



OLIVER
TRAVEL TRAILERS

2021



LEGACY ELITE & LEGACY ELITE II

**OPTIONAL
FEATURES**

COMPONENT MANUALS

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OPTIONAL COMPONENT WARRANTY INFORMATION

Anderson “No-Sway” Weight Distribution Hitch

Andersen Hitches
3125 North Yellowstone Highway, Idaho Falls, ID 83401-1709

Email: N/A
Phone: 800-635-6106
Warranty: Limited Lifetime



Barker’s Auto Drain

Barker Manufacturing
1125 Watkins Road, Battle Creek, MI 49015

Email: sales@barkermfg.com
Phone: (888) 367-6978
Warranty: 2-Year Extended



Bright Way Group Batteries

Contact Oliver Travel Trailers Service Department for Warranty
Warranty: 1-Year



Cradlepoint Wireless WAN

Cradlepoint
1111 W Jefferson Street, Boise, ID 83702

Phone: 855-813-3385
Warranty: 1-Year Limited



Furrion Backup Camera

Furrion
52567 Independence Ct., Elhart, IN 46514

Email: support@furrion.com
Phone: 888-354-5792
Warranty: 1-Year Limited



High Pointe Convection Microwave

Contact Oliver Travel Trailers Service Department for Warranty
Warranty: 1-Year

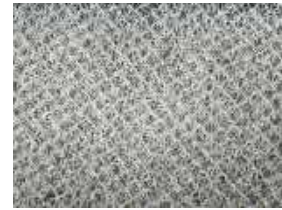




HyperVent Condensation Prevention Matting

HyperVent Marine
1301 4th St., Marysville, WA 98270

Email: hypervent_info@comcast.net
Phone: 360-651-1365
No Warranty



Lithionics Lithium Batteries

Lithionics Battery

Email: support@lithionicsbattery.com
Phone: 727-726-4204
Warranty: 5-Years



Lifeline Deep Cycle Batteries - Legacy Elite

Lifeline Batteries Inc.
292 E Arrow Highway, San Dimas, CA 91773

Email: N/A
Phone: 909-599-7816
Warranty: 5-Years



Magnadyne Omni-Directional Antenna

Magnadyne Corporation
1111 W. Victoria Street, Compton, CA 90220

Email: support@magnadyne.com
Phone: 1-310-735-2000
Warranty: 1-Year



Nature's Head Composting Toilet

Nature's Head, Inc.
PO Box 250, Van Buren, Ohio 45889

Email: sales@naatureshead.com
Phone: 251-295-3043
Warranty: 5-Year



SureCall Fusion2Go 3.0 Cell Phone Amplifier

SureCall
48346 Millmont Drive, Fremont, CA 94538

Email: support@surecall.com
Phone: 1-888-365-6283
Warranty: 3-Year





OPTIONAL COMPONENT WARRANTY INFORMATION

TRUMA AquaGo Comfort Tankless Water Heater

Truma Corp.
825 E Jackson Blvd, Elkhart, IN 46516

Email: info@trumacorp.com
Phone: 1-855-55-TRUMA
Warranty: 1-Year
(2-Year when registered at time of purchase)



Wifi Ranger WIFI Booster

Mito Corporation
213 County Road 17, Elkhart, IN 46516

Email: questions@wifiranger.com
Phone: (574) 295-2441
Warranty: 1-Year



Winegard Carryout G2 Satellite

Winegard Company
3000 Kirkwood Street, Burlington, IA 52601

Email: help@winegard.com
Phone: 1-800-788-4417
Warranty: 2-Years Parts, 1-Year Labor



Xantrex Inverters & Remote

Xantrex
541 Roske Drive, Suite A, Elkhart, IN 46516

Email: N/A
Phone: 800-670-0707
Warranty: 24 Months



ZAMP Solar Package

ZAMP Solar, LLC.
63255 Jamison Rd, Bend, Oregon 97703

Email: support@zAMPsolar.com
Phone: 541-728-0924
Warranty: 1-Year Limited





Andersen “No-Sway” Weight Distribution Hitch INSTALLATION MANUAL

For all 4” Drop/Rise WD Kits AND all 8” Drop/Rise WD Kits

IMPORTANT! DEALER OR INSTALLER: Please make sure your customer receives this manual for safety tips, warranty, and future removal or installation information

IMPORTANT ALERT: Potential issues may exist when using the Andersen ‘No Sway’ Weight Distribution Hitch with Atwood 88007, 88010, 88555 and 88600 couplers. (For more information, see page 2)



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Want to see a video of the install?



Use your Smart Phone to scan the QR Code above or go to our Installation videos on the web at help.AndersenHitches.com/install



andersenhitches.com

Featuring the patented, super-quiet Anti-Sway and Anti-Bounce TMD (True Motion-Dampening™) system

3”, 2-1/2” & 2” Shanks Available

16,000 lbs GTWR (2-5/16” 16K ball) • 14,000 lbs GTWR (2-5/16” ball) • 10,000 lbs GTWR (2” ball) • 1,400 lbs tongue



NOTE: THERE IS NEVER A NEED TO GREASE BALL OR COUPLER



IMPORTANT ALERT!

Potential issues may exist when using the Andersen ‘No Sway’ Weight Distribution Hitch with Atwood 88007, 88010, 88555 and 88600 couplers. All other Atwood couplers work great.

When these few Atwood couplers are combined with the Andersen Weight Distribution system — and other weight distribution systems — there is a potential issue where some couplers can become unlatched over time due to wear on the internal latch system. This issue is present because of the unique design of the couplers.

To our knowledge, this potential issue ONLY affects the Atwood 88007, 88010, 88555 and 88600 couplers. All other Atwood couplers work great. Older (pre-Atwood) Marvel couplers also work great. Newer models may also encounter these issues if designed in a similar style.

Although we have heard of Atwood coupler users who have had some success with modifying the latch mechanism and greasing the paw and ball, **Andersen Manufacturing does not officially endorse any solution other than replacing the coupler itself with a different Atwood coupler.** (See your local Dealer or contact us for recommendations on a replacement coupler)

Please feel free to contact us if you have further concerns or questions.

Customer Service: 208.523.6460
customerservice@anderseninc.com
help.AndersenHitches.com



Using the WD Hitch with late model vehicles that have electronic anti-sway

The Andersen WD Hitch features its own sway controls that are designed to auto-adjust to the load in your trailer and prevent trailer sway when installed properly. Unfortunately, some newer electronic anti-sway systems can misread the anti-sway efforts of the Andersen WD Hitch and the anti-sway system may actually cause the trailer to sway as the two systems work against each other.

These potential issues typically occur with electronic anti-sway systems that are designed to detect trailer sway and automatically use the vehicle brakes to help control the sway. Please note that this type of anti-sway system is different from electronic traction control, which does not cause this type of problem. If you experience this type of issue, you will need to turn off the electronic anti-sway in your vehicle in order to tow with the Andersen WD Hitch.

This issue is most likely to occur in 2011 and newer truck models from Ford, GMC, Dodge, and Chevy. Refer to your tow vehicle’s owners manual to determine if you have electronic anti-sway and how to disable it while using the WD Hitch to tow.



IMPORTANT INFORMATION



FOR SAFETY Secure your trailer using wheel chocks before setting up or adjusting the Andersen Weight Distribution Hitch.

The operator is responsible for making necessary adjustments to the weight distribution hitch to maximize performance for each trip and every time the load changes.

REMEMBER Any time you change your load weight in the towing vehicle or trailer, re-check to see how level you are and make adjustments as needed. Also, before each trip — and regularly during a trip — check all hardware, bolts and nuts for wear and fatigue. Make sure that they are all properly tightened and that all pins and clips are secured in place.

It is critical to check the tire pressure of each of the tires on the trailer and tow vehicle before towing.



WARNING



Refer to your vehicle's owners manual for maximum towing capacity. **DO NOT** overload your vehicle — failure to follow vehicle manufacturer's recommendations could result in damage to your vehicle, personal injury or death. **Your combined load and trailer weight should be less than the lowest weight rating of your tires, vehicle, and hitch.** You should also refer to the manufacturer's instructions for your trailer and follow all safety warnings, setup instructions, and maintenance before installing your hitch.

Make sure the trailer coupler is coupled and secured properly before towing, and that safety chains are in place.

Do not modify Weight Distribution Hitch components outside of the recommendations found within this manual. (e.g. shortening/extending chains, welding brackets to the trailer frame, etc.)

IMPORTANT! No hitch setup can guarantee that trailer sway will be avoided altogether. It is the driver's responsibility to adjust equipment and driving habits according to towing conditions. The driver is responsible for their own safety and the safety of passengers and those around them.

NOTE: AS WITH ANY WEIGHT DISTRIBUTION HITCH,
DO NOT USE THE ANDERSEN WD HITCH WITH ANY KIND OF SURGE BRAKE SYSTEM

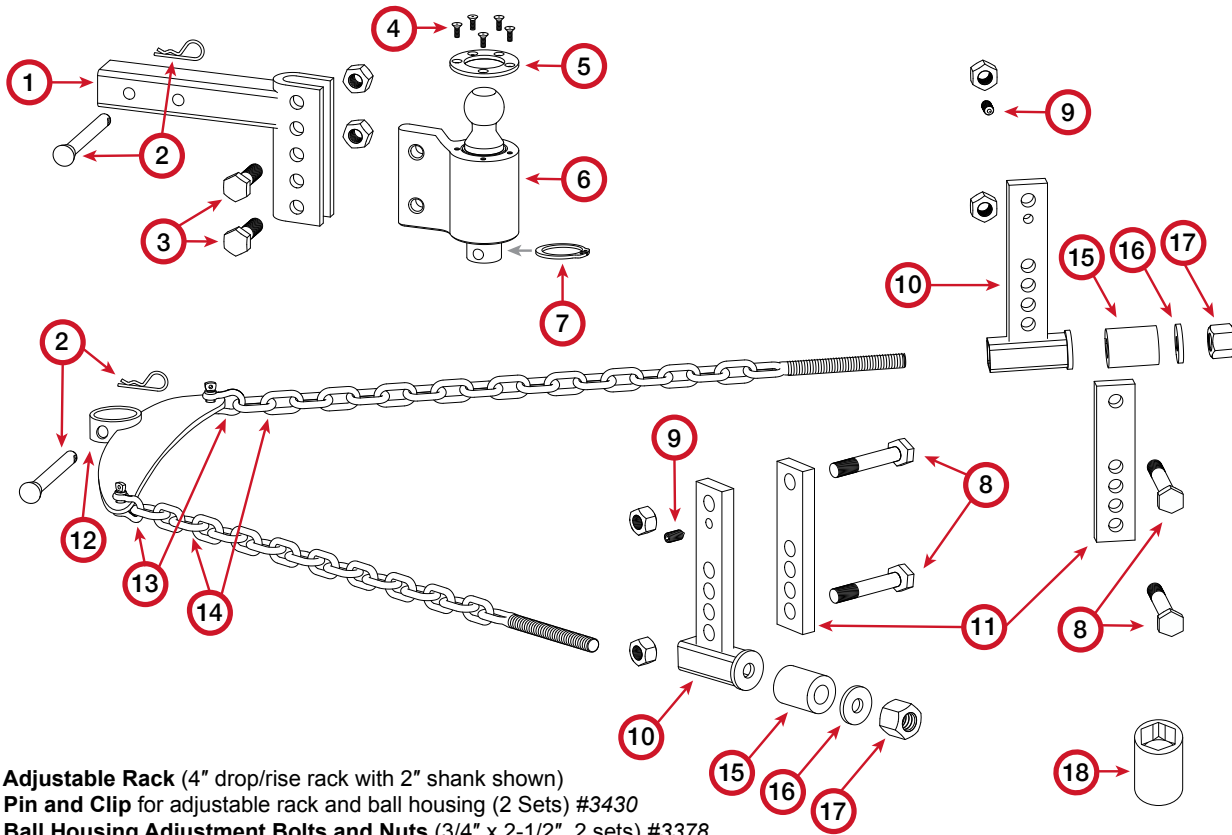
A NOTE ABOUT SUSPENSION

Ensure that the suspension of both the tow vehicle and trailer are in good working order before you embark on a trip. Bad suspension may result in the Weight Distribution Hitch not being able to properly even out your load. Always load trailer correctly according to the manufacturer's recommendations for maximum weight limits and cargo placement. Do not overload trailer or towing vehicle.

We are proud that our Weight Distribution Hitch is rated up to 1,400 lbs tongue weight to meet the SAE J-684 strength requirements. However, if your trailer tongue weight is pushing 1,400 lbs, we recommend possibly improving or 'beefing up' the suspension of both 1/2 ton and 3/4 ton vehicles.



PARTS ILLUSTRATION – WEIGHT DISTRIBUTION HITCH

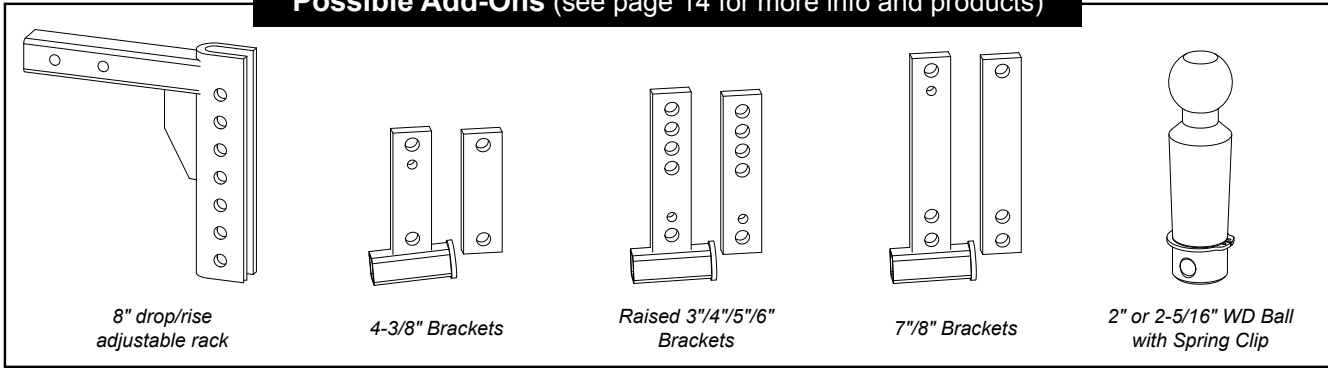


- 1. Adjustable Rack (4" drop/rise rack with 2" shank shown)
- 2. Pin and Clip for adjustable rack and ball housing (2 Sets) #3430
- 3. Ball Housing Adjustment Bolts and Nuts (3/4" x 2-1/2", 2 sets) #3378
- 4. Ball Housing Plate Screws (5 pcs, attached to ball housing)
- 5. Ball Housing Plate (attached to ball housing)
- 6. Ball Housing (includes housing, tapered ball, and brake material cone) #3383, #3355
- 7. Spring Clip (attached to tapered ball) #3376
- 8. Frame Bracket Bolts and Nuts (5/8" x 4", 4 sets)
- 9. 'Pointed' Set Screws (2 or 4 pcs, depending on your specific WD kit)
- 10. Outside Frame Brackets (2 pcs, universal 3" / 4" / 5" / 6" brackets shown)
- 11. Inside Frame Brackets (2 pcs, universal 3" / 4" / 5" / 6" brackets shown)
- 12. Tension (Triangle) Plate #3356
- 13. Chain Shackles (2 pcs) #3374
- 14. Tension Chains with End Bolts (2 pcs) #3357
- 15. High-Density Urethane Springs (2 pcs) #3358
- 16. Spring Washers (2 pcs) #3388
- 17. Tension Nuts (1-1/4", 2 pcs) #3370
- 18. 1-1/4" Socket #3384

TOOLS NEEDED FOR INSTALLATION

- Measuring Tape
- 5/16" Allen Wrench
- Two 1-1/8" Box End or Adjustable Wrenches
- Two 15/16" Box End or Adjustable Wrenches
- Torque Wrench capable of 150 ft-lbs of torque
- 1-1/4" Socket (provided, fits 1/2" drive)

Possible Add-Ons (see page 14 for more info and products)



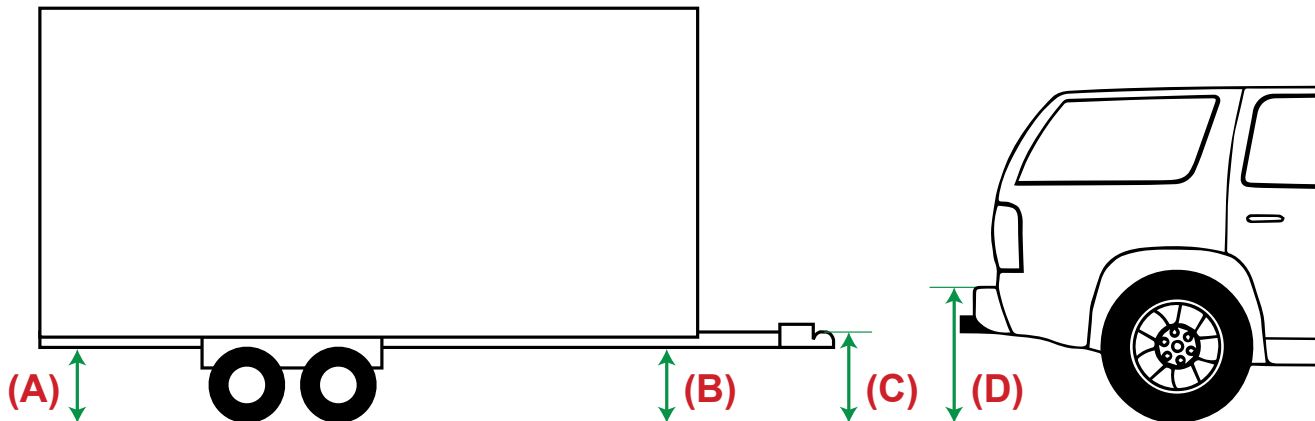


SECTION 1: PREPARATION

1-1. Start on level ground. If you are planning on hauling ATVs or other heavy equipment, you should load the trailer and tow vehicle with those items beforehand. Follow proper weight distribution guidelines as laid out in the manufacturer's recommendations for the tow vehicle and trailer. Make sure to stay within the limitations of each manufacturer's maximum weight recommendations.

IMPORTANT! When possible, make sure that any auto-leveling system is disabled or turned OFF temporarily during installation.

1-2. Ensure that the trailer is parallel to the ground by comparing measurements (A) and (B) — i.e. from the ground to the frame on both the front and back of the trailer.



SECTION 2: INSTALLING THE RACK AND BALL HOUSING (SWAY CONTROL)

2-1. Once the trailer is level, place the adjustable rack into the hitch receiver on your towing vehicle. Secure it to the receiver using the standard pin and clip (provided) or your own locking pin.

(Optional locking receiver pin available from Andersen - Part #3429)

2-2. Place the Ball Housing into the adjustable rack so that the top of the ball is about 1" to 1-1/2" higher than the top of the trailer's coupler (C).

2-3. Place the two ball housing adjustment bolts through the holes in the rack and Ball Housing unit to hold it in place (you will tighten the adjustment bolt nuts in step 3-1). **At this time, you will want to measure the height of your tow vehicle bumper (D) for use in step 3-4.**

2-4. Raise the tongue of the trailer up high enough so that the ball mount can comfortably fit under the trailer coupler. Back your tow vehicle up so that the ball mount is directly under the trailer coupler and then set the FULL WEIGHT of the trailer down on the ball.

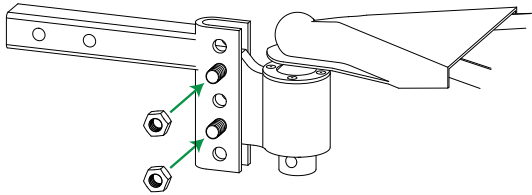
The front end of your trailer should now be about 1" to 1-1/2" lower than the back. If the front of the trailer is **MORE** than 1-1/2" lower than the back, you might need to raise the trailer coupler off of the Ball Housing and move the Ball Housing up a notch or two so that it is close to level (i.e. within 1-1/2" difference).



DO NOT GREASE THE BALL OR COUPLER! Since the ball and coupler move together, there is no friction that would create a need for grease, and any grease that works its way into the ball housing can decrease the anti-sway abilities of the Andersen WD Hitch.

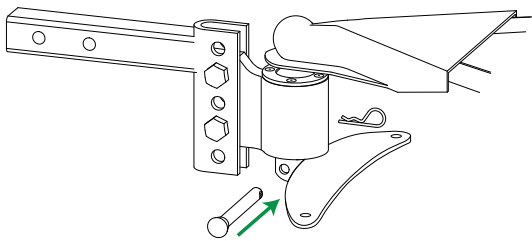


SECTION 3: ATTACHING THE TENSION PLATE AND CHAINS



3-1. Raise the trailer up so there is almost no weight on the ball. Next, place the two nuts onto the ball housing adjustment bolts and tighten to approximately 150 ft-lbs of torque using two 1-1/8" sockets or wrenches. This will squeeze the sides of the adjustable rack around the Ball Housing. Then, use the coupler latch to lock the trailer coupler onto the ball.

IMPORTANT! For this part of the installation, make sure there is **ALMOST NO WEIGHT** being placed on the ball when you lock the trailer coupler in place on the ball.



3-2. Attach the Tension Plate to the bottom of the Ball Housing by securing it in place using the pin and clip provided (see left). If you want to, you can use our locking receiver pin (Part #3429) for this purpose as well.

3-3. Look at a bird's-eye-view of the Tension Plate (see below) to make sure that the Tension Plate is close to perpendicular to the trailer frame (fig. 3-1). If not, raise the trailer jack off the ground and use the tow vehicle to move the Trailer forward or backward at an angle until the plate is close to perpendicular to the trailer frame (fig. 3-3). **NOTE: The plate does NOT need to be perfectly perpendicular, a little off of perpendicular is fine.**

IMPORTANT: DO NOT USE A HAMMER TO TRY AND LINE THE PLATE UP.

