it from the battery. Only this inverter battery switch safely isolates the inverter from the battery. So always remember to turn the coach and inverter disconnect switches off before you use the Lithionics battery button to turn the battery off or on. Don't use the inverter or house battery switches to turn anything back on until after you have turned your Lithionics battery back on and it has stabilized for a minute or so once the blue light is on, meaning the battery is ready to supply power. Build using it into your normal shutdown and startup routine, using it just like you use the coach battery switch, for your Leisure Travel Van.

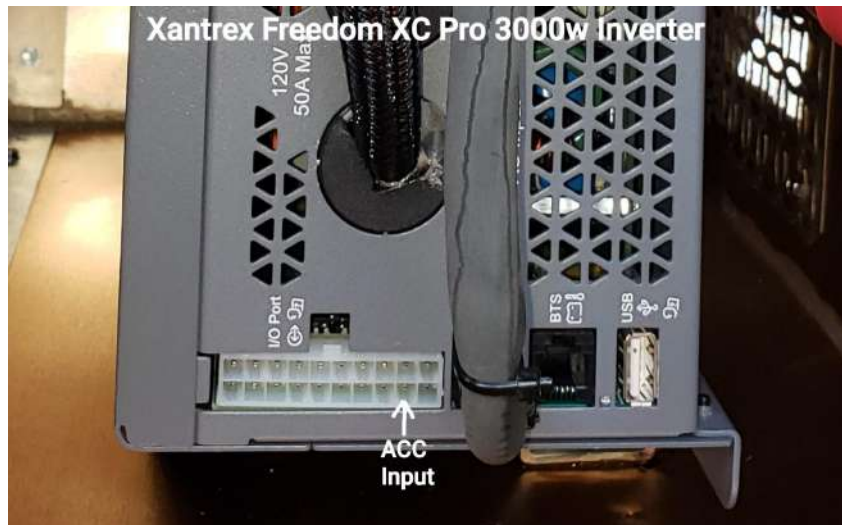
Note: An Inverter Battery disconnect switch is important for a number of reasons. First, to make the 3000w inverter installation meet all applicable safety code requirements (NEC, AYCB, and RVIA). You must be able to isolate electrical components in order to safely work on them or isolate them in case of issues. Second, disconnecting the inverter from the battery completely stops any draw off the battery from the inverter. If you aren't using the inverter and just have it turned off at the remote display control panel, it is still drawing a smaller amount of power from the battery to stay in a state of readiness to be used. Third, most inverter Error Codes or Shutdown issues need to be addressed with a hard reset. A hard reset is where you must disconnect all power, shore and battery, and let the inverter sit isolated for 30 minutes and then reconnect to the battery. I've experienced these with my Xantrex inverter a number of times and I was so glad I installed an inverter battery disconnect switch between the battery and inverter

so it was simple to perform a hard reset. Just flip the switch, wait 30 minutes, and flip the power back on to the inverter.

Now check for clearance between the door support strut when the compartment door closes. If the strut hits the cables then you need to reposition the cables so the strut clears it in closing. You may need to add some of the black foam that came with your Lithionics battery between the cables and the front of the compartment cable access hole. Take a piece of foam that sticks out on the exterior side of the wall so you can stuff the foam tightly between the cable and front of the hole edge and then cable/zip tie the portion sticking out on the exterior side to secure the foam in place. Now the cables should be out of the way of being pinched by the compartment door strut when the door is closed.

Xantrex 3000w Inverter ACC Input Connection (Ignition Control Feature)

The old Magnum Inverter had an ignition control wire that can be adapted to the ACC Input terminal on the Xantrex 3000w inverter 20 pin connector. On the Leisure Magnum Inverter installations, they used a combination battery temperature sensor cable and ignition signal control wire plugged into the Magnum. Don't be confused by the name ignition control, the 12vdc signal is not related to the vehicle ignition switch in any way. The term ignition just means a switched 12vdc power supply. The Leisure red wire is a fused positive 12vdc wire from the House 12vdc Fuse Panel in the Power Distribution Center, it is controlled by the Coach/House Battery Disconnect Switch. This ignition control wire is attached to Fuse #2 (5a) found on the Power Distribution Center fuse panel. The Magnum battery temperature sensor was removed in previous sections because a Lithionics battery has its own internal Battery Monitoring System (BMS), which includes temperature. The ignition signal wire can be connected to the Xantrex 3000w Inverter at the ACC pin port, but you need a special 20 pin connector, the StarTech connector identified in the **Parts Section**.



If you pull the covering back on the Magnum phone style cord ignition control wire you'll find it leads to a single red wire that goes up through the inverter bay ceiling/coach floor.

This red wire will need to have a small piece of 16 awg wire attached to it to lengthen it to attach to the StarTech Connector 20 pin connector which gets plugged into the Xantrex Freedom XC Pro 3000w ACC Input 20 pin connector.

The Xantrex Freedom XC Pro 3000w ACC Input is an ignition control feature (12vdc trigger wire powered by the coach's battery switch through the fuse panel) that turns OFF the power to the inverter controls (inverter remote) automatically when you turn the coach's battery switch to OFF.

The Xantrex Inverter Ignition Control settings allow you to choose whether you want the inverter controls to be powered on automatically (Auto) or manually (Lockout) when the coach battery switch is turned ON. The inverter ignition control setting AUTO setting automatically turns the inverter controller ON with the coach battery switch and OFF with the coach battery switch.

The Lockout setting requires you to manually turn ON the inverter controller after you turned the coach battery switch ON. Leisure uses the Lockout setting with their Xantrex 2000w inverter installations on the 2020 and newer models. Regardless of the setting, Automatic or Lockout, the inverter control power is automatically turned OFF with the coach battery switch. This is really the most important aspect of the inverter ignition control feature. While the coach battery switch turns off the inverter control power, which is the largest draw when not using the inverter, you still need to remember to turn the inverter battery disconnect switch off as well so you completely disconnect all battery power going to the inverter, particularly when storing your Leisure Travel Van, to ensure there are no inverter parasitic draws on the battery.

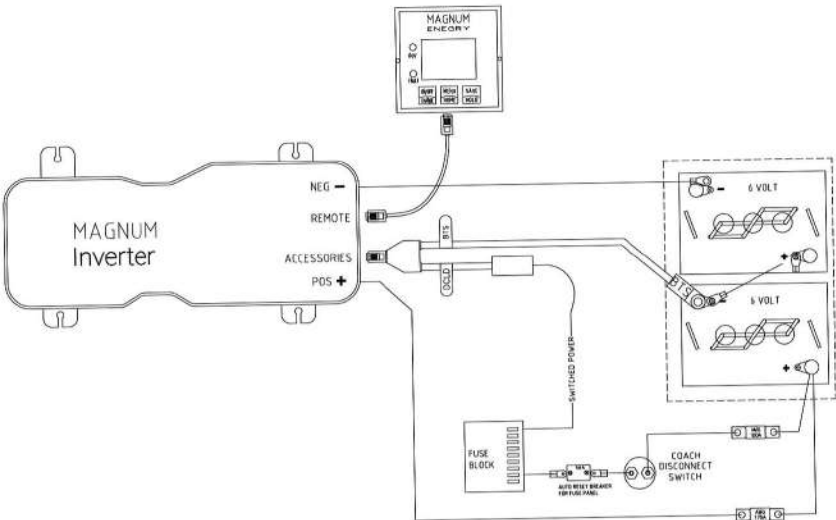
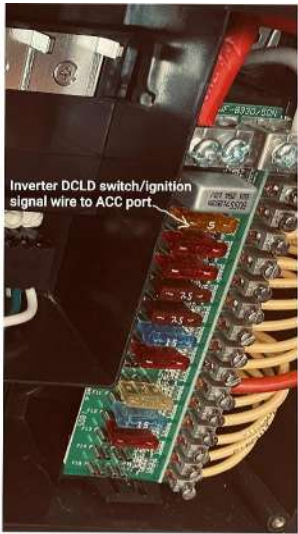
The inverter disconnect switch is the absolute inverter power cutoff because it completely disconnects the battery from the inverter. Religiously using the inverter disconnect switch, as you do the coach battery disconnect switch is something you must build into your routine, but the ignition control feature can serve as a sort of safety net or backup to at least turn off the inverter control power if you forget to use the inverter battery disconnect switch to completely shut off the inverter. It isn't well understood that the inverter uses 3-5a per hour if it is left on, so you always want to ensure the control power is off and the inverter is disconnected from the battery when storing your Leisure.

Detailed Freedom XC Pro ACC Connection Modification

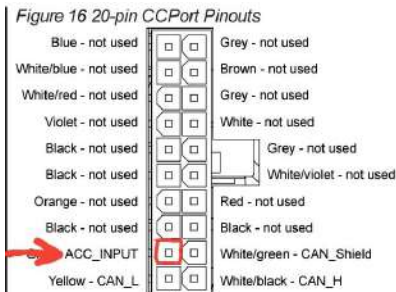
In order to connect the red Magnum ignition control wire to the Xantrex ACC Input port you need to recognize that there is a big difference between the Magnum phone style cord connector and the Xantrex 20 pin connector. The functions are the same despite different connectors. Don't be confused by the name ignition control, the 12vdc signal is not related to the vehicle ignition switch in any way. The term ignition just means a switched 12vdc power supply of anyone's design. You definitely want to reattach the old Magnum Inverter switched power (ignition control) red wire (red wire connected to the MM-DCLD adapter pigtail) to the ACC Input terminal on the 3000w inverter using the recommended StarTech 20 pin connector.



Leisure used a combination of a battery temperature sensor cable and ignition signal control wire plugged into the old Magnum using a double phone jack adapter. The ignition signal is not from the vehicle ignition switch but rather from the house 12vdc fuse box which is activated by the house battery disconnect switch by the door. This red ignition control wire is attached to Fuse #2, a 5a fuse, (on 2019 Unity FX). The battery temperature sensor wire will no longer be used because a Lithionics battery has its own internal Battery Monitoring System (BMS), it has its own internal temperature sensor. So you should have just completely pulled that wire from the inverter bay and battery box and will just reuse the red ignition signal wire (can be connected to the Xantrex 3000w Inverter at the ACC pin connector, but it has to be extended using a piece of 16 awg wire to lengthen it). The Xantrex Inverter Ignition Control and Charger Ignition Control settings should be set to Lockout discussed later, then when you flip the House Battery Switch (assuming the inverter battery disconnect switch is already on), by the steps to off, the Inverter controller shuts off with the rest of the House battery power. In order to ensure that there is no risk for the inverter to drain your house batteries. You should always use the inverter battery disconnect switch to completely disconnect the inverter from the battery whenever you are parked/storing your Leisure for more than a couple of weeks.



To attach the single Magnum red wire to the Xantrex Freedom XC Pro 3000w you need to buy this 20 pin connector, <https://www.amazon.com/dp/B0002GRQRW>, and cut the wires off of the smaller connector that fits the Xantrex inverter, with the exception of the ACC position pin wire. Use the smaller (male connector with female ferrules) StarTech connector end (20 pin) to snap into the Xantrex 3000w Inverter connector and then splice the red wire, to a new length of 14 awg wire with blue butt connectors that require crimping or the solder heat shrink style (see Parts Section), to the new orange 20 pin connector wire for the ACC position and push it into place on the Xantrex 3000w inverter. If you don't have a butt connector then you can use a small tan or blue wire nut, or even twist the bare wires together and secure them with electrical tape to splice them together.



Connecting to ACC Signal

With the 20-pin Communications Harness (PN: 808-0820), the Freedom XC PRO can be wired to inhibit inverter operation in the absence of a vehicle's (or vessel's) +12VDC ignition control signal. This feature can avoid unnecessary battery drain that would otherwise occur if the inverter/charger was operated without a charging source such as the vehicle alternator.

To enable ignition control:

1. Ensure that AC and DC power are both OFF.
2. Ensure the vehicle's ignition is turned to OFF position. It is highly recommended to remove battery power by disconnecting the vehicle's battery cables. Refer to the



Connect the Xantrex Remote Display

The old Magnum Inverter display and phone cord won't work with the new Xantrex inverter. The Magnum display uses a 4 wire phone cord whereas the Xantrex inverter display uses a 6 wire phone cord. So abandon the old Magnum cord and remote in place. Tie the old phone cord up out of the way.

The Xantrex Inverter uses a special 6 wire phone cord so use the one that came with the Xantrex Bluetooth or non-Bluetooth optional remote display to connect it to the Xantrex inverter. Plug the Xantrex Inverter Remote Display phone cord into the 3000w inverter (RJ12 6 wire connector phone style cord) remote connection port. You can either find a convenient location to mount the remote display or since it is Bluetooth you could simply cable tie it inside the Inverter bay if you don't want to mount it, pictured below. If you are interested in pulling the cord to the over door panel and mounting the remote in place of the old Magnum display refer to information at the end of this guide for the section titled **How to Route Remote Display Cord to the Over Door Panel.**



Replacing the Inverter Compartment Separation Wall

The Xantrex 3000w Inverter handles very high power and as such can produce sparks, so it is a good idea to reinstall the separation wall if you plan on storing things in the remainder of the compartment that might be flammable. If you just bent the old separation wall up to work then bend it back in place and reattach it with #6 x 1/2" self-drilling sheet metal screws. Run a bead of Silicone caulk up around each corner and across the seam on the floor to prevent water that gets blown into the inverter area from leaking into the storage side and getting the carpet and everything stored there wet.

Note: You may inadvertently hit the silver inverter button with your arm while trying to reattach the wall. Verify that the silver button is popped out to enable the use of the inverter remote display controller power button.



If you completely removed the separation wall and the old wall is undamaged, then reattach it using #6 x 1/2" self-drilling sheet metal screws. If you cut out a center portion of the old wall then just cut a slightly larger new wall section from the aluminum sheet and screw it into the remaining lip of the old wall connection joints. If you damaged the old wall it is very easy to fabricate a new one or trim away the damaged edges and reinstall using 1" aluminum L angle stock. If you need to make a new wall, just go to any hardware store and buy #6 x 1/2" self-drilling sheet metal screws, sheet metal shears, a sheet of thin aluminum 24" x 36", and 2

pieces of 1" x 48" angle aluminum stock. You might be able to reuse the old wall by cutting off the bent parts of the wall and then screwing them to an angle aluminum frame that you create, see pictures below. Just line the storage compartment with the angle stock to make a new mount for the separation wall pictures show. If you mangled the separation wall or want to cut a new wall from aluminum sheeting, using the 1" angle bar stock gives you an easy way to put the wall back in place. Aluminum sheets are readily available in lots of sizes at Lowe's/Home Depot.

If needed, you can reattach the carpet to the compartment floor or walls using contact spray adhesive.