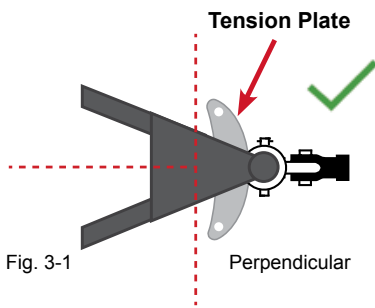


Fig. 3-1

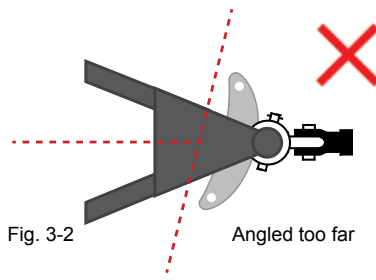


Fig. 3-2

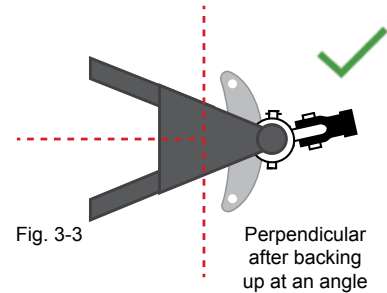
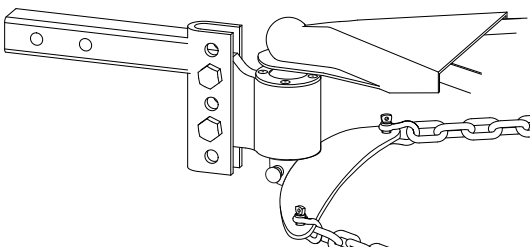


Fig. 3-3



IMPORTANT: DO NOT USE A HAMMER TO TRY AND LINE THE PLATE UP, IT WILL DAMAGE THE PLATE

3-4. With your trailer coupler locked and secured to the ball, extend your jack and RAISE THE TRAILER an inch or two above the bumper height measurement (D) taken in installation step 2-3. This ensures that the coupler is pulling up on the ball (which will also raise the WD rack and the back of your vehicle). **Leave the trailer in this raised position while you continue with the following steps.**



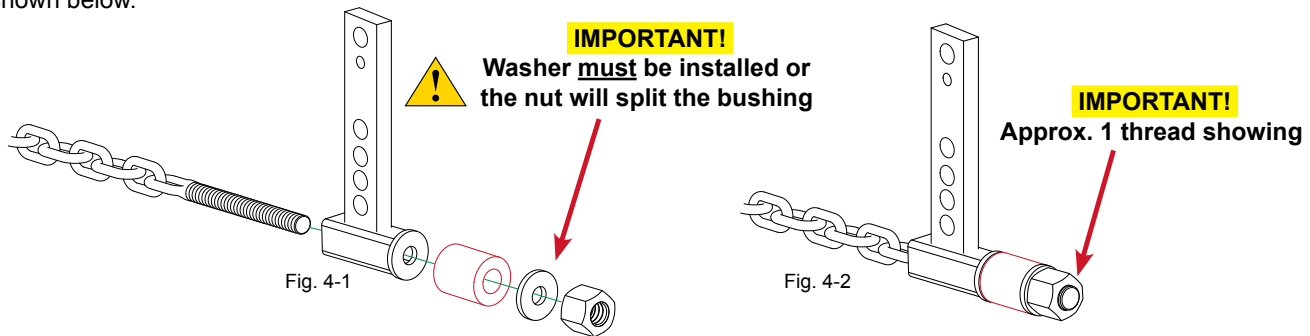
3-5. Attach the chain shackles to the Tension (Triangle) Plate by threading the shackle pin through the hole on the plate (everything should look like the diagram on the left).

3-6. Hand-tighten both shackle pins until they are fully seated.



SECTION 4: ATTACHING THE FRAME BRACKETS TO THE TRAILER

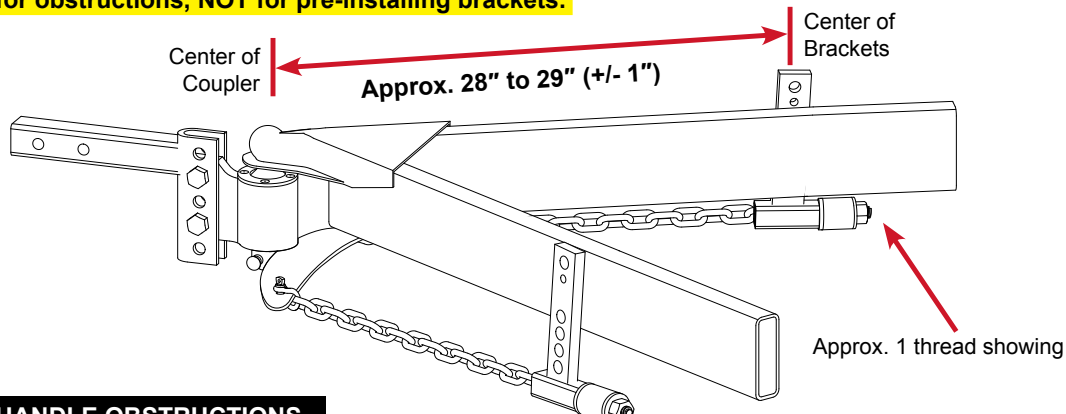
4-1. With the TRAILER STILL RAISED, attach both tension chains to the outside frame brackets using the hardware shown below.



1. Insert the chain bolt into the **SQUARE** opening of the outside frame bracket (**DO NOT** thread it through the round “washer” side first). Make sure the chain is not twisted.
2. Place the red high-density urethane spring onto the protruding bolt.
3. Place the washer on the bolt (Fig. 4-1).
4. Thread the Tension Nut on the bolt until approximately 1 bolt thread is protruding from the end (Fig. 4-2).

4-2. Pull the chains tight to get an idea of where the brackets will touch the frame and check for any obstructions or wiring that might be in the way. With one thread showing at the end of the tension nut, the frame brackets will touch the frame at approximately 28” or 29”. **See page 10 for bracket placement on ‘Y’ Style Trailer Frames.**

IMPORTANT! Since each set up can be different, only use this **MEASUREMENT** as an approximate position to look for obstructions, **NOT** for pre-installing brackets.



HOW TO HANDLE OBSTRUCTIONS

If you have any **OBSTRUCTIONS** or fixtures on the frame that get in the way of the frame brackets, there are two options:

1. Move/adjust the obstructing object forward or backward so it is out of the way. Some items like propane tanks and batteries can be moved or raised using off-the-shelf frames or brackets. See your local Authorized Andersen Dealer for further help and options.

2. Accommodate for the obstructions by removing or adding links to the WD tension chains (on the shackle end). You can **SHORTEN** the chain (up to approx. 5 links, leaving 10 or more links) or **ADD** several inches to the chain (as many links as needed) with no adverse effect. If you do remove/add any chain links, be sure to remove/add the same number of links from both chains. Chain extensions (Part #3366) can be ordered through your authorized Andersen Dealer.

SHORTENING CHAINS: You can permanently remove chain links using bolt-cutters or other cutting equipment OR you can insert a heavy-duty threaded link between the chain and shackle to effectively shorten the chains without actually removing links — unused links will hang free. If you do not have bolt-cutters or other cutting equipment and want to permanently remove chain links, see your local Authorized Andersen Dealer for help.



ANDERSEN HITCH

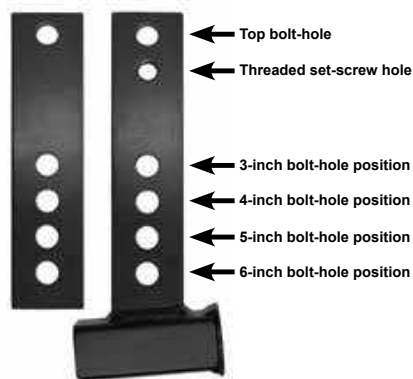


CAUTION! Double-check around the trailer frame to see if there are any brake lines, gas lines, or wiring that could be damaged by installation of the frame brackets. If so, find a way to reroute them before final installation.

4-3. Make sure both chains are equal in length, and relatively straight (not twisted). Then, while keeping the chains tight, LOOSELY attach (barely hand-tighten) both pairs of frame brackets to the tongue of the trailer using the positioning below. Do not insert the set screws yet.

NOTE: If you are installing multi-size frame brackets, use the bolt holes that are closest to your frame size

(see picture at right for sizing on universal brackets).



ENSURING CORRECT BRACKET INSTALLATION

Correct Bracket Positioning

The larger brackets attached to the tension chains should be placed on the OUTSIDE of the trailer frame. As discussed in installation step 4-3, start by loosely attaching these outside brackets to the smaller brackets placed on the INSIDE of the trailer frame.

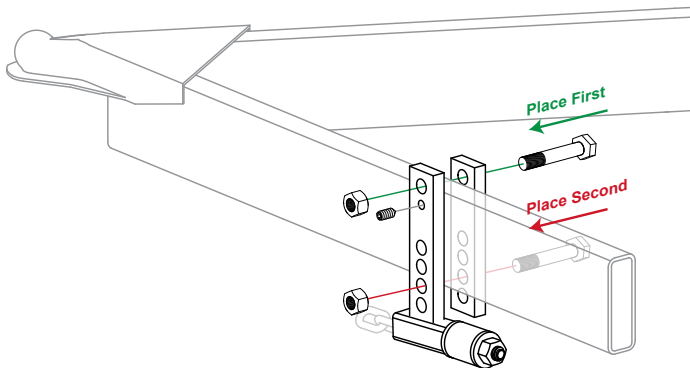
Correct Bolt Installation Order

If installing 3"/4"/5"/6" universal brackets, 4-3/8" brackets, or 7"/8" brackets, begin by loosely attaching each set of inside and outside brackets with a frame bracket bolt and nut through the TOP bracket holes with the nut on the inside. Then, use a second frame bolt and nut through the first set of bracket holes below the lower edge of your trailer frame. **Do not install the pointed set screws until installation step 4-6.**

If installing RAISED 3"/4"/5"/6" brackets, begin by loosely attaching each set of inside and outside brackets with a frame bracket bolt and nut through the BOTTOM bracket holes with the nut on the inside. Then, use a second frame bolt and nut through the first set of bracket holes above the upper edge of your trailer frame. **Do not install the pointed set screws until installation step 4-6.**

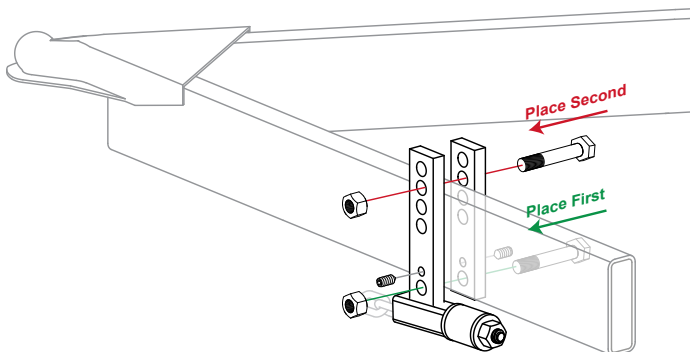
CORRECT INSTALLATION ORDER FOR:

- 3"/4"/5"/6" (Universal) Brackets
- 4-3/8" Brackets
- 7"/8" Brackets



CORRECT INSTALLATION ORDER FOR:

- RAISED 3"/4"/5"/6" Brackets





4-4. Once you have your brackets loosely connected, pull the top of the bracket sets away from the coupler until the top and bottom bolts rest on the frame **and the chains are tight** — the brackets will now be angled as seen below. Now tighten down all four bracket bolts using two 15/16" sockets or wrenches.



NOTE: Brackets should end up at an angle on your trailer frame

4-5. Make sure all brackets are clamped tightly — we recommend around 75-90 ft-lbs of torque depending on your frame.

IMPORTANT: Some lighter frames may begin to crush if torqued too high, so be aware of your frame's capabilities.

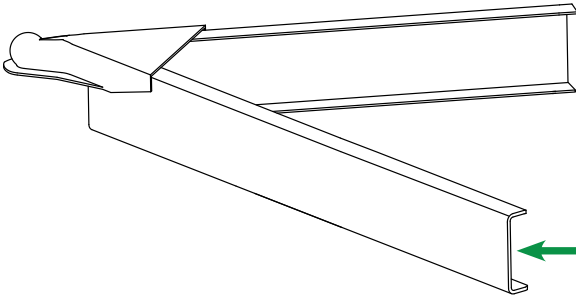


4-6. Using a 5/16" allen ratchet or allen wrench, screw in all set screws until they **barely touch** the trailer frame. Then, proceed to tighten them 1-1/2 to 2 more full rotations. If you find that your brackets tend to shift, you can use one of the following optional set screw installation methods for a more secure connection.

NOTE: If you are installing a kit with Raised 3"/4"/5"/6" brackets, you will use four set screws — one set on the outside brackets and one set on the inside brackets as shown on page 8.

C-CHANNEL FRAMES

If your trailer has a 'C-channel' style frame as shown in the illustration on the right, you will need to install the set screws or brackets using one of the two optional methods that follow. Both optional methods are designed to help ensure a secure hold for the brackets of your WD kit.



1. OPTIONAL SET SCREW INSTALLATION - PRE-DRILLING
(for both Regular and C-Channel frames)

A good option to strengthen and secure the hold of the set screws is to pre-drill a 7/16" hole into the frame where the set screws will be located. Before drilling, insert the set screw into the frame bracket and turn it until the tip makes contact with the frame, then turn it a little more to apply pressure and make a mark on the trailer frame. Remove the set screw and drill a hole in the frame at the point you marked. After drilling, replace and tighten the set screws into the hole to prevent the bracket from slipping.



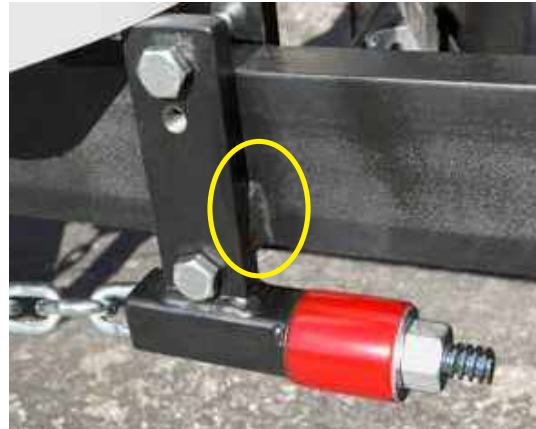
ANDERSEN HITCH

2. OPTIONAL FRAME BRACKET INSTALLATION - WELDING (for both Regular and C-Channel frames)

Using the services of a certified welder, another option is to add a 2" weld along the lower back side of both outside frame brackets (on the same side the red spring is on). This will give you a very secure installation of the frame brackets without the need for set screws. Before welding you will need to grind the paint off of the area to be welded.

For best performance, you will want to weld the brackets at an angle that allows the straightest travel of the chain through the outside bracket.

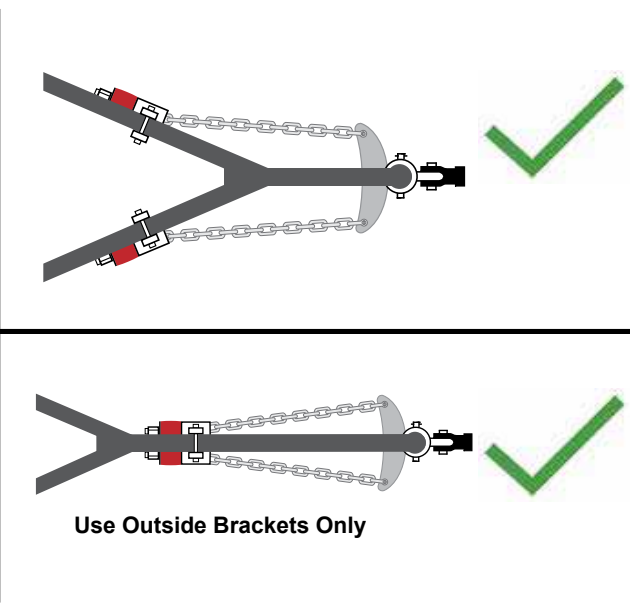
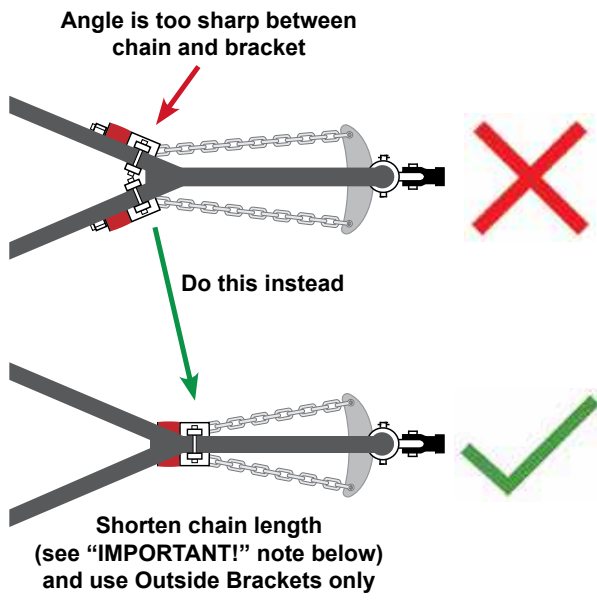
NOTE: You do not need to weld the inside frame brackets. Should you decide to sell your trailer later, the weld could be easily removed by prying the bracket away and grinding off the leftover weld.



NOTE: AS WITH ANY WEIGHT DISTRIBUTION HITCH, DO NOT USE THE ANDERSEN WD HITCH WITH ANY KIND OF SURGE BRAKE SYSTEM

'Y' STYLE TRAILER FRAMES

The Andersen 'No-Sway' Weight Distribution Hitch can accommodate nearly all 'Y-style' trailer frames. In some cases you may need to remove or add a few chain links to allow installation at the optimum position on the trailer frame. In some cases you may need to install the unit using just the outside frame brackets — bolting them to each other rather than to the inside frame brackets. Use the examples below as a guide.

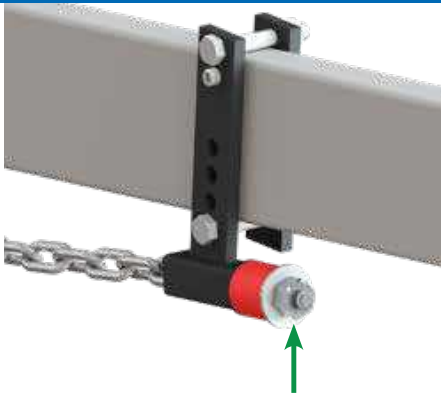


IMPORTANT! You can **SHORTEN** the chain (up to approx. 5 links shorter) or **ADD** several inches to the chain (as many links as needed). For more information, see page 8 under "How to handle obstructions."

NOTE: If you do remove/add any chain links, be sure to remove/add the same number of links from both tension chains. If you have any questions about a particular installation please call our customer service center at 800-635-6106.



SECTION 5: SETTING THE TENSION



IMPORTANT - BEFORE USING A WRENCH, hand-tighten both Tension Nuts until the chains are tight

5-1. Once the frame brackets are firmly and securely in place, **make sure your chains are still tight**. Then, **using the 1-1/4" socket (provided), HAND-TIGHTEN both Tension Nuts** as much as you can — this is now your starting point when tightening with a wrench. Now, using a wrench with the provided 1-14" socket, tighten both Tension Nuts another 3–4 threads. The red urethane springs will be compressed and have a little bit of a curved edge.

5-2. Lower the trailer and set the full weight of the trailer onto the ball. The front and back end of your trailer should now be close to level.

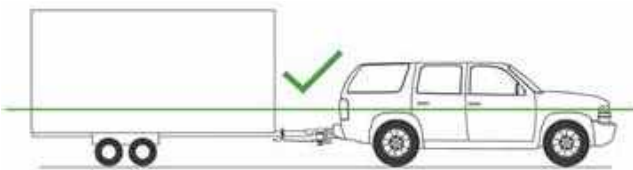
To **fine-tune** the weight distribution, you can tighten or loosen both Tension Nuts one thread at a time. Although it is not crucial, it is a good practice to tighten or loosen both of the Tension Nuts about the same amount.

See Section 6 for further checking and adjustment.

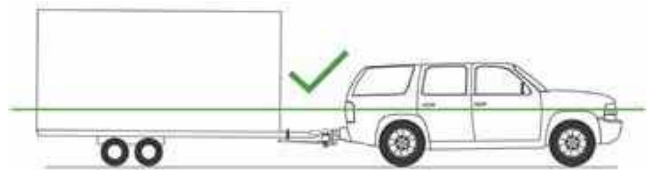
SECTION 6: CHECKING AND ADJUSTING THE TENSION

6-1. For most circumstances, you will be able to see just how well the installation and adjustment is going by standing back and looking at how level the trailer and tow vehicle are. The trailer should be level, while the tow vehicle should be pretty close to level. If either is drastically uneven, follow the troubleshooting steps on the following page.

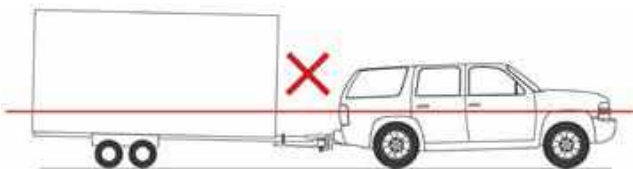
IMPORTANT Trying to get the Tow Vehicle perfectly level is **NOT** necessary — you just don't want to be too extreme in either direction (too much towards the tow vehicle's front axle or too much towards the rear axle). After hundreds of installations we have found that it is quite effective to basically "sight level" the tow vehicle and get it as close to level as you can by tightening/loosening the Tension Nuts. We have illustrated some good and bad examples below:



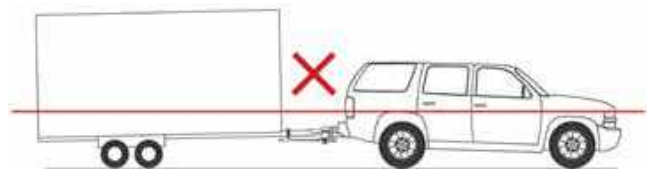
GOOD: Trailer and tow vehicle are level



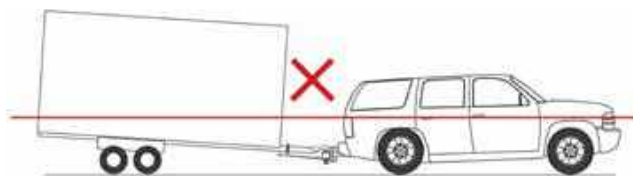
GOOD: Trailer is level, rear of tow vehicle is a little lower than front



BAD: Trailer is not level and rear of tow vehicle is a lot lower than front
1. Check the Load 2. Check Installation 3. Tighten Tension Nuts



BAD: Trailer is not level and back of tow vehicle is higher than front
1. Check the Load 2. Check Installation 3. Tighten Tension Nuts



BAD: Far too much weight on back of tow vehicle Trailer is severely off-level
1. Check the Load 2. Check Installation 3. Tighten Tension Nuts



REMEMBER Any time your load changes in the towing vehicle or trailer, re-check to see how level you are and make adjustments as needed. Also, check the tightness of all nuts and bolts often and re-tighten as necessary.