BIG FINISH! Turning the Power Back On

Once you have everything installed it's time to check if it all works. You must be unplugged from shore power to complete the initial battery and inverter startup, and inverter setup. Make sure the breakers in the breaker box are all flipped on or up, except the vacant tandem breaker you left in place if applicable. The very first thing you need to do is verify that the Lithionics Battery Firmware is up to date. This is very important because Lithionics puts out new battery firmware as they learn new things in field testing, like how to address the high capacitive in-rush current

of large inverters or add additional protection features or make advancements in battery design and power curve efficiency. Before you turn on the Lithionics battery, first make sure the new inverter battery disconnect switch is off and then turn on the Lithionics battery with its little blue lighted power button on top. Download the Lithionics Li3 Battery APP and when you open the APP it will immediately connect to the Lithionics battery. Click on the wheel cog in the upper right corner and the next screen will give you an option to check the firmware. This video will guide you to check for any Lithionics firmware updates, https://youtu.be/jJsIDYVr1_Y. You can name your battery as well if you would like a unique name, <https://youtu.be/o4vfwNLPvWY>.

IMPORTANT Before Proceeding: If you hear loud unexpected noises or smell any kind of hot burning smells as you begin to turn things on and test your installation, immediately turn everything off and re-check your wiring.

After giving the Lithionics battery a minute or so to fully power on and stabilize. Turn the Leisure house/coach battery switch on. Turn the solar panel power back on (your installed switch or remove solar panel covering). If you have a solar controller with a Lithium setting then change its setting to that otherwise leave it on the AGM battery setting profile.

Now turn the inverter battery disconnect switch on. You should immediately hear the Xantrex Inverter Fans start running. If the fans don't run immediately, then you may have a problem.

I look for the Microwave clock to be blinking as my verification that the inverter is making 120vac power. If you don't see this then check the remote display to see if you have any warning messages. If the inverter isn't working, turn the house battery switch and inverter battery switch off and re-check all your wiring and connections. There is a problem somewhere and you must correct it before proceeding. It could be as simple as you forgot to have all the breakers flipped up and on.

So far so good, everything is working as expected. Now let's get everything setup.

Download the Xantrex **FXC Control APP** and follow the prompts to connect via Bluetooth to your phone. It is easy to adjust the settings on a Xantrex Inverter via Bluetooth and the FXC Control APP. Xantrex has a number of different APPs but only the **FXC Control App** will work with the Xantrex Freedom X/XC Bluetooth Remote Display Controller so make sure you download only the FXC Control App, if you downloaded any other Xantrex Apps they will interfere with the FXC Control App so delete them from your phone before you try to use the FXC Control App.

Now verify that the voltage shown on the Xantrex Remote Display or FXC Control App is nearly identical to the Lithionics battery voltage as seen on the Lithionics APP.

NOTE: If these voltages do not match, I mean they are significantly different from each other, then you have a connection problem somewhere. They should match up when there is no load on the inverter.

For troubleshooting you will need a voltmeter so you can begin doing voltage checks from the battery to the inverter to find out why the inverter isn't getting the same voltage as the battery is reading. Check every connection to ensure it is tight, no wire/cable should be able to be moved. Check the voltage of every connection between the battery and inverter terminals. They must read the same exact voltage as the battery terminals are reading or you have something wrong

with connections, crimps, wire, fuse, washers or heat shrink where they should not be, etc. Every connection must be checked for the correct voltage until you find the cause of the low voltage. If you find issues then turn off the inverter switch, Leisure battery switch, and battery, then replace fuse, re-tighten, repair, the offending element(s).

You must find the cause of the DC voltage issue or you could damage the battery or inverter. Once you track down the bad connection, turn the Lithionics battery on, the Leisure battery switch back on, and restore the DC power to the inverter by turning the inverter battery disconnect switch back on, then the inverter fan should start running immediately. If this doesn't occur you'll have to keep troubleshooting. But if the inverter battery terminals are reading the same voltage as the battery then the issue you had should be resolved, unless there is something wrong with the inverter itself.

Inverter Firmware

It is easy to set up a Xantrex Inverter with the Bluetooth Remote Display and the FXC Control App. But the first thing you should do is check to see if your firmware for the Inverter and Bluetooth Remote Display are the latest versions. First verify the Firmware Version by viewing the version numbers on screens U2 and U3 of the actual Xantrex Remote Display panel unit. The U2 and U3 screens are the last 2 screens, use the center button, with the pointing arrow to the right, to scroll through the screens. Verify that your Remote firmware revision on the U2 Screen is 1.23 or higher. Verify the inverter firmware version on the U3 screen is 1.06 or higher.



U2 and U3 screens read as firmware versions 1.23 and 1.06, respectively. These or higher numbers reflect the most up to date firmware. I believe the latest versions out there are 1.28 and 1.07, respectively. If either of the U2 or U3 firmware versions need updated then follow the instructions below. [Otherwise Skip to page 43, Inverter Settings Section.](#)

Updating the Xantrex Inverter and/or Remote Display Unit Firmware

You can find instructions and the latest firmware and download instructions here, <https://www.xantrex.com/power-products/inverter-chargers/freedom-xcpro.aspx>. You must use a USB Flash drive of at least 2GB, standard formatted on the computer. Download the files exactly as the Xantrex instructions direct. You'll need to create a folder called **FreedomX_Firmware** and then you download the inverter firmware Zip file from the Xantrex website. Unzip the file and move the 2 firmware update files **fxcc.enc** and **fxcc_manifest.cbor** into the FreedomX_Firmware folder. Then download the Bluetooth Remote firmware update and move it into the FreedomX_Firmware folder on the flash drive as well. Rename the Bluetooth

Remote file to REMOTE.bin. Then make sure the Xantrex inverter is on, Green light next to the center button of the Remote Display Control panel or by turning it on with the power button on the Remote Display Control panel. Plug the USB flash drive into the USB port on the right bottom corner of the inverter unit itself.



The inverter will immediately start processing the download, indicated by flashing lights on the USB drive. Wait about 10 minutes. You'll know the download is done when the flash drive and inverter stop the flashing lights and the Xantrex Remote Display shuts off. Then turn the Remote Display back on with the power button and verify the updated Firmware Version numbers. Remove the USB Flash Drive. Verify the Firmware updates completed by viewing the version numbers on screens U2 and U3 of the Xantrex Remote Display panel.

Inverter Settings

The following are the settings I recommend based on my own testing and operation.

SETTINGS	
INVERTER	
Inverter Ignition Control	Lockout >
Low Battery Cut off	11.0v >
Low Battery Cut off Delay Timer	120 s >
Low Battery Recovery Voltage	12.1 V >
Power Save Time	Off >
Power Save Mode	Disable >
Output Frequency	60.0 Hz >
Output Voltage	120 V >
Inverter Output Power Limit	3000 W >
Inverter Output Power Limit Timer	300 s >
Transfer Mode	Appliance >
Inverter Shutdown Recovery	Automatic Restart >
CHARGER	
Battery Type	LifePO4 >
Default Battery Temperature	Hot >
Charger Ignition Control	Off >
Equalize Charging for Flooded Battery	Disable >
Charger Current	50.0 A >
SETTINGS	
CUSTOM	
Custom Absorption Voltage	14.4 V >
Custom Float Voltage	13.4 V >
GRID	
Utility AC Under Voltage Level	102 V >
Breaker Rating	30.0 A >
SYSTEM	
Audible Alarm	Enable >
Reset to Default Settings	>
DEVICE INFORMATION	
Current Firmware	00003.16
Remote Firmware	00001.23
Serial Number	92812009700039
Manufacture Date	2020-09
FGA	818-3010
Model Information	XC PRO 3000
Feedback	>

Once you are sure the inverter is functioning properly (refer to the Testing in Battery Mode section from the manual, pictured below), only then plug into shore power to Test in Grid Mode.