TROUBLESHOOTING HOW LEVEL YOU ARE

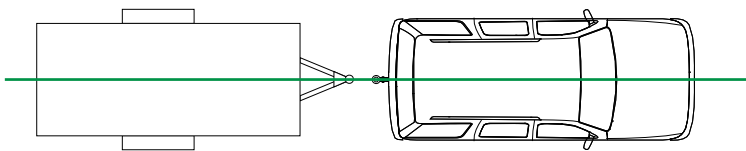
1. **Check the Load.** Is there too much weight in the trailer or tow vehicle? If not, perhaps the load is too far to the front or back of the trailer or tow vehicle and needs to be distributed better.

TIP: It's better to keep the weight shifted towards the front of the trailer than the back... approximately 60% in the front and 40% in the back.

2. **Check Your Installation.** Start again from Step 1 and double-check each of the installation steps.
3. **Adjust the Tension Nuts.** Drop the trailer jack to remove heavy tension from the chains. Then, tighten or loosen each tension nut one thread at a time and check the result by raising the trailer jack and putting the full weight of the trailer back on the chains. Tightening will move the weight distribution towards the front axle of the tow vehicle, loosening the Tension Nuts moves the weight towards the rear axle of the tow vehicle. To determine if the bolts are tightened the same amount, count the number of threads showing on the end of the chain bolts.

Having trouble installing? If you have read through the safety information on pages 3 & 4, and followed all of the installation instructions well, but are still having difficulty with the installation, please contact your local Authorized Andersen Dealer, or visit our help website at help.AndersenHitches.com, or call our customer service center at 1-800-635-6106.

UNHOOKING THE TRAILER FROM THE TOW VEHICLE



For convenience in hooking back up LATER: Before you unhook the trailer from the tow vehicle, try to park the trailer and tow vehicle as close to evenly in line as possible (as shown at left).

1. Once you are parked, chock the tires of your trailer and remove your safety chains (not the Tension Chains).
2. Use your trailer's jack (or support leg) to lift the trailer and take the weight off of the back tires of the tow vehicle.
3. Make a note of how many threads are showing. Using the 1-1/4" socket, loosen both Tension Nuts.
4. Remove the pin and clip attached to the bottom of the ball and Tension Plate (fig. 1).
5. Remove the TensionPlate — you can leave the chains and shackles attached to it (fig. 2).
6. In some cases you may need to lower the coupler, placing the weight of the trailer back onto the ball so it centers itself in the coupler, then raise the coupler back up and completely off of the ball.
7. Now you have the option to use the Weight Distribution ball as a standard hitch ball for towing other trailers (as shown in fig. 3).

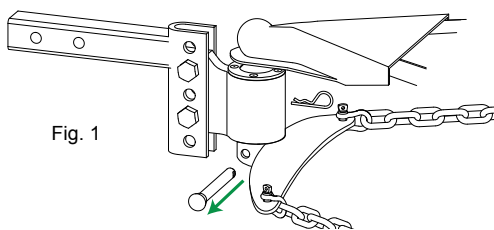


Fig. 1

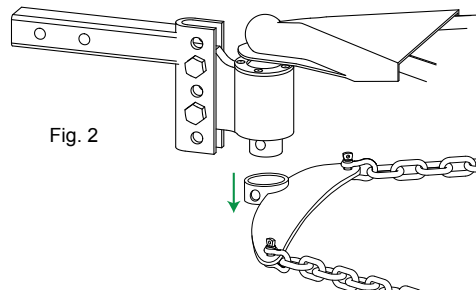


Fig. 2

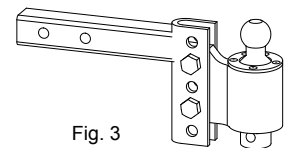


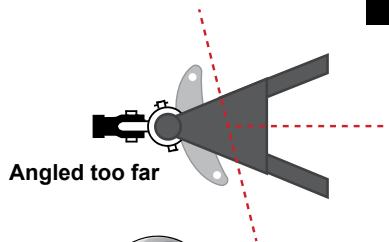
Fig. 3



HOOKING THE TOW VEHICLE BACK UP TO THE TRAILER

1. Using your trailer's support leg or jack, lower the trailer coupler onto the ball — make sure there is almost no weight on the ball, and secure the coupler latch.
2. Use the trailer jack to raise the back of the tow vehicle up 1-1/2".
3. Attach the Tension Plate (with chains and shackles attached) and pin it securely in place.
4. Using the 1-1/4" socket, tighten both Tension Nuts (make sure the same number of bolt threads are showing as when you loosened them).
5. Lower the trailer and set the weight of it fully on the ball. Go back to Section 6 and check how level the Trailer and Tow Vehicle are. Make adjustments if necessary.
6. Re-hook up the trailer's safety chains (not the Tension Chains) to the tow vehicle.

TENSION PLATE ANGLED TOO FAR?

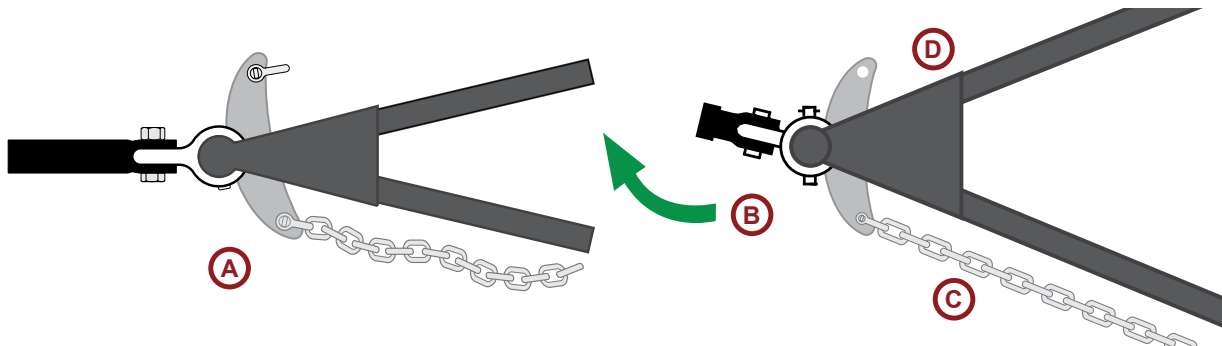


If you are unable to back up your tow vehicle to the same angle as when you unhooked your trailer or the tension (triangle) plate is no longer perpendicular to the trailer, then follow the procedure below to straighten out the tension plate.



IMPORTANT: DO NOT USE A HAMMER TO TRY AND LINE THE PLATE UP, IT WILL DAMAGE THE PLATE

Lower the trailer coupler onto the WD ball, secure the coupler and raise your jack out of the way. Unhook both chains from the tension plate and secure the tension plate to the bottom of the ball.



Attach the chain to the tension plate on the side that is **closest** to the frame brackets (A) — don't adjust the tension nut yet.

Drive forward in the opposite direction of the chain that is attached (B) until the chain is tight (C). This will turn the tension plate and bring it close to perpendicular.

Use your trailer jack to raise the coupler until there is almost no weight on the ball. Hook up the chain on the other side of the tension plate (D) and set the correct tension with both tension nuts.

REMEMBER Any time your load changes in the towing vehicle or trailer, re-check to see how level you are and make adjustments as needed. Also, check the tightness of all nuts and bolts often and re-tighten as necessary.

Questions or Concerns? If you have read the safety information on pages 3 & 4 and followed all of the installation instructions well, but are still having difficulty with the installation or hook up, please contact your local Authorized Andersen Dealer, visit our website at help.AndersenHitches.com or call our customer service center at 1-800-635-6106.



OPTIONAL ADD-ONS FOR YOUR WEIGHT DISTRIBUTION HITCH

More than one trailer?

Add a WD Trailer Kit to your other trailers so you can quickly and easily switch between trailers with your Weight Distribution system.

Includes all mounting hardware shown. Available in optional bracket sizes — shown below. 2" and 2-5/16" tapered balls are also available to fit different size trailer couplers.



#3372
WD Trailer Kit

Includes tension plate, chains, washers, nuts, brackets and mounting hardware.
(Specify bracket size.)



#3382, #3354
Tapered WD Ball

2" Ball (#3382)
2-5/16" Ball (#3354)

AVAILABLE BRACKET SETS

Each bracket set includes 2 inside brackets, 2 outside brackets, 4 bolts, 4 nuts and 2 (or 4) set screws



#3361
4-3/8" Bracket Set



#3359
3"/" Bracket Set
(multi-frame)



#3369
3"/" RAISED
Bracket Set
(low trailer frames only)



#3387
7"/" Bracket Set



#3359XTD
3"/" EXTENDED
Bracket Set
(underslung couplers only)



IMPORTANT DO NOT use above Pins & Clips in place of the bolts & nuts when attaching the WD Ball Housing to the WD Hitch rack.

#3352, #3352-25
2" x 2-5/16" Combo Ball

Use with your WD adjustable rack to pull other trailers when you don't need Weight Distribution



#3351, #3399, #3399-3
WD 8" Drop/Rise Rack

2" Shank 14K (#3351)
2-1/2" Shank 16K (#3399)
3" Shank 16K (#3399-3)



#3353, #3391, #3391-3
WD 4" Drop/Rise Rack

2" Shank 14K (#3353)
2-1/2" Shank 16K (#3391)
3" Shank 16K (#3391-3)



#3366
WD Chain Extensions

1 pair
(adds approx. 11.25" to overall chain length)

FIND MORE ACCESSORIES AND PRODUCTS AT www.AndersenHitches.com



Warranty Registration and Validation

Andersen Weight Distribution Hitch

To register your Weight Distribution Hitch, simply visit

www.AndersenHitches.com/register and complete your registration online.



Andersen Hitches Limited Warranty

PLEASE RETAIN YOUR ORIGINAL BILL OF SALE AS YOU WILL NEED TO PRESENT IT SHOULD YOU REQUIRE SERVICE UNDER THIS WARRANTY.

LIMITED LIFETIME WARRANTY: Andersen Manufacturing, Inc. (hereinafter referred to as "ANDERSEN") warrants specific Andersen brand products ("Products") purchased directly from Andersen or an Authorized Andersen Dealer, in accordance with the terms and conditions detailed herein for the periods indicated below.

⊗ WARNING: IF YOU PURCHASE AN ANDERSEN PRODUCT FROM AN UNAUTHORIZED DEALER, YOUR ANDERSEN WARRANTY WILL NOT BE VALID.

SCOPE OF WARRANTY: Commencing with the date of retail purchase and continuing for the periods specified in the Warranty Period table below, this Limited Warranty is extended to the original purchaser ("BUYER") only and warrants the Product against latent defects in materials and workmanship under normal use and service (rust, corrosion and ordinary wear and tear excepted) and is subject to the Exclusions and Limitations set forth below. A dated purchase receipt or bill of sale, or other proof of the purchase date, is required for Warranty service. If the Product is determined to be latently defective, ANDERSEN will, at its own discretion, replace or repair the Product and/or associated parts.

This Limited Warranty applies only to authentic Products manufactured and/or distributed by ANDERSEN. It does not apply to non-ANDERSEN supplied goods, even if they are packaged or sold with ANDERSEN branded Products or falsely identified as ANDERSEN Products. While some non-ANDERSEN supplied goods sold with an ANDERSEN Product may be covered by their own warranties, ANDERSEN, to the extent permitted by applicable law, provides such third-party products "AS IS".

EXCLUSIONS and LIMITATIONS: IF YOU PURCHASE AN ANDERSEN PRODUCT FROM AN UNAUTHORIZED DEALER, YOUR ANDERSEN WARRANTY WILL NOT BE VALID, please use our List of Authorized Dealers or our Authorized Dealer Locator.

BUYER is responsible for maintenance checks to the Product on a regular basis. It is also the responsibility of the BUYER to have the trailer braking system checked and maintained on a regular basis. Damages resulting from failure to perform these maintenance checks shall not be covered by this Warranty.

As the condition of trailers and vehicles used with the ANDERSEN Product is beyond ANDERSEN's control, ANDERSEN cannot and does not warrant or assume liability for damages incurred to trailers or vehicles during use of the Product.

ANDERSEN does not warrant against discontinuation of Product, defects in items or components not manufactured by ANDERSEN, or against damages resulting from use of such non-ANDERSEN made products or components. ANDERSEN passes on to BUYER the warranty it received (if any) from the maker of any non-ANDERSEN made products or components.

This Limited Warranty does not apply to any Product upon which repairs have been affected or attempted by persons other than those in possession of written authorization from ANDERSEN.

Additionally, this Limited Warranty does not apply with respect to any of the following:

1. Defects or damage resulting from improper installation, unauthorized alteration, unreasonable use, or improper maintenance including, but not limited to loading the Product beyond the Product's rated load capacity.
2. Defects or damage caused by an accident, sudden impact arising from a collision, or other abnormal occurrences.
3. Defects or damage caused by fire, smoke, flood, water damage, lightning, or other acts of nature/acts of God.
4. Defects or damage caused by abuse, misuse, negligence, accident, unauthorized product modification or service, or failure to observe the instructions contained in the manual furnished at the time of original purchase.
5. Damage caused during shipment or handling.
6. Products purchased from anyone other than ANDERSEN or an Authorized Andersen Dealer. If you are uncertain as to whether a dealer is authorized, please visit our List of Authorized Dealers or contact our Customer Service Department.
7. Products that have been altered or repaired by anyone other than ANDERSEN or an Andersen Authorized Dealer in a manner that has affected the product's performance, stability or reliability.
8. Any accessories or products attached to or used with ANDERSEN Products
9. Packing materials and cosmetic items like stickers.
10. Parts which have prescribed useful lives dependent upon the degree of their use, such as rubber pads, duffel bags, chemical products, etc.
11. Maintenance, cleaning or periodic check-ups.
12. Loss of keys to ANDERSEN's Stainless Steel Locking Pins.

THIS WARRANTY IS EXCLUSIVE. To the extent allowed by law, ANDERSEN shall not be liable for any incidental, consequential, or any other damages including, without limitation, breach of any implied warranty, merchantability, or fitness of the Product for a particular purpose. The sole and exclusive obligation of ANDERSEN shall be to repair or replace the defective Product in the manner stated above. ANDERSEN shall not have any other obligation with respect to the Product or any part thereof, whether based on contract, tort, strict liability, or otherwise. It is understood that the seller's liability, whether in contract, in tort, under any warranty, in negligence or otherwise, shall not exceed the return of the wholesale amount of the purchase price paid by the BUYER. Under no circumstances, whether based on this Limited Warranty or otherwise, shall ANDERSEN be liable for incidental, special, or consequential damages. The price stated for the Product is considered in limiting ANDERSEN's liability.

ANDERSEN's employees', representatives' or Dealers' ORAL OR WRITTEN STATEMENTS DO NOT CONSTITUTE WARRANTIES, shall not be relied upon by BUYER, and are not a part of the contract for sale or this limited warranty.

This warranty does not include labor charges nor does it include transportation charges for returning the Product to the consumer. Removal, shipping and installation of the replacement Product or replacement parts shall be at BUYER's expense.

WEIGHT DISTRIBUTION HITCH WARRANTY PERIOD (from date of purchase): Hitch – 1 Year / Brake Material Cone – Lifetime

OBTAINING WARRANTY SERVICE: For warranty service and returns please visit our website and click on "Warranty" at the bottom of the page or call our customer service department at 208-523-6460. Select warranty claims can be submitted digitally through the help.andersenhitches.com website.



AUTO-DRAIN 24130-3" & 24140-1.5" INSTRUCTIONS

OPERATION:

Insure drain valve is properly connected to drain hose. Push and hold rocker switch for 3-4 seconds to fully open or close valve. The indicator light on the switch box will be on at any time the valve is not fully closed. Hold the switch in the closed position until the light goes out.

Be careful when cleaning drain valve, Auto-Drain applies enough force to cause injury.

To manually open valve, remove the 2 (12) screws. This will free the Auto-Drain from the valve housing and allow you to pull/push on the Auto-Drain to open or close the valve.

Reminder!! Leave proper spacing between spacer and rack gear (1/8"-3/16") when assembling. **Prior to tightening bolt (10) see installation notes under IMPORTANT on page 1.**

SWITCH BOX ASSY #34

SPACER WIRE CONNECTION
WIRE WIRE PLUMBING

ROCKER SWITCH

(ONE SCREW SUPPLIED WITH MOTOR BOX ASSY)

ITEM	DESCRIPTION	QTY	PART#
18	SHAFT	1	24749
17	CAM	2	30378
18	SWITCH	1	738-0055
19	SCREW (#4-40 X .52)	2	602-0005
20	WASHER	2	80208
21	CONNECTOR ASSY	1	31478
22	STRAIN RELIEF	1	12819
23	SWITCH BOX	1	31471
24	SCREW (#6 X 1")	2	606-0002
25	ROCKER SWITCH	1	738-0007
26	LAMP ASSY	1	71479
27	HEX BOLT	1	600-0077
28	PATENT LABEL	1	27129
29	PLATE SUPPORT	1	28429
30	BOX LABEL	1	23087
31	WARNING LABEL	1	25478
32	MALE CONNECTOR ASSY	1	31477
33	IN-LINE FUSE ASSY	1	31855
34	SWITCH BOX ASSY	1	31472
35	STRAIN RELIEF	1	17311
36	STRAIN RELIEF	1	743-0016
37	TERMINAL	2	742-0051
38	WIRE BLACK 24"	1	23136
39	WIRE WHITE 24"	1	23137
40	SCREW (#5-40 X .83)	1	602-0035

(NOT SHOWN- COVER FOR SWITCH BOX- P/N 24306)

PARTS LIST FOR 3" AUTO-DRAIN

ITEM	DESCRIPTION	QTY	PART#
1	BASE MACHINED	1	31473
2	RACK GEAR	1	24131
3	COVER MACHINED	1	28876
4	AUTO DRAIN LABEL	1	25012
5	WARNING/SERIAL LABEL	1	25386
6	DRIVE GEAR	1	24134
7	MOTOR BOX ASSY	1	24122
8	SPACER	1	30992
9	HEX NUT 25-22	1	610-0006
10	UNIVERSAL BRACKET	1	30993
11	SCREW (#4-24)	4	605-0007
12	SCREW (#10-32 X 1.12")	2	601-1006
13	WASHER	1	80225
14	LOCKNUT (#10-32)	2	611-2100
15	"E" RING	1	634-1250



Microwave Oven
INSTRUCTION MANUAL
Model:EC028KD7

Read these instructions carefully before using your microwave oven.

If you follow the instructions, your oven will provide you with many years of good service.

PUT THESE INSTRUCTIONS IN A SAFE PLACE FOR REFERENCE



PRECAUTIONS TO AVOID POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY

- (a) Do not attempt to operate this oven with the door open since open-door operation can result in harmful exposure to microwave energy. It is important not to defeat or tamper with the safety interlocks.
- (b) Do not place any object between the oven front face and the door or allows soil or cleaner residue to accumulate on sealing surfaces.
- (c) Do not operate the oven if it is damaged. It is particularly important that the oven door close properly and that there is no damage to the:
 - (1) DOOR (bent)
 - (2) HINGES AND LATCHES (broken or loosened)
 - (3) DOOR SEALS AND SEALING SURFACES
- (d) The oven should not be adjusted or repaired by anyone except properly qualified service personnel.

Specifications

Model:	EC028KD7
Rated Voltage:	120V~60Hz
Rated Input Power(Microwave):	1500W
Rated Output Power(Microwave):	1000W
Rated Input Power(Grill):	1150W
Rated Input Power(Convection):	1500W
Oven Capacity:	1.1 Cu.ft (28 Litre)
Turntable Diameter:	12.4 inch (315 mm)
External Dimensions(LxWxH):	20.47 X18.7 X14.76h (520X475X375 mm)
Net Weight:	Approx 45.41 Lbs (20.6 kg)
Warning:	Handling the cord on this unit or cords associated with accessories sold with this product, will expose you to a chemical known to the state of California to cause cancer, and birth defects or other reproductive harm. Wash hands after handling.



SAFETY

1. The oven must be on a leveled surface.
2. The turntable and turntable roller rest must be in the oven during cooking. Place the cookware gently on the turntable and handle it carefully to avoid possible breakage.
3. Incorrect use of browning dish may cause the turntable to break.
4. Use only the specified bag size when using Direct Access Popcorn.
5. The oven has several built-in safety switches to ensure that the power remains off when the door is open. Do not tamper with these switches.
6. Do not operate the microwave oven empty. Operating the oven with no food or food that is extremely low in moisture can cause fire, charring or sparking.
7. Do not cook bacon directly on the turntable. Excessive local heating of the turntable may cause the turntable to break.
8. Do not heat baby bottles or baby food in the microwave oven. Uneven heating may occur and could cause physical injury.
9. Do not heat narrow-necked containers, such as syrup bottles.
10. Do not attempt to deep-fry in your microwave oven.
11. Do not attempt home canning in this microwave oven, as it is impossible to be sure all contents of the jar have reached boiling temperature.
12. Do not use this microwave oven for commercial purpose. This microwave oven is made for household use only.
13. To prevent delayed eruptive boiling of hot liquids and beverages or scalding yourself, stir liquid before placing the container in the oven and again halfway through cooking time. Let stand in the oven for a short time and stir again before removing the container.
14. Use carefully when cooking food in the microwave oven to avoid burning due to excessive cooking.
15. When the appliance is operated in the combination mode, children should only use the oven under adult supervision due to the temperatures generated.
16. Failure to maintain the oven in a clean condition could lead to deterioration that could adversely affect the life of the appliance and possibly result in a hazardous situation.