Step 8: Testing Your Installation

⚠ WARNING
ELECTRIC SHOCK HAZARD
Pressing the Power button to turn the Freedom XC PRO inverter to Standby mode on the display panel does not disconnect DC or AC input power to the Freedom XC PRO. If shore power is present at AC input terminals, it will pass through to the AC output.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

There are two tests to be performed. The first test verifies that the Freedom XC PRO is inverting DC battery power and delivering AC power to its output.

The second test is intended for installations where AC input and output is hard wired to the Freedom XC PRO. This test verifies that the Freedom XC PRO transfers from inverter power to shore power when shore power is present.

NOTE: Shore power (pass-through) refers to the AC input power from a utility grid, generator or external AC source.

When you are ready to test your installation and operate the Freedom XC PRO, close the DC fuse and Disconnect or the DC circuit breaker to supply DC power to the Freedom XC PRO.

Testing in Battery Mode

To test the Freedom XC PRO:

1. For hard wired installations, ensure shore power is not present.
2. Press the Power button to turn the inverter/charger on. The green LED indicating Battery mode (Inverter mode) turns on and the LCD screen displays the **BATT. MODE** icon.
3. Plug a test load, such as a lamp within the power rating of the inverter/charger into the Freedom XC PRO GFCI or an AC outlet hard wired to the Freedom XC PRO.
4. Turn the lamp on to verify that it operates.

If the lamp operates, your installation is successful. If your installation has AC input and output hard wired to the Freedom XC PRO, proceed to *Testing in Grid Mode*.

If the status LED on the display panel glows red, see the Troubleshooting chapter.

Testing in Grid Mode

To test the Freedom XC PRO:

- With the test load from the previous test still connected and operating, connect the shore power source.
- The Freedom XC PRO transfers the test load to shore power. The green LED indicating grid mode turns on and the LCD screen displays the **AC MODE** icon.
- If the test load operates, your installation is successful.

NOTE: If the Power button on the Freedom XC PRO is turned ON, the Freedom XC PRO will automatically supply the appliances with inverter power if the shore power source fails or becomes disconnected.

If the Power button on the Freedom XC PRO is turned ON and shore power voltage is too low (less than 90 volts AC), the unit will transfer to inverter power to continue running your appliances.

NOTE: Whether or not the Power button is turned ON, shore power will pass through the Freedom XC PRO to the output when shore power is within normal operating range. The unit also starts charging the battery after the transfer to grid mode.

NOTE: In the event of low or no battery voltage, shore power will pass through the Freedom XC PRO to the output even when shore power is outside the normal operating range.

You can now close up the battery box if you haven't already done so.

More Detailed Settings and Operational Information

The ACC Input- Ignition Control wire you connected as I described earlier, has features for **Inverter Ignition Control** and **Charger Ignition Control**. Both have 3 settings to choose from. I recommend the setting of **Lockout** for the **Inverter Ignition Control** and **Off** for the **Charger Ignition Control** setting. Then the Leisure Coach Battery Switch will signal the Inverter Control System (power to the inverter remote display controller) to turn Off with the Leisure battery switch. The Lockout setting requires you to manually manipulate the inverter remote display controller to turn the inverter on or off while boondocking. Remember the inverter is always on when connected to Shore power or running the generator. This is because their power must always pass through the inverter in order to supply the inverter bus on the right side of the breaker box.

You can also adjust the **Charger Current** setting to your desired charging parameter, but I recommend you set it at less than 50a until you get accustomed to its operation. You may have to play with this setting depending on your needs because it doesn't always balance the loads properly and you may find you have to reduce the charger current very low depending on the capacity of a shore power outlet or the generator, particularly if you are trying to run the air conditioner at the same time. Running the air conditioner and battery charging from a 20a shore power connection or the generator may cause problems. With how things function so be aware of this and keep adjusting the battery Charger Current setting lower and lower until the anomalies dissuade. I've had to adjust the battery charger current down to 5a to get my air conditioner compressor to run properly.

Under normal 30a shore power use, I leave my Charger Current set on 50a because I mostly recharge my Lithionics battery at Campgrounds when I have a 30a power pedestal to plug into and I'm also using the air conditioner and the rest of the coach. I set it at 50a because I don't want to draw so much charging power for the battery when I need much of the 30a shore power to run everything else in the coach as well. Battery charging at 50a per hour will fully charge my Lithionics 315 ah battery in 6 hours so that's perfect because we overnight on shore power. The Xantrex is supposed to be smart enough to balance your shore power usage needs against the

need to charge the battery and then automatically adjust the Charger Current depending on how much unused current is available. I found this doesn't always work at the higher Charger Current setting. The manual describes its operation like this, "The charger is power factor corrected to use AC current as efficiently as possible. Minimizing the AC current used by the charger means more current is available for your AC loads. The Freedom XC PRO has a power share feature which prioritizes your AC loads by reducing the Charger Current and maintaining the total input current to less than the breaker setting." I don't find this to work if the Charger Current setting is set to high, in fact if it is set to high and you are running the air conditioner the charger won't turn on at all or the charger works but the air conditioner compressor won't turn on. Some people have reported to me that they trip breakers, so a number of things can go wrong if the air conditioner operation and battery charger loads aren't managed properly.