IMPORTANT SAFETY INSTRUCTIONS

When using electrical appliances basic safety precautions should be followed, including the following:

WARNING - To reduce the risk of burns, electric shock, fire, injury to persons or exposure to excessive microwave energy:

1. Read all instructions before using the appliance.
2. Read and follow the specific: "PRECAUTIONS TO AVOID POSSIBLE EXPOSURE TO EXCESSIVE MICROWAVE ENERGY" found on page 2.
3. This appliance must be grounded. Connect only to properly grounded outlet. See "GROUNDING INSTRUCTIONS" found on page 5.
4. Install or locate this appliance only in accordance with the provided installation instructions.
5. Some products such as whole eggs and sealed containers - for example, closed glass jars - are able to explode and should not be heated in this oven.
6. Use this appliance only for its intended use as described in the manual. Do not use corrosive chemicals or vapors in this appliance. This type of oven is specifically designed to heat, cook or dry food. It is not designed for industrial or laboratory use.
7. As with any appliance, close supervision is necessary when used by children.
8. Do not operate this appliance if it has a damaged cord or plug, if it is not working properly, or if it has been damaged or dropped.
9. This appliance should be serviced only by qualified service personnel. Contact nearest authorized service facility for examination, repair, or adjustment.
10. Do not cover or block any openings on the appliance.
11. Do not store this appliance outdoors. Do not use this product near water - for example, near a kitchen sink, in a wet basement, near a swimming pool, or similar location.
12. Do not immerse cord or plug in water.
13. Keep cord away from heated surface.
14. Do not let cord hang over edge of table or counter.
15. When cleaning surfaces of door and oven that comes together on closing the door, use only mild, nonabrasive soaps, or detergent applied with a sponge or soft cloth.
16. To reduce the risk of fire in the oven cavity:
 - 1). Do not overcook food. Carefully attend appliance when paper, plastic, or other combustible materials are placed inside the oven to facilitate cooking.
 - 2). Remove wire twist-ties from paper or plastic bag before placing bag in oven.
 - 3). If material inside of the oven ignites, keep oven door closed, turn oven off, and disconnect the power cord, or shut off power at the fuse or circuit breaker panel.
 - 4). Do not use the cavity for storage purposes. Do not leave paper products, cooking utensils, or food in the cavity when not in use.
17. Liquids, such as water, coffee, or tea are able to be overheated beyond the boiling point without appearing to be boiling. Visible bubbling or boiling when the container is removed from the microwave oven is not always present.



THIS COULD RESULT IN VERY HOT LIQUID SUDDENLY BOILING OVER WHEN THE CONTAINER IS DISTURBED OR A UTENSIL IS INSERTED INTO THE LIQUID.

To reduce the risk of injury to persons:

- 1) Do not overheat the liquid.
- 2) Stir the liquid both before and halfway through heating it.
- 3) Do not use straight-sided containers with narrow necks.
- 4) After heating, allow the container to stand in the microwave oven for a short time before removing the container.
- 5) Use extreme care when inserting a spoon or other utensil into the container.

SAVE THESE INSTRUCTIONS

GROUNDING INSTRUCTIONS

This appliance must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This appliance is equipped with a cord having a grounding wire with a grounding plug. The plug must be plugged into an outlet that is properly installed and grounded.

WARNING - Improper use of the grounding can result in a risk of electric shock.

Consult a qualified electrician or serviceman if the grounding instructions are not completely understood, or if doubt exists as to whether the appliance is properly grounded. If it is necessary to use an extension cord, use only a 3-wire extension cord that has a 3-blade grounded plug, and 3-slot receptacle that will accept the plug on the appliance. The marked rating of the extension cord shall be equal to or greater than the electrical rating of the appliance.

DANGER - Electric Shock Hazard

Touching some of the internal components can cause serious personal injury or death. Do not disassemble this appliance.

WARNING - Electric Shock Hazard

Improper use of the grounding can result in electric shock. Do not plug into an outlet until appliance is properly installed and grounded.

1. A short power-supply cord is provided to reduce the risks resulting from becoming entangled in or tripping over a longer cord.
2. Longer cord sets or extension cords are available and may be used if care is exercised in their use.
3. If a long cord or extension cord is used:
 - 1) The marked electrical rating of the cord set or extension cord should be at least as great as the electrical rating of the appliance.
 - 2) The extension cord must be a grounding-type 3-wire cord.
 - 3) The longer cord should be arranged so that it will not drape over the counter top or tabletop where it can be pulled on by children or tripped over unintentionally.



RADIO INTERFERENCE

1. Operation of the microwave oven may cause interference to your radio, TV or similar equipment.
2. When there is interference, it may be reduced or eliminated by taking the following measures:
 - 1) Clean door and sealing surface of the oven
 - 2) Reorient the receiving antenna of radio or television.
 - 3) Relocate the microwave oven with respect to the receiver.
 - 4) Move the microwave oven away from the receiver.
 - 5) Plug the microwave oven into a different outlet so that microwave oven and receiver are on different branch circuits.

UTENSILS

CAUTION - Personal Injury Hazard

Tightly-closed utensils could explode. Closed containers should be opened and plastic pouches should be pierced before cooking.

See the instructions on "Materials you can use in microwave oven or to be avoided in microwave oven."

There may be certain non-metallic utensils that are not safe to use for microwaving. If in doubt, you can test the utensil in question following the procedure below.

Utensil Test:

1. Fill a microwave-safe container with 1 cup of cold water (250ml) along with the utensil in question.
2. Cook on maximum power for 1 minute.
3. Carefully feel the utensil. If the empty utensil is warm, do not use it for microwave cooking.
4. Do not exceed 1 minute cooking time.



Materials you can use in microwave oven

Utensils	Remarks
Aluminum foil	Shielding only. Small smooth pieces can be used to cover thin parts of meat or poultry to prevent overcooking. Arcing can occur if foil is too close to oven walls. The foil should be at least 1 inch (2.5cm) away from oven walls.
Browning dish	Follow manufacturer* instructions. The bottom of browning dish must be at least 3/16 inch (5mm) above the turntable. Incorrect usage may cause the turntable to break.
Dinnerware	Microwave-safe only. Follow manufacturer's instructions. Do not use cracked or chipped dishes.
Glass jars	Always remove lid. Use only to heat food until just warm. Most glass jars are not heat resistant and may break.
Glassware	Heat-resistant oven glassware only. Make sure there is no metallic trim. Do not use cracked or chipped dishes.
Oven cooking bags	Follow manufacturer* instructions. Do not close with metal tie. Make slits to allow steam to escape.
Paper plates and cups	Use for short term cooking/warming only. Do not leave oven unattended while cooking.
Paper towels	Use to cover food for reheating and absorbing fat. Use with supervision for a short-term cooking only.
Parchment paper	Use as a cover to prevent splattering or a wrap for steaming.
Plastic	Microwave-safe only. Follow the manufacturer* instructions. Should be labeled "Microwave Safe". Some plastic containers soften, as the food inside gets hot. "Boiling bags" and tightly closed plastic bags should be slit, pierced or vented as directed by package.
Plastic wrap	Microwave-safe only. Use to cover food during cooking to retain moisture. Do not allow plastic wrap to touch food.
Thermometers	Microwave-safe only (meat and candy thermometers).
Wax paper	Use as a cover to prevent splattering and retain moisture.

Materials to be avoided in microwave oven

Utensils	Remarks
Aluminum tray	May cause arcing. Transfer food into microwave-safe dish.
Food carton with metal handle	May cause arcing. Transfer food into microwave-safe dish.
Metal or metal-trimmed utensils	Metal shields the food from microwave energy. Metal trim may cause arcing.
Metal twist ties	May cause arcing and could cause a fire in the oven.
Paper bags	May cause a fire in the oven.
Plastic foam	Plastic foam may melt or contaminate the liquid inside when exposed to high temperature.
Wood	Wood will dry out when used in the microwave oven and may split or crack.



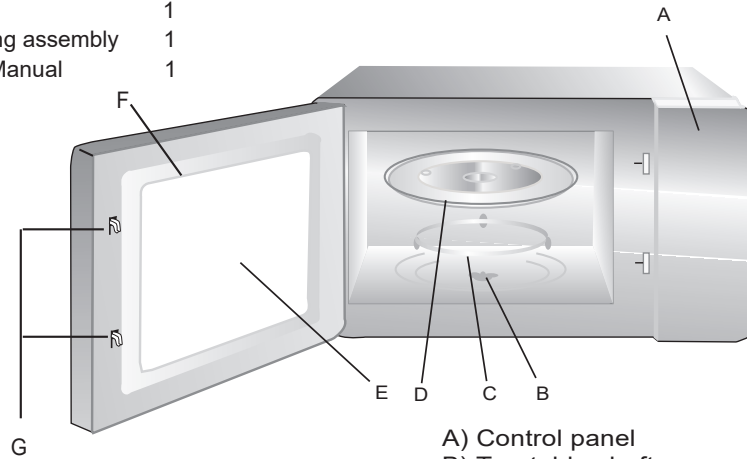
SETTING UP YOUR OVEN

Names of Oven Parts and Accessories

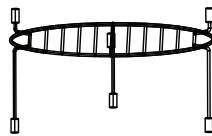
Remove the oven and all materials from the carton and oven cavity.

Your oven comes with the following accessories:

Glass tray	1
Turntable ring assembly	1
Instruction Manual	1

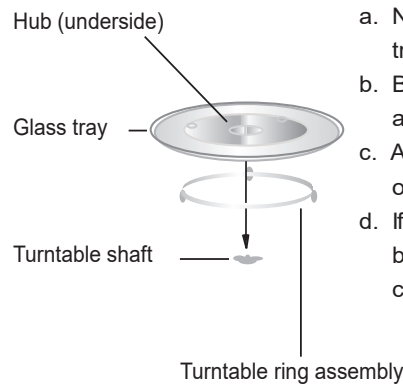


- A) Control panel
- B) Turntable shaft
- C) Turntable ring assembly
- D) Glass tray
- E) Observation window
- F) Door assembly
- G) Safety interlock system



Grill Rack (Only for Grill series)

Turntable Installation

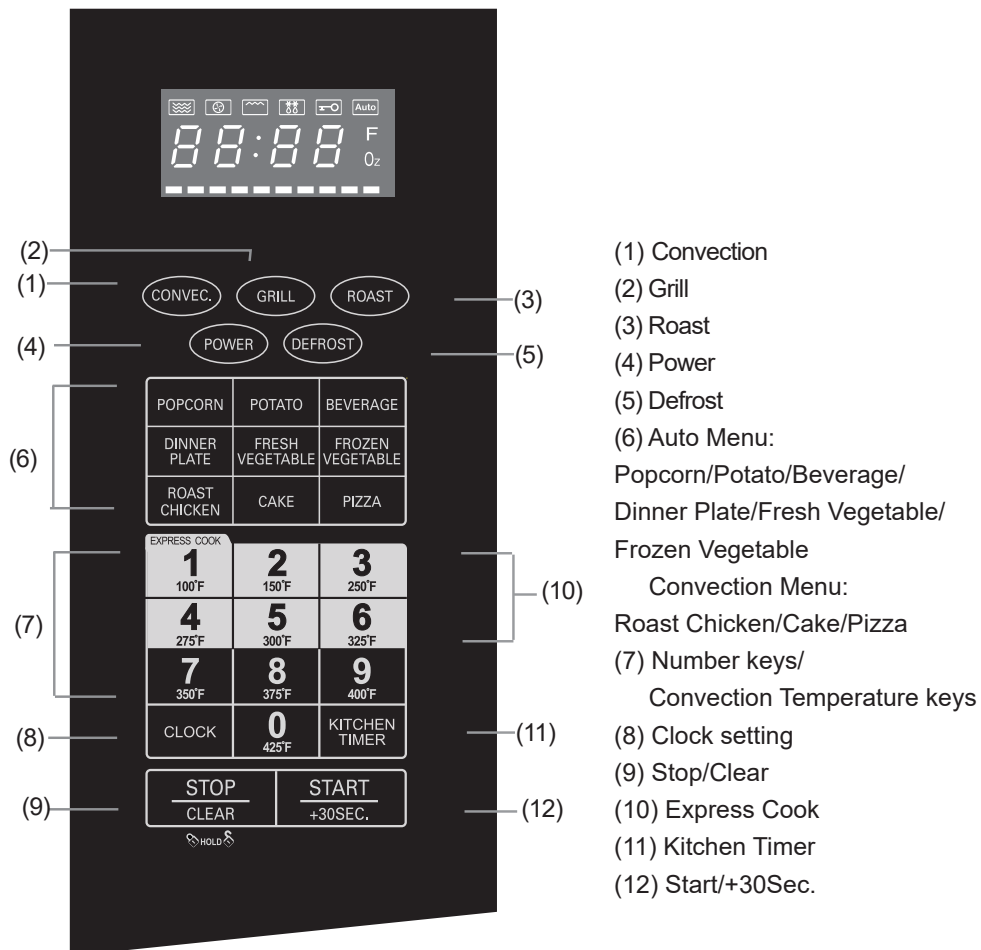


- a. Never place the glass tray upside down. The glass tray should never be restricted.
- b. Both glass tray and turntable ring assembly must always be used during cooking.
- c. All food and containers of food are always placed on the glass tray for cooking.
- d. If glass tray or turntable ring assembly cracks or breaks, contact your nearest authorized service center.



OPERATION

Control Panel and Features





OPERATION INSTRUCTION

1. Clock Setting

When the microwave oven is electrified, the oven will display "0:00", and buzzer will ring once.

The input time should be within 1:00-12:59.

Example: To set 12:12 .

- (1) Press the "**Clock**" button, and the buzzer will ring once.
- (2) Press the number keys: "1","2","1","2" in order.
- (3) Press "**Clock**" to finish clock setting. ":" will flash, and the time will light.

Note: 1) If the clock is not set, "0:00" is displayed and the clock will not count.
 2) During the process of clock setting, if you press "**Stop/Clear**", the oven will go back to the previous status automatically.

2. Kitchen Timer

- (1) Press "**Kitchen Timer**" , "0:00" is displayed.
- (2) Press the number keys to set the timing within the range of 99 minutes and 99 seconds.

For example:
 set kitchen timer as 12 minutes and 12 seconds, please press "1,2,1,2" in turn.
 (3) Press "**Start/+30SEC.**" to confirm; time will count down and display.
 (4) When time counts to "0", the buzzer will sound 5 times and the oven will turn back to the normal state.

Note: (1) Kitchen timer is a timer as an alarm clock.
 (2) In the timing state, the oven will not start with any program and the oven light will not light.

3. Microwave Cooking

Select different microwave power level and set cooking time as you wish. There are 10 power levels available for choosing. Keep on pressing "**Power**" to choose the power.

Level	10	9	8	7	6	5	4	3	2	1
Power	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
Display	PL10	PL9	PL8	PL7	PL6	PL5	PL4	PL3	PL2	PL1

Example: If you want to use 80% microwave power to cook for 10 minutes, you can operate the oven as the following steps.

- 1) Press "**Power**" once, the oven will display "PL10".
- 2) Press "**Power**" twice again to choose 80% power, the oven will display "PL8".
- 3) Press the number buttons of "1","0","0","0" in order, the oven will display "10:00"
- 4) Press "**Start/+30SEC.**" to start cooking, ":" will light and the "Micro." indicator will flash.

4. Grill/Micro.+Grill Combination Cooking

- (1) Press the "**Grill**" button once to choose the grill function, the oven will display "G-1" and " Grill " indicator will light.(Press twice or thrice to choose the combination function with "G-2" or "G-3" displaying)



(2) Set the cooking time.

Example: Set 12 minutes 50 seconds, press "1", "2", "5", "0" in order.

(3) Press "**Start/+30SEC.**" to start cooking. The cooking time counts down, ":" will light and "Grill" indicator will flash.

Note: If half the grill time passes, the oven sounds twice, and this is normal. It denotes turning food over in order to have a better effect of grilling food, and you should turn the food over, close the door, and then press "**Start/+30SEC.**" to continue cooking.

Note: "Grill" Pad presses instructions

Presses Instructions	Display	Microwave	Grill
1	G-1	—	100%
2	G-2	36%	64%
3	G-3	55%	45%

5. Convection Cooking

The convection cooking can let you cook the food as a traditional oven. Microwave is not used. It is recommended that you should preheat the oven to the appropriate temperature before placing the food in the oven.

There are ten temperatures of convection: 100F,150F,250F,275F,300F,325F,350F, 375F,400F,425F.

A. With preheating convection

- 1) Press the "**CONVEC.**" once, the oven will display "100". "F" and "Conv."indicator will light. (Press the convection temperature key to select the temperature you need.)
- 2) Press "**Start/+30SEC.**" button to start preheating.
The temperature figure will flash when the oven reaches the temperature set, and buzzer will ring twice to remind you to put food into the oven, then close the door.
- 3) Press the number keys to set cooking time.
Once the temperature arrives, door must be opened and then closed to input the cooking time.
- 4) Press the "**Start/+30SEC.**" button to start cooking.
"Conv." indicator will flash, ":" will light, and cooking time will count down.

Note: a. Cooking time cannot be input until the preheating temperature arrives.
b. If the time is not input in 5 minutes, the oven will stop preheating. The buzzer sounds five times and turns back to waiting status.

B. Convection Cooking(Without preheating function)

- 1) Press the "**Convec**" once, the oven will display "100". "F" and "Conv."indicator will light. (Press the convection temperature key to select the temperature you need.)
- 2) Press the "**Convec**" button to confirm the temperature.
- 3) Press the number keys to set cooking time.
- 4) Press the "**Start/+30SEC.**" button to start cooking.
"Conv." indicator will flash, ":" will light, and cooking time will count down.



CONVECTION MICROWAVE - HIGH POINTE

6. Convection Roast Cooking

- 1) Press " Roast " once, the oven will display "325F", and the "Micro.", "Conv." indicator will light. (Press the convection temperature key to select the temperature you need.)
- 2) Press " Roast " button to confirm the temperature.
- 3) Press the number keys to set cooking time.
- 4) Press " Start/+30SEC. " button to start cooking, ":" will light, and cooking time will count down.

7. Defrost By Weight

- 1) Press " Defrost " once, the oven will display "dEF1"."Micr." , "Defrost" indicators will light.
- 2) Press the number keys to set defrosting weight within the range of 4 to 100 oz, and "Oz" will light.
- 3) Press " Start/+30SEC. " button to start defrosting, and "Oz" will disappear.

8. Defrost By Time

- 1) Press " Defrost " twice, the oven will display "dEF2"."Micr." , "Defrost" indicators will light.
- 2) Press the number keys to set defrosting time. The max.time is 99 minutes 99 seconds.
- 3) Press " Start/+30SEC. " button to start defrosting.

9. Multi-Stage Cooking

A maximum of two stages of cooking can be set. If one of the stages is defrosting, then it should be put in the first stage. The buzzer will ring once after each stage cooking and the next stage will begin.

Note: Auto menu cooking cannot be set as one of the multi-stage.

Example: cooking with 100% microwave power for 5 minutes and then 70% microwave power for 10 minutes. The steps are as the following:

- 1) Press " Power " once, "PL10" is displayed;
- 2) Press number keys "5","0","0" to adjust the cooking time as you need;
- 3) Press " Power " four times to choose 70% microwave power, "PL7" is displayed;
- 4) Press number keys "1","0","0","0" to adjust the cooking time as you need.
- 5) Press " Start/ +30 SEC. " to start cooking.

10. Speedy Cooking

- (1) In waiting state, instant cooking at 100% power level can be started by selecting cooking time from 1 to 6 minutes by pressing numeral pads 1 to 6. Press " Start/ +30 SEC. " to increase the cooking time 30 seconds by each added pressing; the maximum cooking time is 99 minutes and 99 seconds.
- (2) In waiting state, instant cooking at 100% power level with 30 seconds' cooking time can be started by pressing " Start/ +30 SEC. ". Each press on the same button will increase cooking time by 30 seconds. the maximum cooking time is 99 minutes and 99 seconds.



Note: In microwave, grill, convection or combination cooking state, 30 seconds' cooking time can be added by each pressing of "**Start/ +30 SEC.**" button, and it's invalid at the function of defrost, multi-stage or auto menu cooking.

11. Auto Menu Cooking

1) In waiting state, press the button of "**Popcorn**", "**Potato**", "**Beverage**", "**Dinner Plate**", "**Fresh Vegetable**", "**Frozen Vegetable**", "**Roast Chicken**", "**Cake**" or "**Pizza**" to choose the function and weight of food as you need.

2) Press "**Start / +30 SEC.**" to start cooking.

Note: Refers to the next page for auto menu chart.

12. Lock-out Function for Children

Lock: In waiting state, press "**STOP/CLEAR**" for 3 seconds, there will be a long "beep" denoting entering into the children-lock state and "🔒" indicator will light. LED will display current time or 0:00.

Unlock: In locked state, press "**STOP/CLEAR**" for 3 seconds, there will be a long "beep" denoting that the lock is released, and "🔒" indicator will disappear.

13. Food Detection Algorithm

In standby mode, open the door, and then close the door. If the cooking program is set within 5 minutes, the oven will start cooking normally; if more than 5 minutes, the oven cannot start cooking, the buzzer will sound once, and the screen will display "FOOD" repeatedly. Switching the door and then setting the cooking program within 5 minutes, the oven can start cooking.

14. State Inquiry

- 1). During cooking, press "**Convec**", "**Power**", "**Grill**" to check the responding power, and the power will be displayed for 2-3 seconds;
- 2) During cooking, press "**Clock**" to check the current time, and the time will be displayed for 2-3 seconds.

Pay Special Attention:

When cooking with "Microwave", "Convection", "Grill", "Roast" or "Time Defrost" function, the maximum cooking time is 99 minutes and 99 seconds.



CONVECTION MICROWAVE - HIGH POINTE

Auto menu Chart

Menu	Weight (Oz)	Display
Popcorn	1.75 OZ	1.75 OZ
	3.00 OZ	3.00 OZ
	3.50 OZ	3.50 OZ
Potato	1 portion	1
	2 portions	2
	3 portions	3
Beverage	about 8.80 OZ	1
	about 17.60 OZ	2
	about 26.40 OZ	3
Dinner Plate	8.00 OZ	8.00 OZ
	12.00 OZ	12.00 OZ
	16.00 OZ	16.00 OZ
Fresh Vegetable	4.00 OZ	4.00 OZ
	8.00 OZ	8.00 OZ
	16.00 OZ	16.00 OZ
Frozen Vegetable	4.00 OZ	4.00 OZ
	8.00 OZ	8.00 OZ
	16.00 OZ	16.00 OZ
Roast Chicken	16.00 OZ	16.00 OZ
	24.00 OZ	24.00 OZ
	32.00 OZ	32.00 OZ
	40.00 OZ	40.00 OZ
	48.00 OZ	48.00 OZ
Cake	16.00 OZ	16.00 OZ
Pizza	10.00 OZ	10.00 OZ
	22.00 OZ	22.00 OZ

Note: 1) Cake menu is under convection cooking with 325F-preheat function, and you should preheat first following the auto menu operation, when the oven reaches the temperature, it will stop working and sound to remind opening the door to put cake in, then press "**Start / +30 SEC.**" to start cooking.

2) You should use the grill rack when roasting chicken in order to have a better effect of cooking.



MAINTENANCE

Troubleshooting

Check your problem by using the chart below and try the solutions for each problem. If the microwave oven still does not work properly, contact the nearest authorized service center.

TROUBLE	POSSIBLE CAUSE	POSSIBLE REMEDY
Oven will not start	<ul style="list-style-type: none"> a. Electrical cord for oven is not plugged in. b. Door is open. c. Wrong operation is set. 	<ul style="list-style-type: none"> a. Plug into the outlet. b. Close the door and try again. c. Check instructions.
Arcing or sparking	<ul style="list-style-type: none"> a. Materials to be avoided in microwave oven were used. b. The oven is operated when empty. c. Spilled food remains in the cavity. 	<ul style="list-style-type: none"> a. Use microwave-safe cookware only. b. Do not operate with oven empty. c. Clean cavity with wet towel.
Unevenly cooked foods	<ul style="list-style-type: none"> a. Materials to be avoided in microwave oven were used. b. Food is not defrosted completely. c. Cooking time, power level is not suitable. d. Food is not turned or stirred. 	<ul style="list-style-type: none"> a. Use microwave-safe cookware only. b. Completely defrost food. c. Use correct cooking time, power level. d. Turn or stir food.
Overcooked foods	Cooking time, power level is not suitable.	Use correct cooking time, power level.
Undercooked foods	<ul style="list-style-type: none"> a. Materials to be avoided in microwave oven were used. b. Food is not defrosted completely. c. Oven ventilation ports are restricted. d. Cooking time, power level is not suitable. 	<ul style="list-style-type: none"> a. Use microwave-safe cookware only. b. Completely defrost food. c. Check to see that oven ventilation ports are not restricted. d. Use correct cooking time, power level.
Improper defrosting	<ul style="list-style-type: none"> a. Materials to be avoided in microwave oven were used. b. Cooking time, power level is not suitable. c. Food is not turned or stirred. 	<ul style="list-style-type: none"> a. Use microwave-safe cookware only. b. Use correct cooking time, power level. c. Turn or stir food.



HYPERVENT CONDENSATION PREVENTION MATTING

HyperVent Marine

A DIVISION OF SLUMBER EASE MATTRESS FACTORY

1301 4TH STREET, MARYSVILLE, WA 98270

360 657 5503 FAX 360 651 1365

Thank you for your order. We believe you'll be very satisfied with the performance of HyperVent, its durability, and low maintenance. It is the only product known to us that addresses the **prevention of condensation** beneath mattresses and cushions.

Installing HyperVent

- 1) The grey, thin material goes **up**; the white, coarser material faces **down**.
- 2) The flap of grey material along one edge is for joining two pieces. Lay the pieces together, spread or spray an adhesive on the flap and proceed according to the directions for the adhesive. If you want to keep the pieces separate but still butted up to each other, let the flap overlay onto the other piece or trim to your desire.

NOTE: If you have a pattern that will need multiple pieces, place or join the pieces together, draw (trace) the pattern onto the grey side, then trim as necessary.

- 3) Usually, it is best to leave the HyperVent about $\frac{1}{4}$ " to $\frac{1}{2}$ " **undersized** from the item that it will be under. For example; a mattress that is 60 x 80, cut between 59"-59 $\frac{1}{2}$ " by 79" – 79 $\frac{1}{2}$ ". You may do the same for odd shapes/angles.

For mattresses that have a beveled edge against an outside bulkhead/hull, you may want to consider placing a strip of HyperVent or other insulation between the mattress and the bulkhead/hull. This is usually done when the condensation/sweating is extremely high in this area.

- 4) Tuck your bedding **under** the mattress, but **above** the HyperVent.

Cleaning

HyperVent is easily cleaned with a hose while the material is spread out on the dock or boat deck. Avoid high pressure spraying to prevent the de-lamination of the grey fabric from the thicker white material. Swishing HyperVent around in a tub with household cleaners is okay as well. Let HyperVent dry and reinstall.

How it Works

HyperVent works to prevent condensation by allowing air to circulate beneath mattresses/ cushions. This air warms the supporting surface and eliminates the cold surface and allows moisture to evaporate. There can be climatic conditions that develop inside a cabin so favorable to condensation that even HyperVent cannot completely solve the problem. HyperVent will reduce condensation under any circumstances. **If** moisture forms beneath the HyperVent, be sure the bedding is tucked in under the mattress but above the HyperVent and open the cabin as much as practical for ventilation.



Program Your Keypad

1. Write down your "new" code below
2. Hold down the "8" button, simultaneously press the "LOCK" button, then release both. A long confirmation beep signifies that you have entered the programming mode
3. Key in the existing code then press the "LOCK" button ("1234" is the default).
4. Key in your new code, then "LOCK" button.
5. Key in the same new code and again press "LOCK". A long confirmation beep confirms your new programming.
6. To ensure your new code is working, key in the new code and press the lock or unlock button. The Keypad should confirm the accepted code by actuating the deadbolt.

If programming is unsuccessful, simply press the "CODE RESET" button for 5 seconds on the back handle and repeat step #1.

* The keypad will time-out at 10 seconds. If you make a mistake, simply start over with step #1.

(We recommend 4 to 6 digits)



Program Your Fob/Remote

1. Turn switch to "ON" at the back of your handle. Then, press and release the "FOB LEARN" button located just above the ON/OFF switch. A short, quick beep will confirm that you have entered programming mode.
2. Press the "LOCK" button on your remote until the handle confirms a sync with a long beep. (May take 2 to 3 clicks).
3. Finally, press the "LOCK/UNLOCK" button to confirm the actuation of the deadbolt on your RVLock handle.

*If programming did not work, or if you have additional remotes to program, simply repeat steps #1, #2, and #3.

*Holding down the "LEARN" button for 10 seconds (or until you hear a beep) will remove all previously synced remotes from the handles memory.

NOTE:

Up to 10 remote fobs can operate the same Keyless Handle. Remote fobs also have the ability to control multiple Keyless Handles.



SEE VIDEO TUTORIALS
ONLINE AT RVLOCK.COM

Changing Handle Batteries



Remove the 2 screws on the back battery cover next to the "ON/OFF" switch and install 4 AA alkaline batteries.

- * Fast beeps before the lock actuates means the batteries are low.
- * Changing the batteries on your handle will not change the current code or remote fob programming.
- * To save battery life and avoid handle damage, remove the batteries in the handle when you are not in travel season.



NATURE'S HEAD COMPOSTING TOILET

NATURE'S HEAD[®] **Self-Contained Composting Toilet**

Installation Manual and User's Guide



Saving Our Water for Tomorrow



Nature's Head, Inc.
www.NaturesHead.net

Sales
PO Box 250
Van Buren, OH 45889
Phone: 251-295-3043
Email: sales@NaturesHead.net

Corporate
535 Bayou Sara Avenue
Saraland, AL 36571



Made in the USA



Nature's Head® Composting Toilet

Congratulations on your acquisition of a NATURE'S HEAD® composting toilet! Although the concept of a composting head (toilet) is not a new one, the unit which you have purchased is the freshest of the new generation of this kind of product.

We saw a need for an improved design and more user-friendly product. The concept has been refined and reworked to provide you with a product that is easier to use, aesthetically pleasing, more space-efficient, and more affordable alternative to other products. While designed to withstand the rigors of the boating environment, the NATURE'S HEAD® toilet is well suited for many other applications.

Wherever you choose to install your new NATURE'S HEAD® toilet, it is sure to provide you with years of worry-free sanitation solutions without the hassles, inconvenience, expense, and odors of other sanitation systems.

WHAT'S IN THE BOX?

- 1) Your new NATURE'S HEAD® composting toilet
- 2) Liquids Bottle and Cap
- 3) Basic installation kit:
 - 5 feet of 1½ inch inside diameter hose with ends
 - inside vent flange
 - agitator handle
 - 2 mounting brackets and knobs
 - 4 mounting screws (for wood floor installations)
 - 6' single pin cable for 12 volt fan
 - fuse holder and fuse for direct battery attachment
 - Allen wrench for installation of spider handle
 - Spray bottle
- 4) Instruction manual
- 5) Warranty Card

Note: The exhaust fan for the head was installed before shipment.



INSTALLATION

ITEMS YOU MAY NEED TO COMPLETE YOUR INSTALLATION

Your NATURE'S HEAD® composting toilet comes with most of the items necessary for completion of your installation. The outside vent is not included because each application is different and many will require a different vent. Also the 12V to 110V Power Transformer (AC Adapter) is not included because all installations do not require this.

What might I need to install Nature's Head...

... for My Tiny House installation?

If you are using 110 volt house power, you will need our Power Transformer (AC Adapter). If using 12 volt, batteries and or solar, the toilet comes with the necessary parts. Our PVC vent assembly is an easy way to vent through the wall or floor.

... for My RV installation?

The toilet comes with the 12 volt parts needed. You will need our Power Transformer (AC Adapter) to plug into an outlet to power the fan ONLY if using 110 house power. The mushroom vent is an easy way to vent through the side or roof. The PVC vent is good for through the floor venting. You may already have an existing vent to connect to.

... for My Tiny House or Cabin installation?

The toilet comes with everything for a 12 volt system. If using 110, house power you will need our Power Transformer (AC Adapter) to plug into an outlet to power the fan. The PVC vent is a good way to vent through the wall or the floor on a raised cabin.

... for My Boat installation?

The toilet comes with the 12 volt parts needed. The venting, you can use the mushroom vent for cabin side or roof. It can also be used over an old pump out fitting hole.



INSTALLATION, continued

Hose Length

Some installations may require increased hose lengths which may be purchased on a per foot basis. PVC pipe, available at most home improvement or hardware stores, may also be substituted for longer hose sections.

Floor Construction

For floor construction other than wood, a different type of mounting bolt may be required. If the installation is on concrete floor, many customers have found it convenient to mount the toilet to a section of plywood rather than trying to drill masonry. The plywood can be placed on the concrete floor and painted or varnished for appearance.

Electrical Requirements

If regular household current is available (110 volts), the head can be powered by a 12 volt Power Transformer (AC Adapter). These may be purchased from Nature's Head, Inc.

Composting Medium

Some type of composting medium is required.

Sphagnum Peat Moss: The most commonly used material is sphagnum peat moss (organic) which is available at most garden stores or home improvement stores. It is usually available in a shrink-wrapped 3 ft cubic bale for \$8 to \$10. This quantity of sphagnum peat moss should sustain use of the head for a year or longer. The sphagnum peat moss should be organic, no additives. **DO NOT** use MIRACLE-GRO peat moss, as it is enriched with plant food.



Example

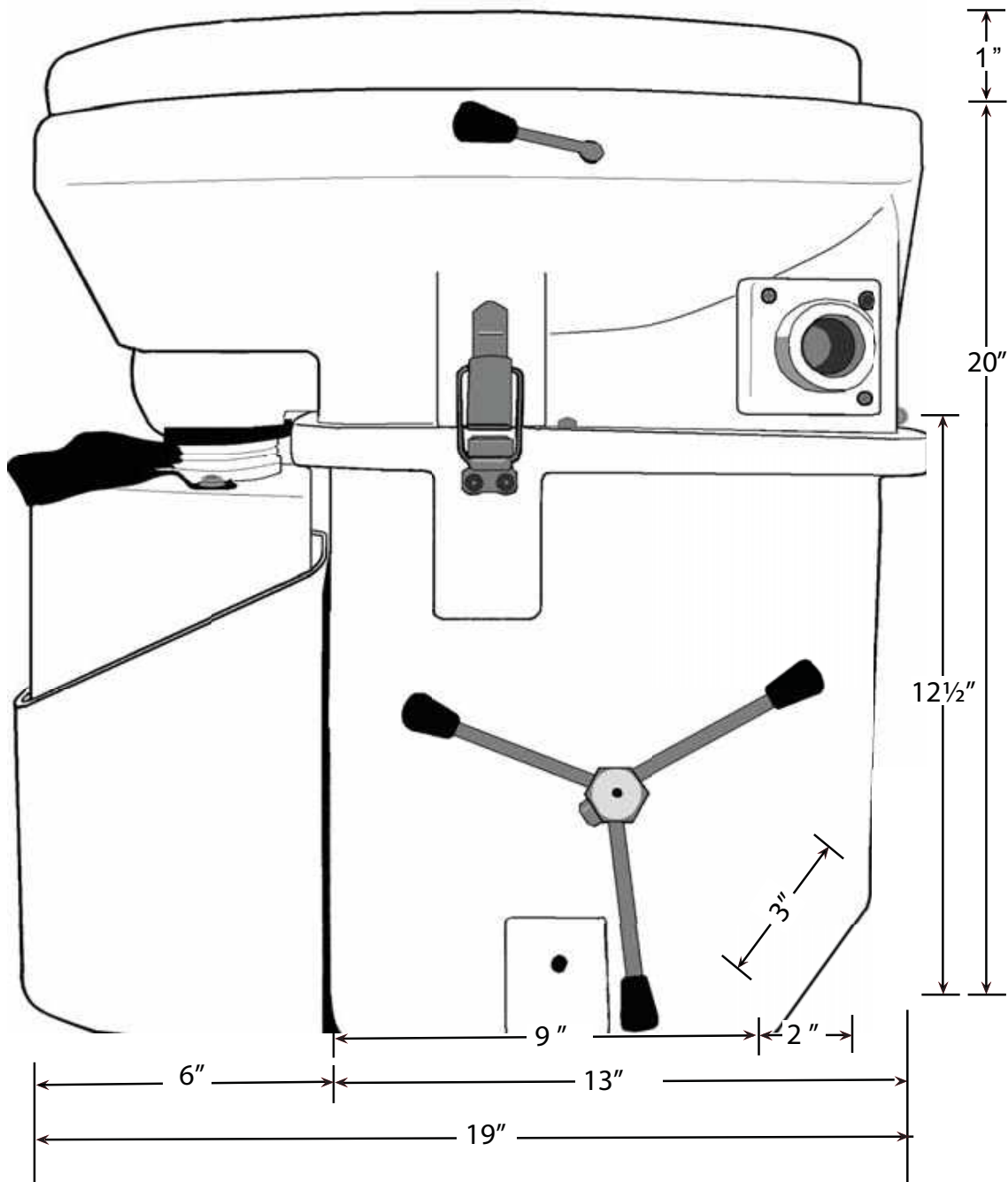


Example

Coconut Coir: Coconut fiber (also referred to as coir brick) is also an acceptable composting medium. However, it is more costly and less readily available. It may be obtained at hydroponic gardening outlets or online. The bricks on the left weigh 250 grams (a bit more than 1/2 pound each). Coir bricks can be placed in a plastic bag: add 5 measuring cups of water per brick and let sit for 12 hours. This brick will expand to just a little more than 2 1/2 gallons.



INSTALLATION: Dimensions



Note:

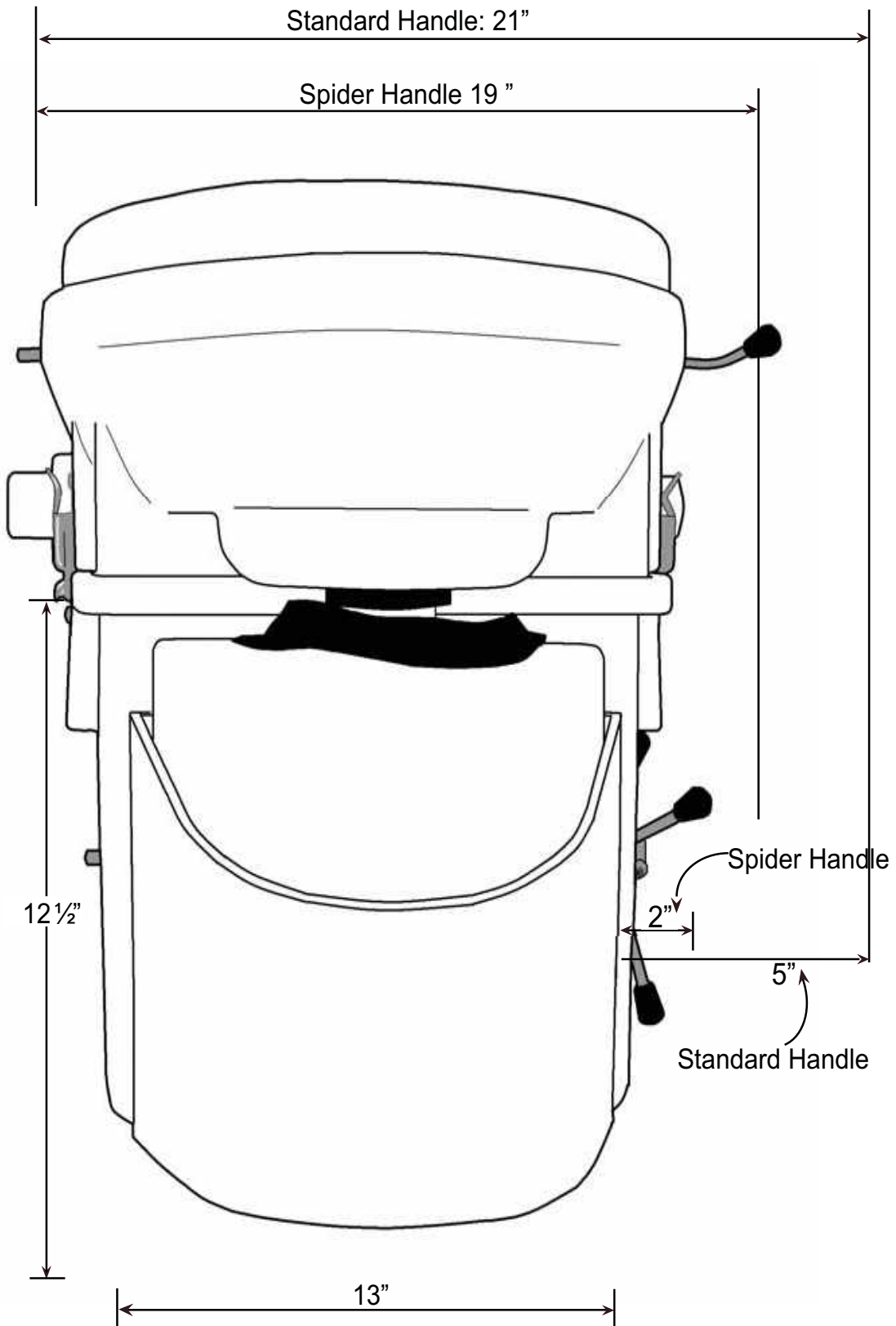
Dimensions can vary up to 4% due to the rotational moulding of polyethylene plastic.

Please note as stated in our instructions the following.

- Allow approximately 1.5 inches behind toilet if against a bulkhead or wall for the bowl to tilt for servicing.
- To disengage the bowl from the base, face the toilet. The bowl slides to the left 2 inches to disconnect from the slip hinge
- Handle and agitator, as well as the fan housing, can be switched to either side.



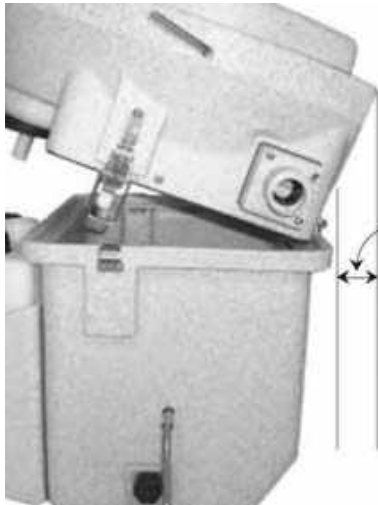
INSTALLATION: Dimensions





INSTALLATION: Location

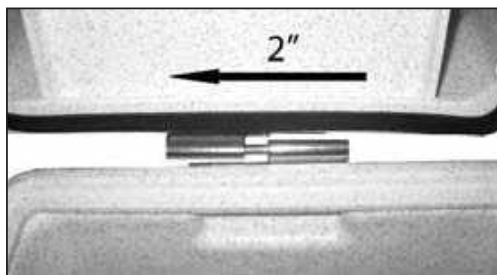
When selecting the location for your new Nature's Head®, be certain to allow enough space behind and on both sides for the toilet to function and be serviced.



Be sure that the lid will open fully. You must also be certain that the bowl has enough room to tilt rearward to allow for its removal and for the removal of the liquid tank.

If mounted against a wall or bulkhead, allow a minimum of 1½ inches between the toilet and the wall.

It is necessary to allow adequate room for the hose connection and agitator handle. Both of these may be relocated to the opposite side of the unit if needed. In some space-restricted areas it may be necessary to offset the toilet to one side or even turn the toilet slightly to one side to allow for extra clearance.



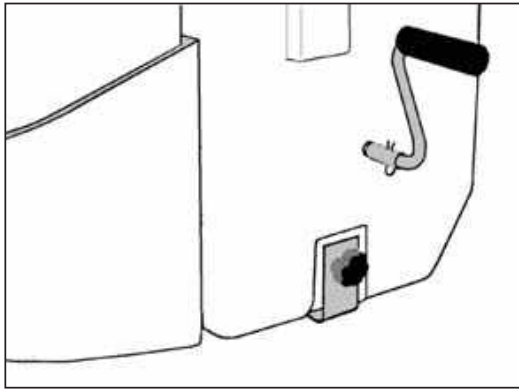
With the standard handle attached, the width of the unit is 21 inches.

For more confined spaces, the optional spider handle decreases the width to 17 ¾ inches. Two inches, to the left side of the head (as you face it), is required to slide the bowl off the slip hinge for servicing the base.

In severely confined spaces, removing the mounting knobs and sliding the toilet away from the mounting location may be a more desirable method of servicing the unit.



INSTALLATION: Mounting



It is necessary to secure your toilet to the floor using the two L-brackets.

The normal mounting is to position the L-brackets under the base in the recesses in the toilet, as shown on the left. Counter sunk mounting screws are included for installing to a wood floor.