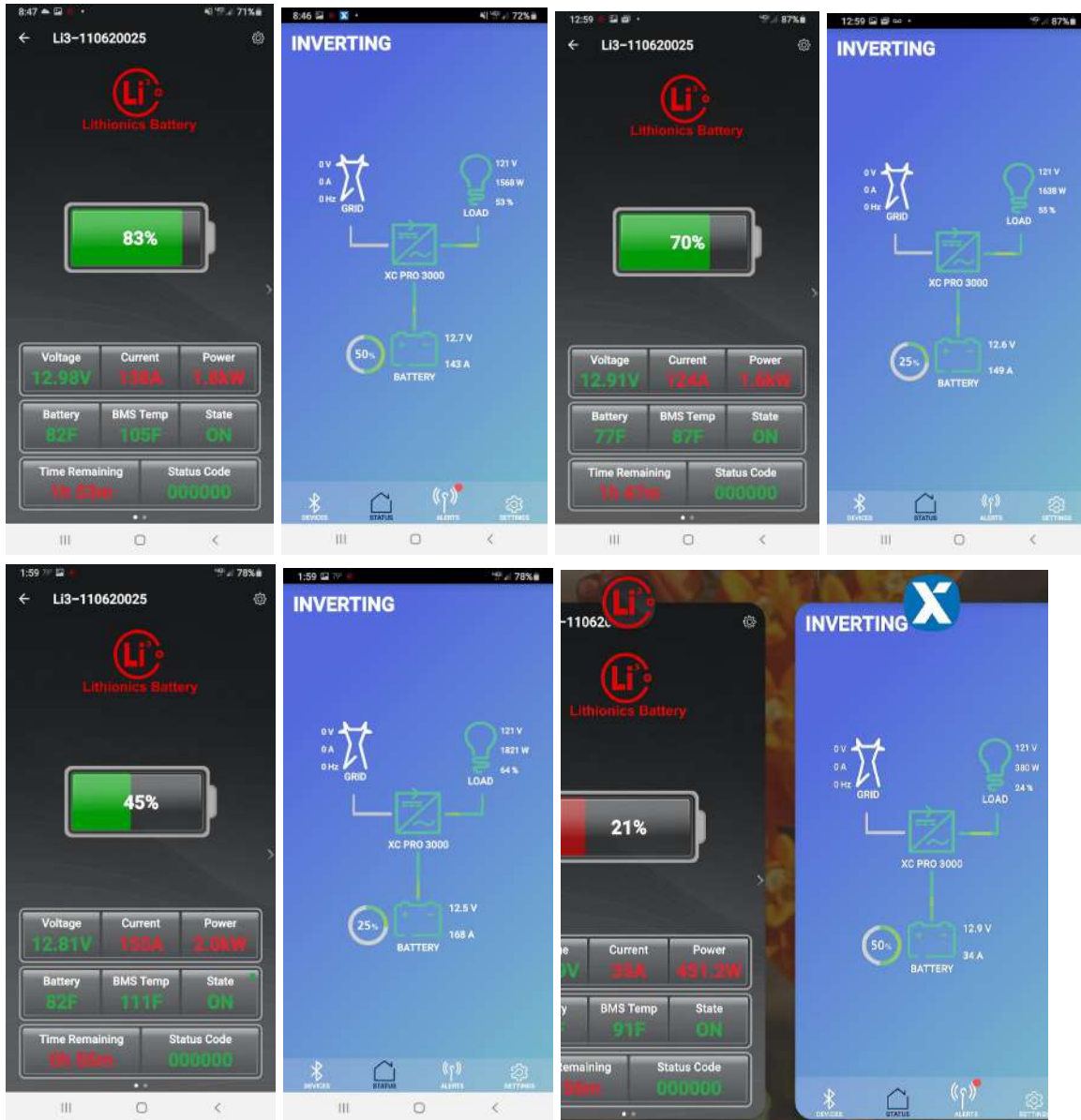
Even though the Xantrex inverter is supposed to manage the loads automatically, with priority to supplying the coach loads first. This means it is supposed to only provide battery charging from any power that is leftover after the coach power is supplied. But I have noticed when at some campgrounds that don't have good power or when using the generator, that the Xantrex automatic load management doesn't always occur either, particularly when running the high power demand air conditioner. In some circumstances, you may discover the inverter isn't charging the battery at all because the power demand of the coach is too great. As a result, you need to reduce the inverter Charger Current setting to a smaller number. I found when running the air conditioner that the inverter automatic load management feature works best with a Charger Current setting of less than 50a. My point is when using shore or generator power, always be prepared to dial down the battery charger if things are running as expected in the coach.

Note: I set the Low Battery Cut Off Delay Timer to 120s to give myself time to shutdown the air conditioner when I get the warning alert before the Inverter turns itself off. Sometimes a hard shutdown of high amp appliances, like the air conditioner, in mid operation can cause damage.

Xantrex provides several preset standard battery type settings to choose from, the LifePO4 preset is the correct setting for Lithionics batteries.

I highly recommend running your battery down to 20-15% State of Charge (SOC) (battery symbol percentage icon on App), fully testing your air conditioner operation, because you need to know what you can expect before you trust the system completely. Don't be surprised when you see that the Xantrex battery voltage and battery percentage doesn't accurately align with the Lithionics App readings. This is going to happen because of the voltage drop you get when the inverter is powering high amperage appliances. As you can see in the pictures below, how different the readings are when high amps are being drawn from the battery versus the lower amps. So only rely on the Lithionics Battery Monitoring App for accurate information about the Lithionics battery.

If you are boondocking I highly recommend you run the refrigerator from propane because on battery it uses 14a-20a per hour (ah) and you could run your battery down 50% using the refrigerator overnight on battery vs propane which requires less than 1ah from the battery to keep the propane valve open. Running the refrigerator off battery while driving is just fine because you have solar and engine alternator charging from the Sterling DC-DC charger (24ah) when driving. But be aware if you need battery charging you won't get much because the refrigerator can take up to 20a from the Sterling alternator charging.



Remember the Lithionics NeverDie battery cutoff is 10% SOC or 12.0v whichever occurs first. Once the NeverDie battery cutoff occurs you must manually turn the battery back on with its blue lighted power button. If you turn the battery back on after it shuts off at the NeverDie cutoff you can continue to use the battery until it shuts off again at 0% SOC or 11.6v, whichever comes first. When using this last 10% it is recommended only for 12vdc needs as if you continue to try and use it for 120vac loads from the inverter, like the air conditioner, you'll go to 0% SOC in less than 2 minutes. The last 10% of battery use should really be for just emergency things until you can get the generator started or plugged into shore power or start the engine and get on the road driving to begin recharging the battery. You must take immediate action to charge the battery once it has reached 10% or lower SOC. Letting a battery sit discharged for any length of time will cause battery damage.

Note on Mercedes Sprinter Engine Idling and use of Biodiesel: It is widely thought that Mercedes doesn't recommend idling the Sprinter Diesel engine for longer than 5 minutes or there may be engine/ emission issues. This is partially true, because whether you can idle the engine or not is completely dependent on whether your fuel contains biodiesel and at what percentage. Here are some better defined parameters on idling your Unity. If you use diesel fuel that contains no Biodiesel or a biodiesel content of B5 or less, then it is OK to idle the engine for 2-3 hours so long as you immediately hit the road and run at highway/interstate speeds for at least 20 minutes for the regen cycle to run. If you only occasionally use greater (>) than B5 biodiesel fuel, then you can still idle as described above. The occasional tank of >B5 fuel isn't harmful (just don't store it with >B5, especially in cold weather). I use the same rule with greater than B5 fuel, it's fine to use as long as you are running it hot and long on the highways/interstates. My saying for it being OK to use up to B20 fuel is only if you can Drive It Like You Stole It! However, if you have a consistently steady use of greater than B5 fuel and cannot drive in this manner, then it is imperative to limit the idling to 5 minutes or less and change the engine oil more frequently.

More on Managing Your Loads and Your Air Conditioner

More things I've learned about the Xantrex Freedom XC Pro 3000w Inverter from mine and others' experience. But much of what I am learning has to do with ensuring you get good air conditioner operation. So many people question why their air conditioner isn't cooling and often the solution is to just reduce your other loads. In particular, the battery charger current setting being too high is the biggest reason for poor air conditioner and other coach appliance operation issues. So always consider reducing your inverter battery charger current setting as your first action. Managing loads means you only run one high amp draw appliance like the air conditioner, microwave, coffee maker, hair dryer, induction cooktop, space heater, or inverter battery charger (on high amps) at a time.

The Xantrex Inverter is not reliable for management of loads as its manual claims. So you must understand the limitations of your system and take action. Oftentimes when on shore/generator power, reducing the inverter battery charging current to the lowest setting of 5a , and switching the Dometic refrigerator to propane is very easy and gives your air conditioner an immediate benefit if it is struggling to cool.

When you are using 20a shore power to run the Air Conditioner (whenever the air conditioner is referred to it is understood that an EasyStart/SoftStart has been installed) you basically can't be running anything else. Remember the inverter is always on when plugged into shore power and as such would need to have the battery charger current setting reduced to its lowest setting, 5a. Otherwise when trying to run the air conditioner from a 20a shore power breaker it may trip when the compressor kicks on.