To mount the L-brackets to the floor, position the base of the toilet in the previously selected location. Attach the L-brackets to the toilet with the knobs provided. If you choose to mount the L-brackets facing out (not under the toilet) simply mark the holes of the brackets on the floor with a pencil for drill locations. If you choose to mount them under the toilet, carefully trace around as much of the outline of the bracket as possible. Measure the distance between the bracket and the lines you drew.

Now remove the brackets from the toilet and move the toilet out of the way. Carefully position the L-brackets inside of the lines that you drew and mark the holes for drilling. Before drilling any holes in your floor or walls, be sure you know what is behind them! The holes in the brackets are for #12 countersunk bolts or screws. If you are using the screws provided you will need to drill a 1/8 inch pilot hole in the drill marks you made on the floor.

If you are uncertain if your brackets are positioned correctly, drill and mount just one bracket. Then reposition the toilet and mount to the one attached bracket. Check the positioning of your other bracket and marks. If all looks good, proceed with drilling and mounting the other bracket. If your markings are off, adjust your lines and proceed with mounting the second bracket. If mounting the toilet to a floor that will get wet frequently, a small amount of sealant should be placed in the holes before installing your screws. Attach your toilet and check to be sure everything works and fits as you intended.

Do not over tighten the hold down knobs as you will damage the threads in the base!



INSTALLATION: Venting

The unit must be vented to the outside of your cabin whether it is a boat, RV, truck, or vacation property. This helps keep your bathroom smelling fresh, and allows for proper growth of beneficial bacteria which facilitates the composting process.

Installing the venting system will be the most difficult portion of the installation. The average do-it-yourselfer should be able to easily accomplish this if one is familiar with and has the proper tools. Depending on the type and placement of your vent, you may be required to cut holes in the wall, ceiling, or the floor. If you are unsure if you are qualified to complete this portion, it may be wise to hire a contractor or handyman to do this for you.



Due to the variety of ventilation choices available, the external vent has not been provided. Mushroom vents, solar vents, and our PVC Vent Assembly Kit are commonly used for venting to the exterior. All of these can be purchased from Nature's Head.

The unit may be vented vertically through the roof, or most common horizontally through the wall, or down through the floor. For installations in homes, cabins, and other permanent structures the venting can be placed horizontally through the wall with our PVC Vent Kit.

This vent flange, included with the toilet, is used beneath a mushroom vent or solar vent and connects directly to the hose.





INSTALLATION: Venting Airflow Assembly



Attaching the Handle

The toilet is shipped with the agitator handle unattached and must be installed before use. The standard handle is attached with a collar and hairpin clip, while the spider handle attaches with an allen set screw and locknut. In the event that the handle must be moved to the opposite site of the base, the agitator must be manually removed, reversed, and reinstalled. A Video showing how to reverse the agitators can be found on NaturesHead.net/Installation

Reversing the Fan and Filter Housing

If installation of the ventilating hose is more favorable on one side of the unit than the other, the fan/filter housing is interchangeable with the filter-only housing. This is accomplished by swapping sides with the components and their respective housings. A Video showing how to reverse the fan and filter housing can be found on NaturesHead.net/Installation.



INSTALLATION: Venting, continued

Attaching a mesh fabric or screen (not provided) over the opening is necessary to prevent the entry of insects into the system. Any mesh fabric such as window screen or nylon netting will provide an adequate insect barrier.



If a sharp 90 degree turn from the fan housing is needed, a 1¼ inch PVC street elbow (not provided) may be used to achieve a proper configuration.

Installations on boats and RV's are easily managed with the stainless steel mushroom vent with the built-in screen and adjustable top which is self-sealing.

In this case, the vent flange provided with the toilet would be placed on the inside wall around the opening to the vent with the flat side to the wall. On many boats, the pump-out fitting can be removed and the mushroom vent mounted over the existing hole. The venting hose provided with the unit will attach directly to the adapter.

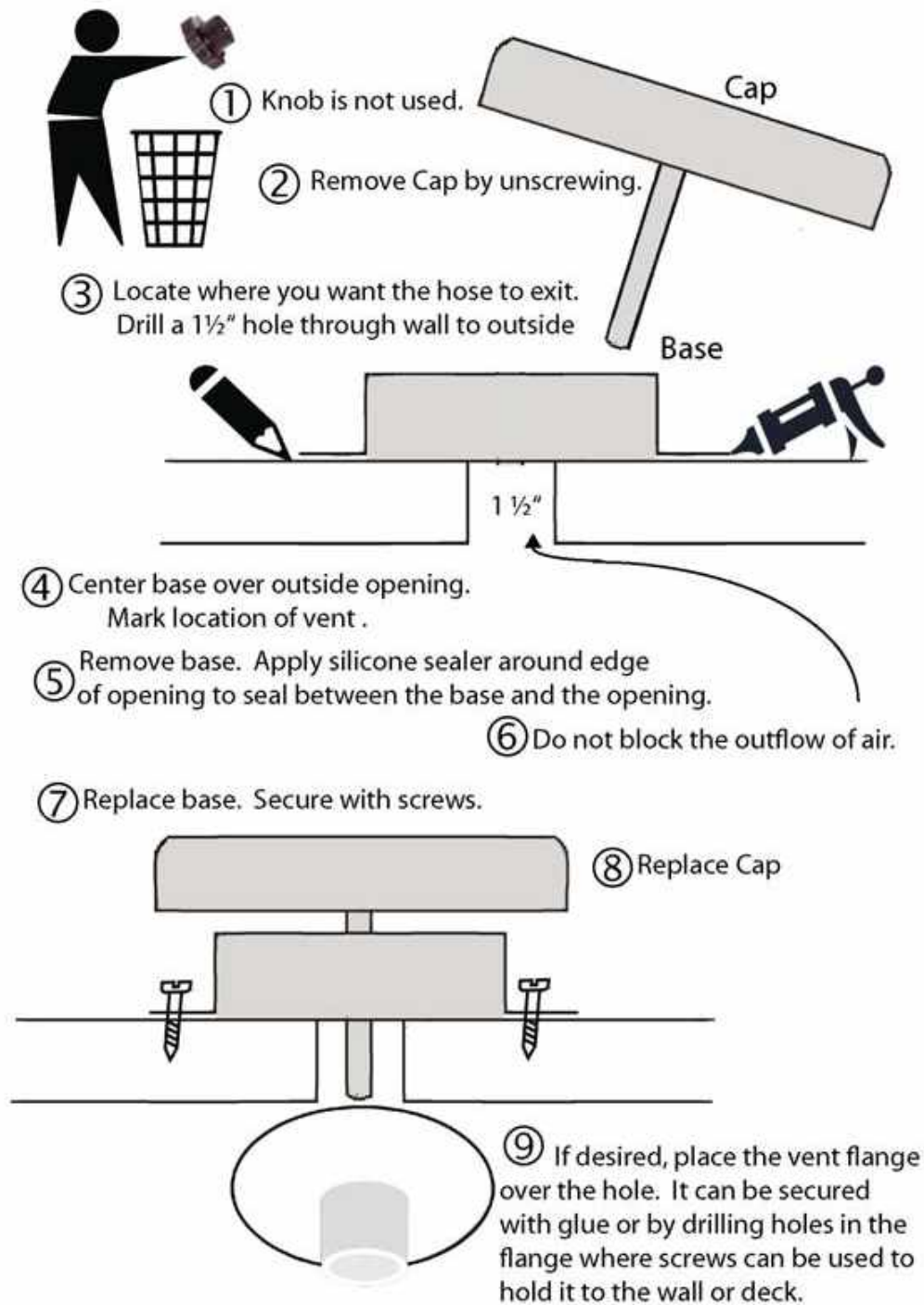
Clamping the hose to the fan housing is not necessary on the connection for the head, and normally not necessary on the exterior connector. With an overhead connection, you may find it necessary to clamp this end depending on the amount of support provided for the vent hose. If the hose is supported properly, you will probably not need a clamp. The vent hose must be attached to the housing which has the fan inside it. The unit is designed to pull fresh air through the head and ventilate it outside. If you disassemble the fan housing, always check to be certain that the fan is blowing out of the vent before re-attaching the vent hose.



INSTALLATION: Venting

NATURE'S HEAD®

Mushroom Vent Installation





INSTALLATION: POWER CONNECTION



As with all electrical connections, be sure your head is on a fused circuit. The fuse should be no less than 2 amps and no more than 5 amps (12V). A fuse holder and fuse are provided for use in a non-protected 12 volt system such as direct attachment to a battery.

The fan may also be powered by a 110 volt source with a Power Transformer (AC Adapter) that reduces the power to 12 volts. If the system is being powered by the 110 volt Power Transformer (AC Adapter) disregard the fuse, fuse holder and single pin cable as they are intended for use ONLY with a 12 volt power source. No fuse is required when using the Power Transformer (AC Adapter).

These Power Transformers (AC Adapter) are available through Nature's Head, Inc.



Assistance

If you are unsure about your wiring system or requirements, consult an electrician.

If you are unsure of a particular step in the installation of your Nature's Head, please check the FAQs for Installation on our website, www.natureshead.net. If you are unable to resolve the issue, send us an email giving your name, phone number, address, distributor name, and a brief description of how we may help.



USING YOUR NATURE'S HEAD

The waterless, urine separating design contributes the extraordinary holding capacity. The composting section holds approximately 60 to 80 uses.

The time frame to empty the solids bin varies with number of people and the time period. The toilet is designed for 1 to 4 people full-time. Generally, two people full-time people's usage will require emptying approximately every 3 weeks; additional people will shorten the time. If using just on weekends with 2 people, that can extend time to 2 months or more. Just a couple of days of non-use extends the period of time. Usually, the level of the compost will not increase; if it does it will be minimal.

The urine bottle holds 2.2 gallons and will require more frequent emptying; two people might need to empty after 3-4 days.

Before use, it is necessary to add compost material to the base of the unit. Gallon size "ZIPLOC®" type bags are an inexpensive manner for storing the medium. To fill your toilet or refill it after emptying, pour two one-gallon bags of pre-moistened sphagnum peat moss or coconut fiber into the base of the toilet. The sphagnum peat moss should rise to the level of, or cover, the agitator bar in a horizontal position.



The sphagnum peat moss should be damp and crumbly, never wet or soupy. If your sphagnum peat moss or coconut fiber is dry, add a small amount of water. When not in use, the lid of the toilet should be in the closed position, preventing the entry of insects and allowing proper ventilation. The peat moss must be regular/organic sphagnum peat moss, no additives. DO NOT use MIRACLE-GRO peat moss.

Do not add additional medium after solids usage. Doing this will result in too much sphagnum peat moss or coconut coir in the unit and will limit your time of usage before emptying.

The primary concept of our composting toilet is the separation of liquids and solid wastes! Be sure to inform your guests as to the proper use of your head. This will allow proper composting action and assist your guests in feeling comfortable with a new piece of equipment.

USAGE, continued

Allowing the overflow of urine into the composting chamber will cause unpleasant odor and prevent proper compost action.

Seated usage is recommended. While seated, the unit may be used with the trap door in the open or closed position. Whether male or female, the user's liquids and solids will be directed to the correct locations from this position. With any bowel movement, the trap door must be open. Male stand-up usage is less acceptable as splatter may result. In the event that the unit is used in a standing position, the trapdoor must remain closed in order to prevent mingling of liquid and solid wastes.

Toilet paper is typically placed in the toilet. Since paper products do not decompose as quickly as solid wastes, they will be visible long after the solid matter has broken down. Any type of toilet paper is acceptable; less substantial brands (such as marine or RV paper) will compost the quickest.

Diapers, wipes and tampons should not be placed in the solids bin. Many brands of these items are made from a mix of rayon and non-organic cotton, and are commonly chlorine-bleached. These will not decompose.

Most users keep a small spray bottle (included) filled with a mixture of water and 2 oz of white vinegar nearby to spray off the bowl in the event that some solid waste adheres to the bowl. Spritzing of the bowl also assists in cleansing the urine passages.

All urine has an odor. It will not be noticed with normal use. It will be present when the storage container is open to the air for emptying. For persistent urine odors in the container, add a few ounces of white vinegar, and/or a few drops of Dawn dishwashing soap to reduce this odor.

After solid waste addition, the sphagnum peat moss or coconut fiber must be agitated 2-3 revolutions slowly in order to mix the waste into the compost and promote the composting process. Contents of the solid waste container must be kept moist, not wet, and remain separated from the liquid waste.



USAGE, continued

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USAGE, continued

When the toilet is functioning correctly, the composted matter will have a musty or soil-like odor and the visual appearance will be very similar to that of the original sphagnum peat moss. It is not normal for the compost to be wet or for there to be odor problems

If the compost is staying wet and you have odor problems, the solids tank is becoming contaminated with urine and steps must be taken to prevent this. If this persists, and you are unable to determine how it is becoming contaminated, please contact us for help.

Vomiting and diarrhea, if not persistent, are unlikely to affect the head function. If increased wetness of the compost results, the situation may be corrected with the addition of a small amount of dry compost medium.

USAGE: Emptying

The liquid waste vessel will contain approximately 2.2 gallons of urine. The translucent material of the container allows easy visualization of the liquid level.

To empty the liquid waste container:

- 1) Release the latches located at both front sides of the unit which secure the bowl to the base,
- 2) Raise the bowl to an angle of approximately 45 degrees, install the cap, and remove the bottle,
- 3) Dispose of the



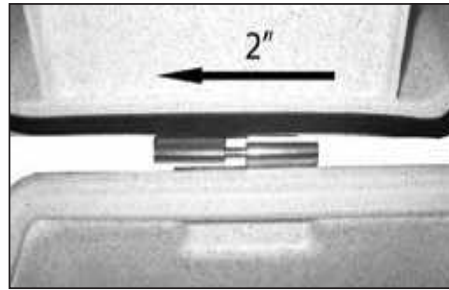
contents in an appropriate manner. The urine bottle may be emptied into a conventional toilet or other appropriate facility. Many books and articles have been written on the benefits of using diluted urine as a fertilizer. This may also be part of your environmental plan for disposing of wastes in a cabin situation.

Should overflow of the liquid waste container occur, the liquid will remain confined to the container base so long as the overflow is not excessive. The liquid tank should be emptied frequently and rinsed with water with detergent or vinegar added. Allowing urine to remain in the storage container for extended periods is unwise as this will result in increased odor production. If the toilet is used in combined bathroom/shower, you may wish to drill a drain hole in the urine tank holder if water accumulation becomes a problem.



USAGE: Emptying

With the bottle assembly removed, lift the seat unit several inches and slide it to the left to disengage the slip hinge. (You may need to unhook your vent hose and power supply if it is necessary to move the bowl to the side.) Remove the knobs from the mounting brackets at each side of the base and the base is now ready to empty.



One of the simplest methods to empty is to place a 13 gallon kitchen bag over the opening of the base (NOTE: the bag does NOT go in the base.) The bag should fit tightly over the rim and allow you to invert the base and empty the contents into the bag without spillage. This is especially useful when the toilet is used for boats and other mobile units, as removing the toilet is unnecessary.

It is unnecessary to clean the interior of the solid waste container as composting will continue from the residual matter clinging to the sides.

Cleaning the base unit, especially with any chemicals, may inhibit its ability to generate the good bacteria that is breaking down the solid wastes. Simply empty, put in more sphagnum peat moss, and re-assemble your toilet.

It is best you do not leave the liquid wastes in the tank for extended periods. While everyone is different, some urine will smell bad if allowed to sit for extended periods.



USAGE: Disposal

The recommended procedure for disposing of the contents of the solid waste tank is placing it in a proper composting bin to allow it to fully decompose. When traveling in a boat or RV, this may not be practical. The contents of the solid waste tank may be safely placed into a conventional dumpster if it has been allowed to compost fully. When fully composted, the solid wastes may be used to fertilize non-ingestible plantings. Placing human waste compost on edible plants or vegetables is not recommended.

Full-time users have some special circumstances to deal with. Full-time use does not allow enough time for the solid wastes to compost. The most recent waste, although mixed with the already composted material, will not be decomposed. This also means that the fecal bacteria (present in fresh human wastes) may still be present. We recommend taking precautions such as the use of gloves if you may come into contact with waste material. It is advisable that you delay emptying the solid waste for 6-8 hours after the last use.

Another method for dealing with non-composted wastes (if space allows) is to purchase the “extra base” option and swap out the bases. The extra base comes complete with all the necessary hardware, agitator, and bottle holder. It also comes with a vented lid so the contents can be set aside and allowed to compost. A storage bin utilizing the trash bag method of emptying, placing the bag into a small plastic bucket, ventilating the lid, then allow it to finish composting may be constructed. In a cabin setting, contents could be emptied into a traditional compost bin and allowed to finish there. Solids that have not fully composted for at least a year are not suitable for use on ingestible plants.



CLEANSING & MAINTENANCE

A quick spray of water and white vinegar or a natural cleaner from the squirt bottle (included) is all that is needed to keep your NH fresh between uses. If necessary, a moistened paper towel (no synthetics) is excellent for cleansing the interior (as well as the exterior) of the head.

For more intensive cleansing or dried-on matter, a paper towel moistened with a 1:1 solution of vinegar and water may be used, and disposed of, in the same manner, after cleaning. Bleach, ammonia, and other commercial cleaning compounds should never be added to your composting head as they will interfere with the composting process and may lead to unpleasant odors. These cleaners maybe used to clean the exterior surfaces.

Maintenance requirements for the head are very minimal. All metal parts (bolts, hinges, latches, knobs, agitator, and trapdoor components) are either stainless steel or brass. Filters on each side of the base should be removed and cleaned yearly or when emptying the solid wastes. Each filter is secured to the housing with 2 Phillips-head bolts. Remove the bolts, clean and replace. Caution should be taken so that the fan is reinstalled with the airflow exiting the unit.

The full-size molded-in seat of the head is designed for safety and comfort and requires no special care.

CUSTOMER SERVICE

We are committed to providing our customers with outstanding service. If you need assistance please email us, giving us your name, address, telephone number. Approximate date of purchase and name of distributor would be helpful.

Contact Us.

Email: Sales@NaturesHead.net

Phone: 251-295-3043

We periodically send newsletters to our customers and friends in order to share ideas and solutions suggested by our customers, to alert you to new developments and to provide other relevant information. If you have never received one of our newsletters, we invite you to sign up by clicking the link in the footer of our webpage: www.natureshead.net



TROUBLESHOOTING

Find more troubleshooting and FAQ information online at natureshead.net/installation_use. Or email us at sales@natureshead.net.

Fan not working. If using 12 volt battery, check for voltage. Be sure the wire marked positive is attached to the positive from the battery. Check the fuse. Check to see if the single pin hookup is making contact. If using the 110 to the 12v Power Transformer (AC Adapter), check voltage at the outlet. Verify the single pin connection. Try unplugging and reconnecting. When the fan is running, make sure the fan is blowing outward. If the fan is still not working, contact Nature's Head or your distributor for a free replacement.

Compost seems too wet. If too wet due to prolonged diarrhea, add a small amount of sphagnum peat moss. If wet due to excessive condensation, also add a little sphagnum peat moss. Make sure excessive wetness is not due to someone urinating directly into the compost section. This can also contribute to an unpleasant odor. The compost area should have only a musty smell. If a sewage odor is present, please contact Nature's Head for consultation.

Compost seems too dry. If the compost is dry or hard, add some water and turn the agitator after the sphagnum peat moss has absorbed the moisture.

Cold Conditions. Composting works from 55 degrees and warmer. The warmer it is, the faster it composts. When the temperature drops to freezing, the compost will be dormant until heat is introduced to the area.

Fruit flies or gnats. If your toilet incurs flies or gnats, add five cups of natural Diatomaceous Earth to the compost. This can be purchased at swimming pool supply stores or hardware stores. You may also want to try Gnatrol, following packaging directions. If neither of these work, please call us.

Agitator handle turns with difficulty. If the compost gets dry, the handle may not turn easily. Adding used coffee grounds results in added moisture and keeps the compost loose so that it mixes better.

FAQs

We update our Frequently Asked Questions regularly on our website. Please visit NaturesHead.net/faq where you will find many tips, suggestions and solutions that will be helpful to you.



OPTIONS

For enhanced capacity and convenience, consider these options for your NATURE'S HEAD® Composting Toilet. All items are available for purchase on our website www.NaturesHead.net, from our distributors, or by phone at 251-295-3043.

EXTENDED CAPACITY

Extra Liquids Bottle

Bottle with cap.



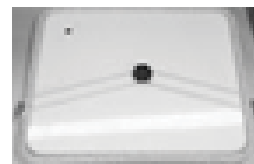
Extra Base, with Lid

Complete with lids for storage allow for further composting and to extend the use of the unit. Bases have the agitator and hinge pre-installed for rapid change out. Handle is included.



Lid for Solids Bin

Vented lid for use when transporting solids bin is necessary.



Power Transformer (AC Adapter)

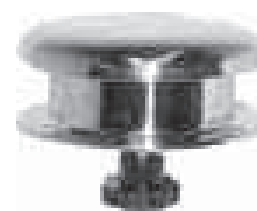
Optional 110 V adapter, used only when using 110V (house) power.



VENTS

Mushroom Ventilator

Polished 304 sheet stainless steel with a screw down knob to open and close the vent. Includes a stainless steel mesh mosquito screen.



PVC Vent Assembly for Structures

Screened vent assembly for through-the-wall installation in structures such as cabins, homes, workshops, barns. Fits 1 5/8 inch opening. 16" connector pipe can be shortened as required. Can be installed horizontally or vertically. Vent hose snugly fits end of connector pipe.





Nature's Head® Composting Toilet

LIMITED WARRANTY

This NATURE'S HEAD® composting toilet and its components are warranted against defects in materials and workmanship for five (5) years from the initial purchase date. During this period any NATURE'S HEAD® toilet, after inspection by Nature's Head, Inc., if deemed defective will be repaired or replaced without cost to the customer.

This warranty extends to the original purchaser only and is non-transferable. Only consumers who purchased the NATURE'S HEAD® toilet from Nature's Head, Inc., or an authorized dealer, and who install, operate, and maintain the toilet in conformance with the instructions in this manual may obtain coverage under this Limited Warranty.

This Warranty does not apply to any problem caused by any condition, malfunction, or damage: (1) caused by defects other than defects in material or workmanship; (2) resulting from normal wear and tear, improper installation, improper maintenance or repair, misuse, abuse, negligence, accident, alteration of a part or the product, or any external cause; or (3) to any accessories, materials, products, or parts not manufactured or supplied by Nature's Head, Inc.