Additionally, the refrigerator can draw more than 14a when it is on startup and trying to cool down. As such you won't be able to run it if you are running the air conditioner and a small amount of battery charging on a 20a outlet. It is critical that you experiment with your system so you understand and can recognize when you need to adjust the inverter battery charger current, and switch the refrigerator to propane, and/or not use other high amperage items, and/or turn other things you are running off.

This also applies to generator operation because it puts out lower voltage power (110-116v) more closely related to what you experience when trying to use a 20a outlet, it does not provide the same strong voltage (120-124vAC) that a 30a power service supplies, so you should treat

generator power with the same limitations as described above. Also be prepared to manage your loads when you encounter low voltage/low power 30a service as you experience in some campgrounds. In the summer, when all campers are running their air conditioners, you may find low voltage situations as well. You have to be prepared to limit the operation of the inverter battery charger and other items when in low power situations!



Never run the air conditioner if grid voltage or load voltage is less than 110V. I personally try and not let my power voltage drop below 114v.

I recommend 50a or less as a general battery charger setting but you still may find yourself at Campgrounds with low voltage power and need to drop the setting more. I don't recall what inverter you have but what you want to do is keep your shore or generator power above 110vAC, no lower. As you can see, in the picture of my Bluetooth Remote Xantrex App status screen, I like to maintain mine to stay above 114vAC. To do this when running the air conditioner as the priority, you must manage your loads by shedding power demands. The first way you can do that is turn your battery charger current to its lowest setting of 5a. If you find after you've reduced the battery charger current you are still at or below 110vAC you need to look at what else you are powering and shed those loads. Go around and unplug everything from the outlets, make sure the refrigerator is running on propane, and don't try to run the microwave.

Additionally these same operating limitations apply to when you are using the Inverter. While the battery charger operation isn't a concern when running the air conditioner off the inverter/battery, the air conditioner takes the same position, it will not compete for the battery power! So it may not run properly if you are also trying to run high wattage/amp draw items like the refrigerator off electric, microwave (for more than seconds), water heaters, furnace fan, coffee machines, hair

dryer, etc. The air conditioner is always going to protect itself from low voltage/low amperage situations by not running the compressor. It may even decide it's too iffy to run the fan motor. A low power situation can seriously damage motors and compressors, so that is why they have protection features that keep them from trying to compete with other power hungry items. The Dometic refrigerator is very power hungry when trying to run from electricity!

The distinction is the voltage part of the power equation, Amp x Voltage=Watt. I discovered when trying to install the EasyStart, when I ran my air conditioner off the generator the AC voltage was 110-116v and when on 30a shore power it was 120-124v. This is why EasyStart recommends using shore power for the EasyStart Learn Process; it needs strong, higher voltage power to properly learn. After the learning process is completed the fact that the EasyStart dampens the amp surge of the air conditioner only helps it to run in lower voltage power situations. This is an important distinction because the recommended power voltage range for running sensitive electrical equipment or appliances with motors/compressors is 114vac to 126vac. Motors can overheat and even fail if their operating voltage is too low because they try to draw more current. Usually running the microwave for seconds doesn't pose a challenge, it is when you must run it for minutes that you need to be aware of the impact, particularly when running the air conditioner.

Low voltage means more amps are required to provide the same amount of watts or power. So managing/balancing your power needs (volts and amps) when relying upon air conditioner operation, whether they are constant or changing for periods of time, is critical if you want good air conditioner performance. So many people question why their air conditioner isn't cooling and often the solution is to just reduce your other loads. Reducing the inverter battery charging current or turning it off, and/or switching the Dometic refrigerator to propane is very easy and gives your air conditioner an immediate benefit if it is struggling to cool. Leisure leaves the default inverter battery charger current settings on the inverters default setting, which is typically the maximum charging capacity, 80a or higher. This inverter battery charging current alone can tip the scales of air conditioner performance. Then if you couple high battery charging current with a low voltage power situation, the air conditioner is not going to compete!

Parts

Basically these are all the items you will need, in addition to the 3000w inverter and Lithionics 315ah Battery (example battery selected for this installation), for a 3000w Inverter upgrade. I'm listing everything I've mentioned. I discussed optional approaches on some things so you have to decide which approach and item you want to use. Some people just buy everything and return what they didn't use

- 1) **Lithionics 315ah battery**, <https://pagosupply.co/shop/lithionics-products>
- 2) **Xantrex Freedom XC Pro 3000w Inverter**,
<https://www.amazon.com/dp/B08C1VRWZL>
- 3) **2/0 AWG Gauge Red + Black Pure Copper Battery Inverter Cables 5 feet each with 3/8" and 5/16" Lugs**, <https://www.amazon.com/dp/B01F4GHZHU>
- 4) **Blue Sea 250a Mega Fuse**, <https://www.amazon.com/dp/B000MMDLA2>
Note: Other quality Brands:
Bussman, <https://www.amazon.com/dp/B000PSRANM>
Littelfuse, <https://www.amazon.com/dp/B000AOGM9O>

Victron, <https://www.amazon.com/dp/B06X93WM2S>

- 5) Blue Sea 300a battery switch (6006)($\frac{3}{8}$ " terminals), Red, <https://amzn.to/3glJR5B>, or Black, <https://amzn.com/dp/B00558LSJE>
- 6) Mesh Screen, <https://www.amazon.com/dp/B08PKQ9L58>
- 7) StarTech 20 pin connector, <https://www.amazon.com/dp/B0002GRQRW>, for adaptation of the Magnum DCLD inverter ignition control feature, more in ACC INPUT and CONNECTION sections.
- 8) Solder Heat shrink Butt Splice, <https://www.amazon.com/dp/B01DPS8DPM>
NOTE: you could also use a small blue or tan wire nut or electrical tape to make the ignition control wire splice, see below for link to wire nut assortment.
- 9) 16 awg wire, <https://www.amazon.com/dp/B00TG1TRL2>
- 10) Quick Change Step Drill Bit, <https://www.amazon.com/dp/B098TQJD1S>
- 11) Cable/Zip Tie Assortment, <https://www.amazon.com/dp/B07JBCKX7M>
- 12) Xantrex Freedom X/XC Bluetooth Remote, <https://www.amazon.com/dp/B08C1SFRFP>
- 13) Black 2" Eternabond Tape to seal Battery box openings (recommended for battery use or battery charging in temperatures below freezing (32°F), <https://www.amazon.com/dp/B00CEL0T2M>
- 14) $\frac{1}{2}$ " Split loom to cover the switch cable, <https://www.amazon.com/dp/B07TCDTFL2>
- 15) **Optional:** WindyNations 2/0 awg cable 12", <https://amzn.to/3B8dG3i>
Note: You can reuse the battery cables from the coach or old batteries, or buy this short one with the correct size lugs. If you use an old cable you will have to drill out one end to fit the $\frac{3}{8}$ " Blue Sea switch terminal just like you have to do on the inverter battery cable.
- 16) **Optional tool set:** <https://www.amazon.com/dp/B074MFYGSF>
Note: this is a great tool set If you don't have one for this project. It contains all the right tools, in a compact carrying case, great to put in your Leisure for on the road!

Local Hardware Store (Lowe's or Home Depot)

- 1) Low profile junction box and 6-Yellow wire nuts (available at hardware stores (available at hardware stores, i.e. Home Depot or Lowes), Junction box with Cover,
▪<https://www.homedepot.com/p/Carlson-Gray-1-Gang-12-cu-in-New-Work-Non-Metallic-Handy-Box-B112HBR/202077374#overlay>
▪<https://www.homedepot.com/p/Gray-1-Gang-Weatherproof-Blank-Cover-WBC100G/300848313>
- 2) 15' of 10/2 with ground orange Romex solid wire (available at hardware stores, i.e. Home Depot or Lowes). Some floor plans may require more than 15' so you might consider a 25' roll. Here is a link to 15' roll,
<https://www.lowes.com/pd/Southwire-Romex-SIMPull-15-ft-10-2-Non-Metallic-Wire-By-the-Roll/3370016>
- 3) Wire/Wing Nuts,
 - Yellow Wire Nuts,
<https://www.lowes.com/pd/IDEAL-WireTwist-25-Pack-Yellow-Wire-Connectors/3128813> or
 - Red Wing Nuts,
<https://www.homedepot.com/p/IDEAL-452-Red-WING-NUT-Wire-Connectors-100-Pack-30-452P/202894278> or
 - Wire Nut Assortment Pack (for use to complete the old inverter circuit and attach ACC Control 20 pin connector to old inverter ignition control wire),
<https://www.homedepot.com/p/Commercial-Electric-Standard-Wire-Connector-Assortment-30-Pack-ESA-30/315849553>
- 4) Electrical Tape,
<https://www.homedepot.com/p/3M-Temflex-3-4-in-x-60-ft-1700-Electrical-Tape-Black-1700-1PK-BB40/310698741?ITC=AUC-151787-23-12070>
- 5) 3/8" Strain Relief (2),
<https://www.homedepot.com/p/Halex-3-8-in-Non-Metallic-NM-Twin-Screw-Cable-Clamp-Connectors-5-Pack-20511/100133208>
- 6) **5/16" or 3/8" Flat Head Machine Screw** (whichever you can find)
 - A. Hillman 5/16-in-18 x 1-in Allen-Drive Screws (2-Count)
<https://www.lowes.com/pd/Hillman-5-16-in-18-x-1-in-Allen-Drive-Cap-Screws-2-Count/50088854> and Hillman 5/16-in x 18 Zinc-plated Steel Nylon Insert Nut,
<https://www.lowes.com/pd/Hillman-5-16-in-Zinc-Plated-Standard-SAE-Nylon-Insert-Lock-Nut/3058723> or 5/16" x 18 tension hex nut,
<https://www.lowes.com/pd/Hillman-5-16-in-x-18-Black-Phosphate-Steel-Hex-Nut-2-Count/3012474>

OR

- B. Lowes Specialty Hardware Section, Grade 8- 3/8" Flat Head Machine Screw,
<https://www.lowes.com/pd/Hillman-3-8-in-16-x-1-in-Allen-Drive-Cap-Screws-2-Count/50088914> and Lowes Specialty Hardware Section, Grade 8- 3/8" Free Spinning Washered Nut,

<https://www.lowes.com/pd/Hillman-3-8-in-x-16-Black-Phosphate-Steel-Hex-Nut-2-Count/3012485>

- 7) **2-30a and 2-15a Breakers**, you'll need Single-Pole Siemen's Type QP or Square D Type HOM, or Eaton Type BR Circuit Breaker. You can find these at any hardware store like Home Depot or Lowes. I've given you links to the various brands of 15a breakers as an example,
- <https://www.homedepot.com/p/Siemens-15-Amp-Single-Pole-Type-QP-Circuit-Breaker-Q115U/100053443?MERCH=>
 - <https://www.homedepot.com/p/Square-D-Homeline-15-Amp-Single-Pole-Circuit-Breaker-HOM115CP/100153952?mtc=>
 - <https://www.lowes.com/pd/Eaton-Type-BR-15-Amp-1-Pole-Standard-Trip-Circuit-Breaker/1114089>
- 8) **Wiss Tin Shears**,
<https://www.homedepot.com/p/Wiss-12-5-in-Straight-Cut-Tin-Snip-A9N/204155040>
- 9) **Aluminum sheet** in 24"x 36" or 36" x 36" any color,
- <https://www.lowes.com/pd/Steelworks-24-in-x-36-in-Aluminum-Solid/3057473> or
 - <https://www.homedepot.com/p/M-D-Building-Products-36-in-x-36-in-Copper-Aluminum-Sheet-57526/205519014>
- 10) **2 pieces of 1" x 48" angle aluminum stock**,
<https://www.homedepot.com/p/Everbilt-1-in-x-96-in-Aluminum-Angle-with-1-16-in-Thick-800057/204325583>
- 11) **3M Spray Contact Adhesive**,
- <https://www.homedepot.com/p/3M-13-8-oz-Super-77-Multipurpose-Spray-Adhesive-77-DSC/316334789>
 - <https://www.lowes.com/pd/3M-3M-Super-77-Multipurpose-Spray-Adhesive-13-8-FIOz/5005374931>
- 12) **Spray Foam**,
<https://www.homedepot.com/p/GREAT-STUFF-12-oz-Gaps-and-Cracks-Insulating-Spray-Foam-Sealant-227112/202893728>
- 13) **#6 × ½ Self Drilling Screws**,
<https://www.homedepot.com/p/Everbilt-6-x-1-2-in-Zinc-Plated-Hex-Head-Sheet-Metal-Screw-100-Pack-801182/20427506>

14) #8 × ½" Pan Head Self Drilling Screws,
<https://www.lowes.com/pd/Hillman-8-x-1-2-in-Phillips-Drive-Sheet-Metal-Screws-10-Count/3036159>

15) Painters Tape,
<https://www.homedepot.com/p/3M-ScotchBlue-0-94-in-x-60-yds-Original-Multi-Surface-Painter-s-Tape-2090-24EC/100085823>

16) DAP Sealant,
<https://www.homedepot.com/p/DAP-5-oz-Ultra-Clear-All-Purpose-Waterproof-Sealant-18387/306641586>

Tools and Duration

The installation of a 3000W Inverter and Lithionics 315ah Battery is estimated at 5 hours. The tools you'll need are;

- 1) Electric or Battery Powered Drill
- 2) Metal cutting tool
- 3) Various standard and deep well sockets and socket wrench (½", 9/16", 13mm (battery bolt/nut) will most commonly be used). Also a 3" socket extension.
- 4) Screwdrivers with Flat, Phillips and #1 and #2 Roberson square tip. Also a short stubby flat blade screwdriver
- 5) Rubber mallet, hammer, large screwdriver or chisel, and various other tools to aid in freeing the inverter bay wall
- 6) Wood blocks to support the inverter
- 7) Wire cutter
- 8) Snap blade utility knife,
- 9) Blue Painters tape and black marker

OTHER INVERTER CHOICES:

Kisae 3000w Inverter and 100a Battery Charger (BIC1230100)

I also installed a Kisae 3000w Inverter and 100a Battery charger and it is a really high quality machine. It holds the voltage drop steady so you don't get spurious inverter shutdowns like you can with the Xantrex inverter. It installs exactly the same as the Xantrex Inverter previously discussed. You can read about this more in my [630AH of Lithionics Lithium Batteries and 6000W of Inverter Power!](#) Which can be downloaded from the How to Guides on the Unity Section of the Sprinter Source Forum or from the LTV groups file section.