Nature's Head, Inc. makes no other warranty, either express or implied, including but not limited to implied warranties of merchantability, fitness for a particular purpose, or conformity to any representation or description, with respect to the NATURE'S HEAD® product or any of its parts or accessories, other than as expressly set forth in this Warranty. Nature's Head, Inc. makes no warranty or representation, either express or implied, with respect to any other manufacturer's product or documentation, its quality, performance, merchantability, fitness for a particular purpose, or conformity to any representation or description. To the extent permitted by law, this warranty and remedies set forth below are exclusive and in lieu of all others, oral or written, expressed or implied. No dealer, distributor, reseller, agent or employee is authorized to make any modification, extension or addition to this Warranty. Some states do not allow the exclusion or limitation of incidental or consequential damages. If such exclusions or limitations are prohibited under the applicable law, the above limitation or exclusion may not apply. This Warranty gives you specific legal rights and you may have other rights, which vary from state to state.

LIMITATION OF LIABILITY

EXCEPT AS PROVIDED IN THIS WARRANTY AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, NATURE'S HEAD INC. IS NOT RESPONSIBLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO DAMAGES TO PERSONAL OR REAL PROPERTY, RESULTING FROM ANY BREACH OF WARRANTY OR CONDITION, OR UNDER ANY OTHER LEGAL THEORY, INCLUDING BUT NOT LIMITED TO LOSS OF USE. THE FOREGOING LIMITATION SHALL NOT APPLY TO DEATH OR PERSONAL INJURY CLAIMS, OR ANY STATUTORY LIABILITY FOR INTENTIONAL AND GROSS NEGLIGENT ACTS AND/OR OMISSIONS.

Warranty claims should be addressed to Nature's Head, Inc. PO Box 250, Van Buren, OH, 45889 or by E-mail to Sales@NaturesHead.net. Include a copy of the sales receipt or other evidence of the date and place of purchase of the toilet and a description of the problem.

NATURE'S HEAD® is a registered trademark of Nature's Head, Inc. All other marks are the property of their respective owners.



SAVING OUR WATER FOR TOMORROW



NATURE'S HEAD, INC.

PO Box 250

Van Buren, OH 45889

251-295-3043

www.NaturesHead.net

LAGUN TABLE LEG



PARTS INCLUDED	INSTALLATION INSTRUCTIONS
<ul style="list-style-type: none"> Tabletop Mounting Plate Arm (Horizontal piece) Leg (Vertical piece) Mounting Bracket Plate Hardware Kit (1-Teak Board/2 Wedges/ 4 ea. SS Bolts, washers & nuts) 	<ul style="list-style-type: none"> Choose a solid vertical surface to install the mounting bracket plate. NOTE: Make sure there is enough clearance to be able to adjust the leg up and down. Some RV dinette cushions stick out, so you may need to use the provided hardware kit to be able to clear them. Use the supplied teak board and/or shims to make the mounting bracket is straight. Use the enclosed bolts to bolt the mounting plate to your solid vertical surface. If the bolts due not work for your application, you can use a 5/16" tapered screws to attach the mounting plate. NOTE: Make sure the screws or bolts you choose to use will not protrude into or through something before drilling or screwing out the plate. Flip your tabletop upside down and install the tabletop mounting plate to your tabletop. NOTE: Make sure that the screws you use are shorter than your tabletop thickness, so you don't go through the tabletop. Install the arm to your tabletop mounting plate by sliding it over the splined piece. (You may have to move it back and forth to slide it on the splined piece) NOTE: Make sure the splined piece from the tabletop mounting plate is inserted completely, so it is flush with the bushing on the arm. Install the splined piece of the leg into the bushing on the other end of the arm. (You may have to move it back and forth to slide it on the splined piece) NOTE: Make sure the splined piece from the leg is inserted completely, so it is flush with the bushing on the arm. Once it is all assembled, lock all the handles and flip it upright. Make sure the bottom handle on the leg is untightened and slide the leg on the mounting bracket plate and tighten handle.
TOOLS NEEDED	
<ul style="list-style-type: none"> 12V Power Drill Gun 1/4" Drill Bit Phillip Drive Bit 6 Screws for Tabletop Mounting Plate (Not Provided) <p style="margin-left: 40px;">NOTE: Must be shorter than your tabletop thickness</p>	
OPERATING INSTRUCTIONS	
<p><u>TOP LEFT HAND HANDLE</u></p> <ul style="list-style-type: none"> Releases the tabletop to swivel 360 degrees <p><u>TOP RIGHT HAND HANDLE</u></p> <ul style="list-style-type: none"> Releases the complete system to swivel 360 degrees <p><u>BOTTOM HANDLE</u></p> <ul style="list-style-type: none"> Releases the vertical height adjustment Be careful when releasing as gravity will pull it down <p><u>ALL HANDLES:</u></p> <ul style="list-style-type: none"> ALL Handles <u>Untighten</u> counterclockwise ALL Handles <u>Tighten</u> clockwise Pushing the button on the handle in allows you to reposition the handle and continue to tighten it. 	

- **THE LAGUN TABLE LEG CAN SUPPORT 50 LBS OF WEIGHT INCLUDING YOUR TABLETOP**
- **1 YEAR WARRANTY FROM MANUFACTURER DEFECTS**
- **MODIFICATIONS TO THE LAGUN TABLE LEG VOIDS YOUR WARRANTY**



Part Number: 74-505



Lithionics Battery®

12V130A-G31-LRBM8 User Guide

NeverDie® Compact Series 100 Internal BMS



RB

NEVERDIE®
LITHIUM-ELECTRONICS - LITHIONICS BATTERY

MiniBMS®
TECHNOLOGY



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Safety

- All electrical work should be performed in accordance with local and national electrical codes.
- Assume that voltage is present at the battery terminals, use insulated tools and gloves while working on the system.
- Always turn off equipment connected to the battery in addition to turning OFF the Power switch on the battery to isolate it from other electrical circuits, before performing any repairs or maintenance on the system.
- Always use proper wire sizes to connect the system to inverters, chargers or other equipment.
- Always use crimped connections to connect to the battery terminals.
- Read and follow the inverter, charger or other equipment manufacturers safety precautions prior to connecting the battery to that equipment.
- Always use charging equipment compatible with Lithium Iron Phosphate battery chemistry. See battery charging section below.

Overview

The 12V130A-G31-LRBM8 battery is a lithium-ion iron phosphate (LiFePO4) chemistry battery with an internal Battery Management System (BMS) technology called *NeverDie® Compact BMS*. The BMS monitors voltage, current and temperature of the cells inside the battery and protects the battery from potential damage by disconnecting the battery circuit when the monitored parameters go outside of the allowed limits. The BMS also transmits monitoring data over the integrated Bluetooth interface, allowing customers to check the battery data on their mobile phones or tablets.



Battery Installation

Before installation, check the battery for visible damage including cracks, dents, deformation and other visible abnormalities. The top surface of the battery and terminal connections should be clean, free of dirt and corrosion, and dry.

Battery power should be turned off prior to the installation and for storage. Check the LED integrated into the Power button to make sure it is completely off. If the LED is on or blinking, press and hold the Power button for 3 seconds until LED turns off.

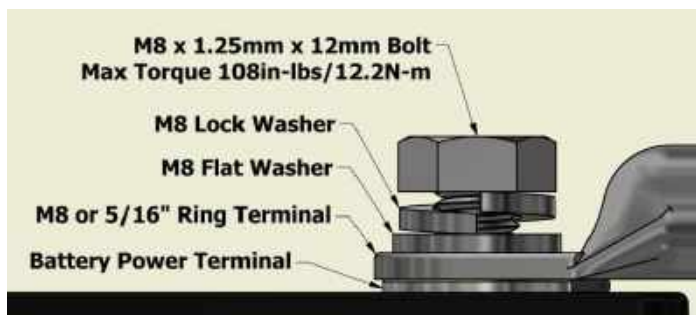
Lithium batteries do not release gas during normal use. There are no specific ventilation requirements for battery installation, although enough airflow should be provided to prevent excessive heat build-up.

The battery should be stored and installed in a clean, cool and dry place, keeping water, oil, and dirt away from the battery. If any of these materials can accumulate on the top surface of the battery, current leakage can occur, resulting in self-discharge and possible short circuits.

The orientation of the battery must be with the terminals facing up as shown. Sideways, and upside-down orientations are not permitted and will void the warranty.



The battery is equipped with two flat threaded terminals designed for a 5/16" or M8 size ring terminal lugs secured by the included M8 bolts, flat washers and lock washers. When using flat washers and lock washers, it is critical to place the ring terminal lug in direct contact with the top surface of the power terminal first 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.

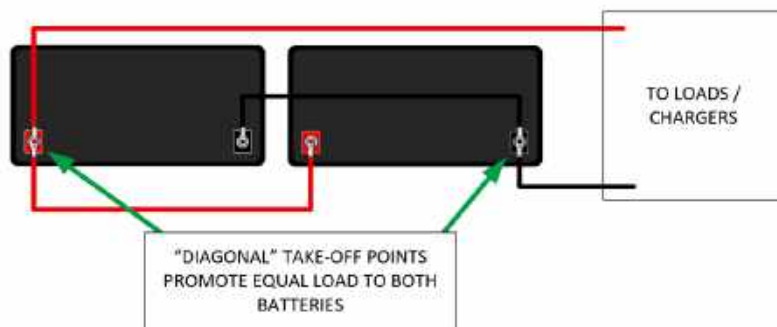


CAUTION: Do NOT place any washers between the battery power terminal and the ring terminal lug, as this could create a high resistance path and cause excessive heating of the connection which could then lead to permanent battery damage and/or fire.

If you must attach more than one lug to each terminal, ensure that at least 1/4" or 6mm of bolt 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 stainless bolts as necessary.

Tighten both M8 power terminal bolts to 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.



For parallel battery connecting, the use of bus bars or diagonal take-off points is required.

CAUTION: Improper terminal connection or lug stacking may cause battery damage that is not covered under warranty.



The battery cables should be sized to handle the expected load. Refer to NEC Table 310.15(B)16 for the maximum amperage based on the cable gauge size. Cable lengths more than 6 feet may require heavier gauge wire to avoid unacceptable voltage drop. When connecting multiple batteries in parallel to make larger battery banks, it is preferable for all parallel cables to be the same length.

For more information refer to the National Electrical Code for correct cable size, which can be located at www.nfpa.org

The battery circuit must be properly fused to handle the expected load and not to exceed the battery specifications.

After installation is complete, turn on the battery power by a short-press of the Power button. The LED indicator will illuminate to confirm the battery's powered on state.

DO NOT connect multiple batteries in series to get higher voltage as it will damage the internal BMS.

DO NOT attempt to disassemble the battery, as it could lead to permanent battery damage and will void your battery warranty.

First Power-up

The battery needs to be fully charged to 14.4V to condition the battery for use. Fully charging the battery calibrates the state-of-charge percentage to be the most accurate and allows the cells to balance if necessary. The battery should be fully charged to 14.4V at least once every 2 weeks.

Operation

Before powering on, ensure the battery terminals are insulated and any connected devices are properly fused.

Due to shipping laws and regulations, your battery may be received at a partial state-of-charge (typically 50%). The battery needs to be fully charged before use. This is necessary to calibrate the state-of-charge meter.

Powering the Battery On The power button is located on the battery lid and/or on the remote accessory harness extension. To turn the battery on, press the power button for one second. The power button status light will illuminate solid on to confirm the battery is powered on and operating normally.

Powering the Battery Off Be sure to shut down any high amperage loads prior to turning the battery off. To turn the battery off, press and hold the power button for 3 seconds. The power button status light will turn off to confirm that battery power is off.

Resetting Power after a Protection Event If the battery detects a fault then it may turn power off. The battery can then be reset by pressing the power button for one second.

Discharging Discharging may be performed at any time the system is powered On. The NeverDie[®] feature allows the system to have a "reserve" amount of energy left in the battery. Once the system is discharged to approximately 12.0V or 10% state-of-charge, whichever comes first, power will be off to leave a "reserve" amount of energy still left in the battery. The battery will also disconnect power if the voltage, amperage, or temperature limits are exceeded during discharging. To enable the remaining reserve energy of the system, press the BMS power button for 1 second. Once the reserve range is enabled the battery should be charged as soon as possible. See page 9 BMS Functions for further details.

WARNING - If the reserve energy is used and the battery module is left in a deeply discharged state without immediate charging, the battery module may become permanently damaged.

Battery Charging

The charging device(s) connected to the Lithium Battery System must be programmed per the recommended charge settings below. Using an improper charger or charge settings could result in undesirable battery performance and accelerated wear. The battery will disconnect power if the voltage, amperage, or temperature limits are exceeded during charging. Please note that voltage rise during bulk charge stage is very slow, followed by a fast voltage rise at the end of charge. Once charge is completed, the voltage drops down to a resting level. This behavior is normal and should not cause any concerns.

Recommended Charge Settings	
Recommended Bulk Charging Voltage	14.4V
Recommended Absorb Charging Voltage	14.4V
Recommended Absorb Cycle Time	30 Minutes
Maximum Absorb Cycle Time	60 Minutes
Recommend Float Voltage	13.4V
Maximum Float Voltage	13.6V
Equalization Mode	Disabled
Temperature Compensation	Disabled

A lithium iron phosphate (described as LFP or LiFePO4) charger or charging profile is required for battery charging. The battery charge voltage should be set to 14.4V, equalization and temperature compensation must be disabled, and if the charger supports float mode, set it to 13.4 - 13.6V. If you are not sure if your charger is suitable for charging your battery, contact Lithionics Battery® or your dealer to confirm charger compatibility, or to purchase compatible charger.



NOTE: Due to partial state-of-charge during storage and shipping, the cells inside the battery may not be perfectly balanced during the first few charge cycles. You may observe some high voltage alerts and cell balancing status codes on the Lithionics Battery® Monitor app, which indicate the balancing process is in progress. This is perfectly normal behavior and should not cause any concerns. After a few full charge cycles the cells will balance out and these alerts will disappear. There is no adverse effect on battery operation, you may continue to use the battery normally during these initial charge cycles.

Screen shots on the left show examples of status codes related to cell balancing.

Power Button with Status Light



The BMS power button is located on the battery lid and includes a status light. You can also attach the optional remote power button (Lithionics Part # 75-224-196) via the panel mount connector. This can be useful if the battery is installed in a location that is not easily accessible. The function and operation of the remote power button remains the same as the main power button on the battery.

Power Button Operation	
Power ON	Press for 1 Second
Power OFF	Press for 3 Seconds
Power Reset	Press for 1 Second (after protection event)

Refer to the table below for an explanation of the power button status light blink patterns.

Battery State	Status Light	Status Light pattern over time
Powered On	Solid ON	
Powered Off	Solid OFF	
Charging	Slow blink	
Low Battery	Short blink	
Fault Alarm	Rapid blink	

< 1 second >
 < 1 second >
 < 1 second >
 < 1 second >

Maintenance and Storage

Maintenance For optimal performance when in use, the battery should be fully charged to 14.4V at least once every 2 weeks. Fully charging the battery calibrates the state-of-charge percentage to be the most accurate and allows the cells to balance if necessary.

Storage Storing your battery at the correct specifications is important as it keeps the battery in the healthiest state possible. Consult the table below for proper storage conditions.

Storage Temperature & Humidity Range	< 1 Month	-4~95°F (-20~35°C), 45~75%RH
	< 3 Months	14~86°F (-10~30°C), 45~75%RH
Long Term Storage	If the battery needs to be stored for > 3 months the voltage should be 13.2V (50% state-of-charge) and stored at the recommended storage specifications shown above. Additionally, the battery needs at least one charge & discharge cycle every six months.	
Self-Discharge Rate	≤3% per month	

Typical storage example < 1 month:

1. Fully charge the battery.
2. Turn the battery **OFF** using the battery power button.
3. Keep the battery in an environment according to the specifications shown above.

Typical storage example > 1 month, up to 6 months maximum:

1. Reduce the battery state-of-charge to 13.2V which is 50% ±10% state-of-charge.
2. Turn the battery **OFF** via the BMS power button.
3. Keep the battery in an environment according to the specifications shown above.
4. Every 6 months charge the battery to 100% state-of-charge, then discharge the battery to LVC, then charge it back to 50% ±10% state-of-charge.



Bluetooth App

Lithionics Battery® has developed the **Lithionics Battery® Monitor** app for iOS and Android mobile platforms, which allows real time battery information. The battery must be turned on via the Power button before the Bluetooth connection can be made. When the battery is turned off, Bluetooth is also powered off to save energy. This app can be downloaded for free on the Apple App Store or the Google Play Store for your iOS 12.4+ or Android 5.0+ device.



To connect Bluetooth:

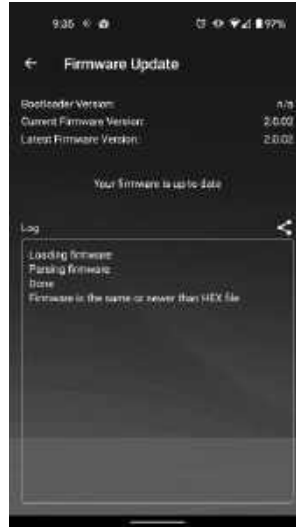
- 1) The battery must be in the ON position.
- 2) Bluetooth must be enabled on your device.
- 3) Open the Lithionics Battery® Monitor App and accept location permissions.
- 4) Under the Device List, select the battery you would like to monitor (the device name is identified by the battery serial number).

Once the Bluetooth connection is made to the battery, the **Battery Info** section of the app automatically displays. This section provides useful info such as the battery state-of-charge percentage, voltage, current, power, internal cell temperature, BMS temperature, power state and estimated time remaining. Clicking on the Status Code at the bottom automatically opens the Status Code reader section.



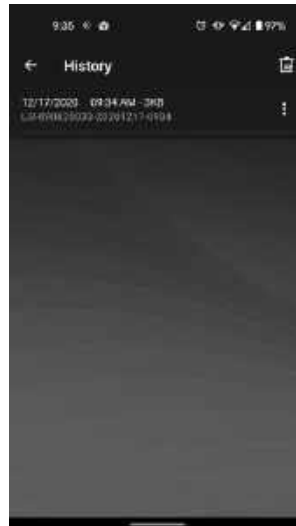
The **Status Code Reader** section of the app makes it easy to visualize the status by observing the color-coded table, see example to the left.

Each active description is color coded in green or red, where green indicates information and red indicates faults or critical conditions requiring attention, such as immediate need to charge the battery.



The Bluetooth app can also be used to access the **Firmware Update** section of the app. The BMS firmware version and update status can be found in the settings menu when connected to the Battery.

NOTE - The firmware update should only be performed if necessary.



Additionally, the app provides **automatic data logging** when connected to the battery. The log files can be found under the settings menu and can be easily shared from the app for troubleshooting or analyzing battery history.



BMS Functions

Below is a detailed description of advanced BMS features and how they affect the state of the battery. Some features depend on setup parameters which are described in detail in the Configuration section of this user guide.

- **Power On/Off** – In addition to the automatic disconnect protections, the battery can be manually turned off to disconnect power at the terminals during installation, service, or storage.
- **Reserve Voltage Cutoff (RVC)** – During discharge, the BMS will disable discharge current at approximately 10% state-of-charge, or when any cell reaches 3.0V (approximately 12.0V total voltage). This allows the battery to store a small energy reserve. Once the battery is in the RVC state you can use the reserve energy by a short-press of the power button.
 - It is recommended to charge the battery soon once it reaches RVC.
 - The battery will fully power off if it is not charged after sitting for 72 hours to further conserve its energy.
- **Low Voltage Cutoff (LVC)** – During discharge, the BMS will disable discharge current when any cell reaches the 2.6V (approximately 10.4V total voltage). Charging current is allowed, so that the battery can still be charged by a charging source. Some charging sources require to “see” the battery voltage before allowing charging, in which case LVC lockout can be temporarily overridden by short-pressing the Power button. This will allow the charger to sense the battery voltage, so charging can begin.
 - It is recommended to charge the battery immediately once it reaches LVC.
 - The battery will fully power off if it is not charged after sitting 12 hours to further conserve its energy.
- **High Voltage Cutoff (HVC)** – During charging, the BMS will disable charge current if any cell reaches 3.75V or higher (approximately 14.8V total voltage). This should not happen during normal operation if the charging sources are setup with correct charge settings. Once the charge current is removed the battery voltage will slowly lower and the BMS will automatically disengage HVC.
- **Cell Temperature Based Cutoff** – When the internal battery temperature goes below or above the temperature limits the BMS will disable charge or discharge current to prevent further use of the battery until the temperature returns to safe operating limits. Different temperature limits are enforced for charging and discharging due to the nature of LiFePO4 chemistry. Please see the specifications table below for temperature limits.
- **BMS Temperature Based Cutoff** – When the BMS temperature goes above 180F the BMS will disable charge and discharge current to prevent further use of the battery until the temperature lowers to below 160F.
- **Over Current Protection** – The BMS will disable discharge or charge current if the amperage exceeds 125A for 2 minutes continuously. To restore normal operation, remove/address the source of the overload, then short-press the Power Button.
- **Short Circuit Protection** – The BMS will immediately disable discharge current if the current value exceeds 1200A. To restore normal operation, remove/address the source of the short circuit, then short-press the Power Button.

NOTE - The lithium battery is capable of significant power output and may maintain the voltage level during a short circuit event, producing a very large current capable of melting or welding connection points and damaging cables and connectors. Even when the BMS detects the short circuit and tries to protect, the BMS may be damaged under such a large current. Make sure that the battery connection is always properly fused and does not rely on the BMS alone for short circuit protection!