Victron Multiplus 3000w inverter: Victron makes high quality inverters (Multiplus and Multiplus II) and integration components like the Cerbo GX and Touch 50/70 color screen, but they are a little more complicated, and a bit larger and heavier so you'll want to do more research and get the Lithionics installation specifications for Victron inverters. Go to the Lithionics Support web page, <https://lithionicsbattery.com/support/>.

For Installation of Multiple Batteries for a Larger Capacity Battery Bank

Remember that the inverter installation is completely independent of the size of a battery bank. The 3000w inverter power output is limited by its design to 250a or around 250a of draw from a Lithionics 315 battery. So if you want to increase the size of your battery capacity nothing needs to change relative to the inverter installation. The only change might be where the batteries connect to supply the coach and inverter with power.

If you are interested in installing more Lithionics batteries together to create a larger capacity battery bank then it is important to use the correct parallel connection method. The Battery-To-Bus Bar method should be used for the optimal efficiency, so the draw from the batteries and charging of the batteries is balanced among the batteries as equally as possible. The Diagonal Takeoff method is still an acceptable method for installing 2 or more Lithionics 315 ah batteries. As you can see from the data chart, below, a test on Lithium and AGM batteries, the battery to bus bar method balances the batteries to the greatest extent possible.

Lithionics Battery: Internal BMS Battery Parallel Connection Options

- Optimal: Battery-to-Bus Bar
For Large batteries like GTX12V315A

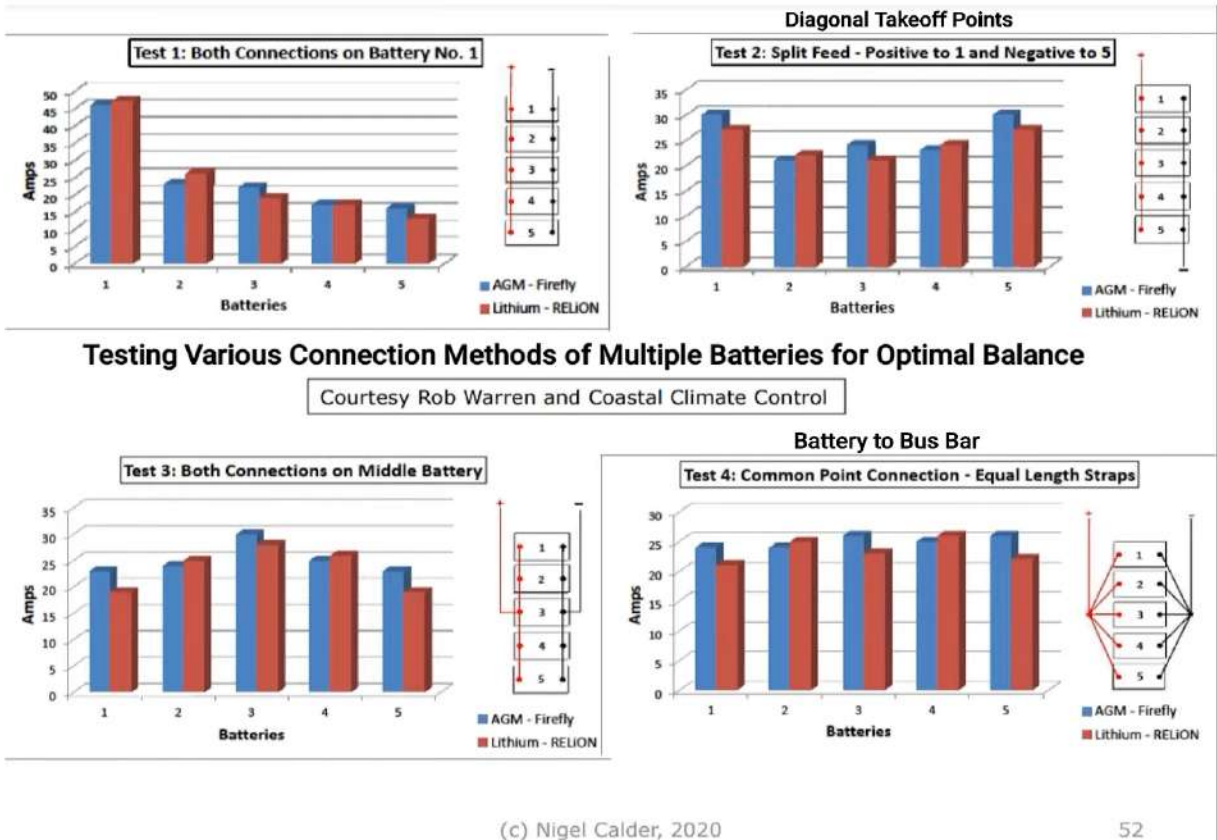


These can be connected in parallel, and Lithionics recommends using bus bars for wiring. Add a Blue Sea 300A Terminal Fuse to each positive.

- Option: Diagonal Take-Off
For small batteries like 12V130A (no more than 3)



Positive to DC Common



I used a Victron Lynx Power In 1000a dual bus bar system for my dual Lithionics 315 battery installation. I put one 315 in the battery box and one next to the inverter and wired everything together, batteries, solar, ClassT Fuse, inverter battery disconnect switch and inverter using the Victron Lynx Power In. It made for a very organized and clean installation. You can read about this more in my [630AH of Lithionics Lithium Batteries and 6000W of Inverter Power!](#) Which can be downloaded from the How to Guides on the Unity Section of the Sprinter Source Forum or from the LTV groups file section.



How to Route Remote Display Cord to the Over Door Panel

Some people want to pull the inverter remote display cord up to the over door compartment and mount it on the panel. Here's how you can do that.



If you are interested in putting it on the over door panel then use the Leisure wiring raceway that can be found under the front corner to the right of the door. Here are photos and directions from the Sprinter Forum members who have used it. I believe the raceway runs to the passenger side over the cab compartment (the unfinished space), and then you have to route the wires to the over door compartment by drilling some holes. So you'll have to investigate this option. The following is an exchange between a 2018 and 2020 Unity owner.

More related to installing the Victron solar controller than the inverter but many people are curious about fishing wire up to the over the door control panel. Under the coach just forward of the step is a large chunk of black foam. If you remove the foam you'll expose a large cover plate held on with screws. Remove the cover plate and you have easy access to the space where all the wires run. Here is a picture of the opening without the cover and one of the cover plate. You can see the #4 cables and Xantrex remote panel cable I pulled through.







Great pictures, now I see how you did it. That's also the route I took trying to run HDMI and USB cables from the battery box to over the door. I was able to slip those small cables past that rubber seal (circled in photo) without removing the foam or metal plate. From there it's a straight shot to the cubby over the passenger seat, but like I said I couldn't get from the cubby to over the door so I removed the cables.

For what it's worth, I do have the Equalizer jacks (installed by LTV) and they don't interfere at all with accessing that plate.



2000w Inverter Breaker Box Configuration

The installation requirements of a 2000w inverter is exactly the same as a 3000W. However a 2000w inverter breaker box configuration has to be slightly different because it cannot supply the same level of power as a 3000w inverter, it only outputs about 14-15a of power continuously. Therefore, it can't support as many circuits. In particular, it cannot run the air conditioner, even with an EasyStart. The air conditioner or 2000w quickly overloads/overheats and shuts down, so don't try to run your air conditioner from a 2000w inverter or you might damage it or the inverter. The picture below depicts the proper circuit breaker configuration for a 2000w Inverter, which is the same configuration Leisure uses with its 2000w inverter installation.