Battery Specifications

Item	Description	
Model	12V130A-G31-LRBM8	
Nominal Voltage	12.8V	
Nominal Capacity	130Ah	
Internal Resistance	≤4mΩ	
Features	NeverDie® Reserve, High and Low Voltage Cutoff, High and Low Temperature Cutoff, Short Circuit Protection, Bluetooth App Support , Remote Reset Port	
NOTE: Battery may <u>not</u> be connected in series to make 24 volts or higher.		
Charge		
Charging temperature range	32~113°F (0~45°C)	
Charge voltage	14.4±0.1V	
Recommended float charge voltage (for standby use)	13.5±0.1V	
Recommended charge current	≤50A	
Allowed max charge current	100A with starting temp of 77°F (25°C)	
Discharge		
Discharging temperature range	-4~131°F (-20~55°C)	
Output Voltage Range	10.4~14.6V	
Recommended discharge current	≤80A	
Max continuous discharge current	100A with starting temp of 77°F (25°C)	
Surge discharge current	<400A for 30s max with starting temp of 77°F (25°C)	
Pulse discharge current	<1000A for 1s max with starting temp of 77°F (25°C)	
Reserve cut-off voltage	12.0V±0.05V	
Discharge cut-off voltage	10.4±0.1V	
Mechanical Characteristics		
Dimensions	Length 12.5in (318mm)	
	Width 6.5in (165mm)	
	Height 8.46in (215mm)	
Weight	Approx. 33.4lbs (15.1Kg)	
Storage		
Storage Temperature & Humidity Range	< 1 Month	-4~95°F (-20~35°C), 45~75%RH
	< 3 Months	14~86°F (-10~30°C), 45~75%RH
	Recommended storage	59~95°F (15~35°C), 45%RH~75%RH
Long Term Storage	If the battery needs to be stored for > 3 months the voltage should be 13.2V (50%SoC) and stored at the recommended storage specifications shown above. <u>Additionally, the battery needs at least one charge & discharge cycle every six months.</u>	
Self-discharge rate	Residual capacity	≤3% per month; ≤15% per year
	Reversible capacity	≤1.5%per month; ≤8% per year



Troubleshooting & FAQ

When troubleshooting your battery, one of the most helpful tools is the battery Status Code feature of the Lithionics Battery Monitor App. If the battery shuts down due to a protective BMS feature, please have the Bluetooth app available when resetting the battery to identify the battery info and status code. It can be helpful to screenshot the battery info screen, which will identify the battery state-of-charge, voltage, current, temperature, and status code. The following status code descriptions can be used in correcting the battery fault condition.

Description of Status Codes in the Lithionics Battery Monitor App	
High Voltage State	The battery's voltage is too high, typically 14.8V (3.75V per cell).
Cell Temp High/Low	The battery's internal temperature is outside of the operating limits.
NeverDie® Reserve	The battery is in the NeverDie® Reserve State, allowing access to reserve energy.
BMS Temp High	The temperature of the BMS is too high, typically due to high charge or discharge current.
Reserve Range	The battery's voltage is low (below 12.0V and/or 10%) and should be charged soon.
Low Voltage State	The battery's voltage is very low (below 10.4V) and should be charged immediately.
Battery Overload	The charge or discharge current is over 125A and power will be turned off after 2 minutes.
Power Off State	The battery was turned off by the Power Button.
Overcurrent State	The discharge current has exceeded 600A, and power is now turned off.
Short Circuit Protection	The discharge current has exceeded 1200A, and power is now turned off.
Cell Over-Voltage	One of the battery's cell voltages is too high. Charge current to the battery is disabled.
Cell Under-Voltage	One of the battery's cell voltages is too low. Discharge current from the battery is disabled.
BMS fault	A BMS fault is present.
Cell 1 Balancing	Cell 1 is balancing.
Cell 2 Balancing	Cell 2 is balancing.
Cell 3 Balancing	Cell 3 is balancing.
Cell 4 Balancing	Cell 4 is balancing.

Frequently Asked Questions

1. The battery has been charging for a long time, why has it not reached 100%?

Depending on the charger output, charging could take several hours to complete. To confirm the battery is charging, check the Bluetooth app to verify positive current is going into the battery. The voltage rise during bulk charge stage is very slow, followed by a fast voltage rise at the end of charge to 14.4V. Once the battery reaches 14.4V, the State-of-Charge percentage will calibrate to 100%. If no current is measured, confirm the charger is powered on, programmed correctly, and there are no Fuses, DC breakers or disconnect switches preventing power from transferring.

2. The battery is at 100%, why is it still charging?

It is normal for the charger to finish the charging cycle for a short period of time after the State-of-Charge percentage calibrates to 100%. A 30-60 minute absorb cycle is recommended as the battery finishes charging and the charging current reduced. The charger should then switch to a float charging mode at the battery resting voltage.

3. I have lost battery power, why did the battery turn off?

The battery has many automatic protections that could cause the battery to turn off. Most commonly, the battery will turn off once you reach the 10% reserve range and just needs to be recharged. Using the Bluetooth app and Status Code can provide you with helpful information for troubleshooting.

4. Why is the battery status light flashing?

The LED flash pattern can indicate if the battery is being charged, in a low voltage state, or experiencing a fault condition. Reference the chart on page 6 for the status light pattern descriptions.

Contact Information

For technical or warranty support please first contact the dealer where the system was purchased.

Additionally, for factory support please send an email with your battery's serial number to Support@LithionicsBattery.com



GTX12V315A-E2107-CS200 User Guide

NeverDie® Compact Series 200 Internal BMS



Rev. A

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Safety

- All electrical work should be performed in accordance with local and national electrical codes.
- Assume that voltage is present at the battery terminals, use insulated tools and gloves while working on the system.
- Always turn off equipment connected to the battery in addition to turning OFF the Power button on the battery to isolate it from other electrical circuits, before performing any repairs or maintenance on the system.
- Always use proper wire sizes to connect the system to inverters, chargers, or other equipment.
- Always use crimped connections to connect to the battery terminals.
- Read and follow the inverter, charger, or other equipment manufacturers safety precautions prior to connecting the battery to that equipment.
- Always use charging equipment compatible with Lithium Iron Phosphate battery chemistry. See battery charging section below.

Overview

The purpose of this Owner’s Guide is to provide explanations and procedures for operating, maintaining, and troubleshooting the GTX12V315A-E2107-CS200 battery. The GTX12V315A battery is a lithium iron phosphate (LiFePO4) chemistry battery with an internal *NeverDie® Compact Series 200 Battery Management System* (BMS). The BMS monitors voltage, current and temperature of each cell inside the battery and protects the battery from potential damage by disconnecting the battery circuit when the monitored parameters go outside of the allowed limits. The BMS also transmits monitoring data over Bluetooth which allows customers to check the battery data on their mobile device.



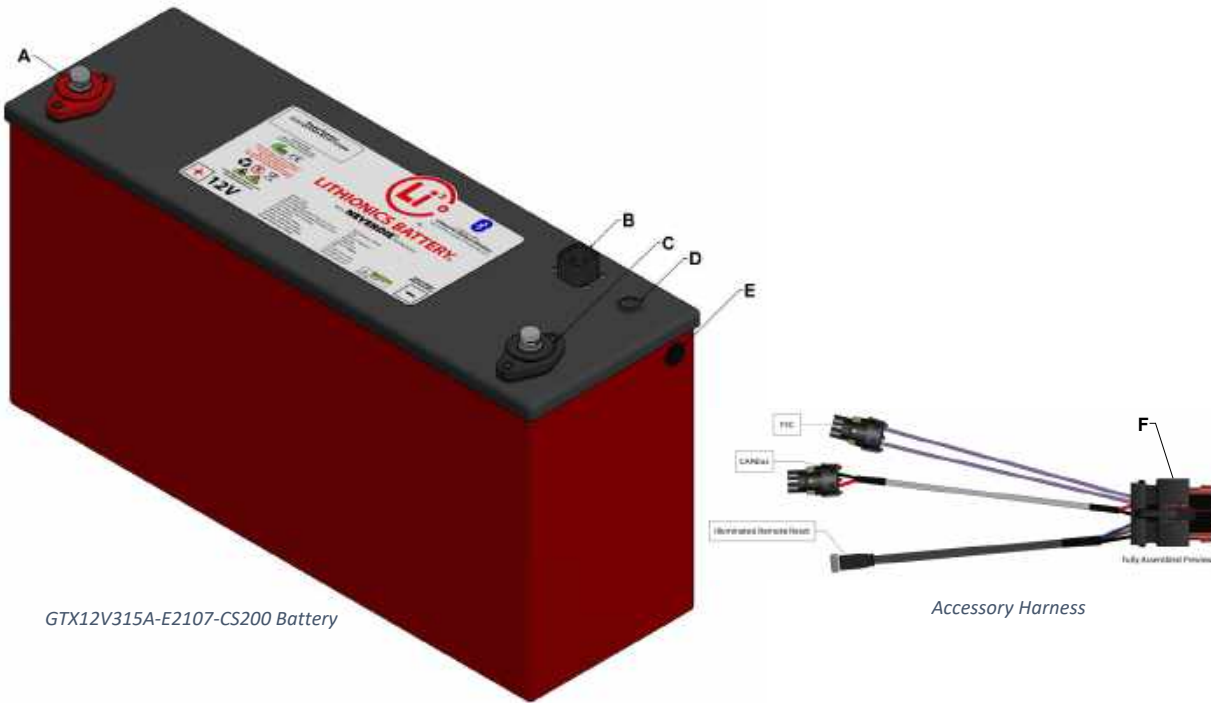
System Components

The GTX12V315A-E2107-CS200 system ships with the following items:

- GTX12V315A-E2107-CS200 Battery
- Accessory Harness (#75-H1FCR-CS2)*
- Protective DC Terminal Covers (Red & Black)
- Two Sets of M8x1.25mm Bolts and Lock Washers for the Terminals

Wiring and bus bars are not included.

NOTE - It is recommended to keep the battery box and packaging material in case you need to return for service.



GTX12V315A-E2107-CS200 Battery

Accessory Harness

Reference	Feature	Description
A	Positive Terminal	Brass, Nickel Plated, M8-1.25 Thread, Torque to 60in-lbs/6.8Nm
B	Accessory Connector	FCC, Remote Power Button, CANbus RV-C
C	Negative Terminal	Brass, Nickel Plated, M8-1.25 Thread, Torque to 60in-lbs/6.8Nm
D	Power Button	Power Button with Status Light
E	Vent	Pressure Balancing Vent
F*	Accessory Harness	Enables Integration of FCC, Remote Power Button, and CANbus RV-C

*Accessory Harness is an optional part.



First Power-up

The battery needs to be fully charged to 14.4V to condition the battery for use. Fully charging the battery calibrates the state-of-charge percentage to be the most accurate and allows the cells to balance if necessary. The battery should be fully charged to 14.4V at least once every 2 weeks.

Operation

Before powering on, ensure the battery terminals are insulated and any connected devices are properly fused.

Due to shipping laws and regulations, your battery may be received at a partial state-of-charge (typically 50%). The battery needs to be fully charged before use. This is necessary to calibrate the state-of-charge meter.

Powering the Battery On The power button is located on the battery lid and/or on the remote accessory harness extension. To turn the battery on, press the power button for one second. The power button status light will illuminate solid on to confirm the battery is powered on and operating normally.

Powering the Battery Off Be sure to shut down any high amperage loads prior to turning the battery off. To turn the battery off, press and hold the power button for 3 seconds. The power button status light will turn off to confirm that battery power is off.

Resetting Power after a Protection Event If the battery detects a fault then it may turn power off. The battery can then be reset by pressing the power button for one second.

Discharging Discharging may be performed at any time the system is powered On. The NeverDie® feature allows the system to have a “reserve” amount of energy left in the battery. Once the system is discharged to approximately 12.0V or 10% state-of-charge, whichever comes first, power will be off to leave a “reserve” amount of energy still left in the battery. The battery will also disconnect power if the voltage, amperage, or temperature limits are exceeded during discharging. To enable the remaining reserve energy of the system, press the BMS power button for 1 second. Once the reserve range is enabled the battery should be charged as soon as possible. See page 9 BMS Functions for further details.

WARNING - If the reserve energy is used and the battery module is left in a deeply discharged state without immediate charging, the battery module may become permanently damaged.

Charging The charging device(s) connected to the Lithium Battery System must be programmed per the recommended charge settings below. Using an improper charger or charge settings could result in undesirable battery performance and accelerated wear. The battery will disconnect power if the voltage, amperage, or temperature limits are exceeded during charging. Please note that voltage rise during bulk charge stage is very slow, followed by a fast voltage rise at the end of charge. Once charge is completed, the voltage drops down to a resting level. This behavior is normal and should not cause any concerns.

Recommended Charge Settings	
Recommended Bulk Charging Voltage	14.4V
Recommended Absorb Charging Voltage	14.4V
Recommended Absorb Cycle Time	30 Minutes
Maximum Absorb Cycle Time	60 Minutes
Recommend Float Voltage	13.4V
Maximum Float Voltage	13.6V
Equalization Mode	Disabled
Temperature Compensation	Disabled

A lithium iron phosphate (described as LFP or LiFePO4) charger or charging profile is required for battery charging. The battery charge voltage should be set to 14.4V, equalization and temperature compensation must be disabled, and if the charger supports float mode, set it to 13.4 - 13.6V. If you are not sure if your charger is suitable for charging your battery, contact Lithionics Battery® or your dealer to confirm charger compatibility, or to purchase compatible charger.

NOTE - Due to partial state-of-charge during storage and shipping, the cells inside the battery may not be perfectly balanced during the first few charge cycles. You may observe some high voltage alerts and cell balancing status codes on the Lithionics Battery® Monitor app, which indicate the balancing process is in progress. This is perfectly normal behavior and should not cause any concerns. After a few full charge cycles the cells will balance out and these alerts will disappear. There is no adverse effect on battery operation, you may continue to use the battery normally during these initial charge cycles.






Power Button with Status Light



The BMS power button is located on the battery lid and includes a status light. You can also attach the optional remote power button via the accessory harness. This can be useful if the battery is installed in a location that is not easily accessible. The function and operation of the remote power button remains the same as the main power button on the battery.

Power Button Operation	
Power ON	Press for 1 Second
Power OFF	Press for 3 Seconds
Power Reset	Press for 1 Second (after protection event)

Refer to the table below for an explanation of the power button status light blink patterns.

Battery State	Status Light	Status Light pattern over time
Powered On	Solid ON	
Powered Off	Solid OFF	
Charging	Slow blink	
Low Battery	Short blink	
Fault Alarm	Rapid blink	
		< 1 second > < 1 second > < 1 second > < 1 second >

Maintenance and Storage

Maintenance For optimal performance when in use, the battery should be fully charged to 14.4V at least once every 2 weeks. Fully charging the battery calibrates the state-of-charge percentage to be the most accurate and allows the cells to balance if necessary.

Storage Storing your battery at the correct specifications is important as it keeps the battery in the healthiest state possible. Consult the table below for proper storage conditions.

Storage Temperature & Humidity Range	< 1 Month	-4~95°F (-20~35°C), 45~75%RH
	< 3 Months	14~86°F (-10~30°C), 45~75%RH
Long Term Storage	If the battery needs to be stored for > 3 months the voltage should be 13.2V (50% state-of-charge) and stored at the recommended storage specifications shown above. Additionally, the battery needs at least one charge & discharge cycle every six months.	
Self-Discharge Rate	≤3% per month	

Typical storage example < 1 month:

1. Fully charge the battery.
2. Turn the battery **OFF** using the battery power button.
3. Keep the battery in an environment according to the specifications shown above.

Typical storage example > 1 month, up to 3 months maximum:

1. Reduce the battery state-of-charge to 13.2V which is 50% ±10% state-of-charge.
2. Turn the battery **OFF** via the BMS power button.
3. Keep the battery in an environment according to the specifications shown above.
4. Every 3 months charge the battery to 100% state-of-charge, then discharge the battery to LVC, then charge it back to 50% ±10% state-of-charge.



Bluetooth App

Lithionics Battery® has developed the **Lithionics Battery® Monitor** app for iOS and Android mobile platforms, which allows real time battery information. The battery must be turned on via the Power button before the Bluetooth connection can be made. When the battery is turned off, Bluetooth is also powered off to save energy. This app can be downloaded for free on the Apple App Store or the Google Play Store for your iOS 12.4+ or Android 5.0+ device.



To connect Bluetooth:

- 1) The battery must be in the ON position.
- 2) Bluetooth must be enabled on your device.
- 3) Open the Lithionics Battery® Monitor App and accept location permissions.
- 4) Under the Device List, select the battery you would like to monitor (the device name is identified by the battery serial number).

Once the Bluetooth connection is made to the battery, the **Battery Info** section of the app automatically displays. This section provides useful info such as the battery state-of-charge percentage, voltage, current, power, internal cell temperature, BMS temperature, power state and estimated time remaining. Clicking on the Status Code at the bottom automatically opens the Status Code reader section.



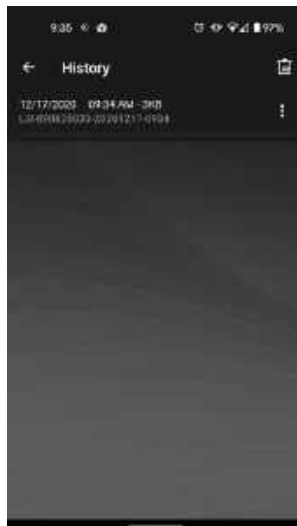
The **Status Code Reader** section of the app makes it easy to visualize the status by observing the color-coded table, see example to the left.

Each active description is color coded in green or red, where green indicates information and red indicates faults or critical conditions requiring attention, such as immediate need to charge the battery.



The Bluetooth app can also be used to access the **Firmware Update** section of the app. The BMS firmware version and update status can be found in the settings menu when connected to the Battery.

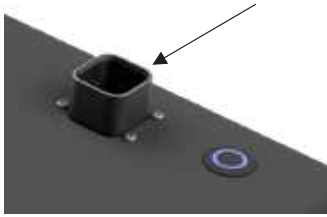
NOTE - The firmware update should only be performed if necessary.



Additionally, the app provides **automatic data logging** when connected to the battery. The log files can be found under the settings menu and can be easily shared from the app for troubleshooting or analyzing battery history.



Accessory Connector



The battery accessory connector is located on the battery lid and is used to access the BMS's ported features. This allows implementation of the features listed below.

Feature	Description
FCC	Field Control Circuit – For use with an alternator regulator enable/disable circuit.
CANbus	RV-C CANbus Data
Remote Reset Button	For use with the Remote Power Button with Status Light



Mating cable extensions are available to integrate the accessory features.

Part Number	Feature	Description
75-149-180	FCC Extension	Dual Weatherpack Connector to Bare Wires, 15ft Length
75-224-196	Remote Power Button with Status Light	M8 Connector to Illuminated Remote Button, 16ft Length

The CANbus messages are formatted for compatibility with RV-C protocol. The CANbus protocol and supported messages are documented and can be found at <http://www.lithionicsbattery.com/user-guides>.

Please contact Lithionics Battery® regarding options for mating CANBus connections.

Accessory Connector Pinout



Pin	Description
1	Reset Button 1
2	Remote LED +
3	CAN Low
4	Remote LED -
5	CAN High
6	Reset Button 2
7	FCC 1
8	FCC 2



Internal Heater Kit

The GTX12V315A-E2107-CS200 battery includes a thermostatically controlled heater kit to internally warm and maintain the battery above 32F/0C. Keeping the battery’s internal temperature above 32F/0C ensures uninterrupted battery power and a longer battery life.

Ambient Temperature	Average Power Used	Average Usage per Day
20F/-7C	9W	16.9Ah
-4F/-20C	21W	39.4Ah

NOTE - The internal heater kit will not activate if the battery is OFF.

BMS Functions

Below is a detailed description of advanced BMS features and how they affect the state of the battery. Some features depend on setup parameters which are described in detail in the Configuration section of this user guide.

- **Power On/Off** – In addition to the automatic disconnect protections, the battery can be manually turned off to disconnect power at the terminals during installation, service, or storage.
- **Reserve Voltage Cutoff (RVC)** – During discharge, the BMS will disable discharge current at approximately 10% state-of-charge, or when any cell reaches 3.0V (approximately 12.0V total voltage). This allows the battery to store a small energy reserve. Once the battery is in the RVC state you can use the reserve energy by a short-press of the power button.
 - It is recommended to charge the battery soon once it reaches RVC.
 - The battery will fully power off if it is not charged after sitting for 72 hours to further conserve its energy.
- **Low Voltage Cutoff (LVC)** – During discharge, the BMS will disable discharge current when any cell reaches the 2.6V (approximately 10.4V total voltage). Charging current is allowed, so that the battery can still be charged by a charging source. Some charging sources require to “see” the battery voltage before allowing charging, in which case LVC lockout can be temporarily overridden by short-pressing the Power button. This will allow the charger to sense the battery voltage, so charging can begin.
 - It is recommended to charge the battery immediately once it reaches LVC.
 - The battery will fully power off if it is not charged after sitting 12 hours to further conserve its energy.
- **High Voltage Cutoff (HVC)** – During charging, the BMS will disable charge current if any cell reaches 3.75V or higher (approximately 14.8V total voltage). This should not happen during normal operation if the charging sources are setup with correct charge settings. Once the charge current is removed the battery voltage will slowly lower and the BMS will automatically disengage HVC.
- **Cell Temperature Based Cutoff** – When the internal battery temperature goes below or above the temperature limits the BMS will disable charge or discharge current to prevent further use of the battery until the temperature returns to safe operating limits. Different temperature limits are enforced for charging and discharging due to the nature of LiFePO4 chemistry. Please see the specifications table below for temperature limits.
- **BMS Temperature Based Cutoff** – When the BMS temperature goes above 180F the BMS will disable charge and discharge current to prevent further use of the battery until the temperature lowers to below 160F.
- **Over Current Protection** – The BMS will disable discharge or charge current if the amperage exceeds 300A for 2 minutes continuously. To restore normal operation, remove/address the source of the overload, then short-press the Power Button.
- **Short Circuit Protection** – The BMS will immediately disable discharge current if the current value exceeds 1200A. To restore normal operation, remove/address the source of the short circuit, then short-press the Power Button.

NOTE - The lithium battery is capable of significant power output and may maintain the voltage level during a short circuit event, producing a very large current capable of melting or welding connection points and damaging cables and connectors. Even when the BMS detects the short circuit and tries to protect, the BMS may be damaged under such a large current. Make sure that the battery connection is always properly fused and does not rely on the BMS alone for short circuit protection!

- **Internal Heater Kit** – The internal heater kit will warm the battery when the cell temperature is 35F and lower and will stop heating when the cell temperature is 40F and higher.



Specifications

Item	Description
Model	GTX12V315A-E2107-CS200
Nominal Voltage	12.8V
Nominal Capacity	315Ah
Nominal Watt Hours	4032
Internal Resistance	≤3mΩ
Features	NeverDie® Reserve, High and Low Voltage Cutoff, High and Low Temperature Cutoff, Short Circuit Protection, Bluetooth Telemetry, CANbus RV-C, FCC, Remote Button
NOTE: Battery may <u>not</u> be connected in series to make 24 volts or higher.	
Charge	
Charging temperature range	32~131°F (0~55°C)
Recommend Charge voltage	14.4V
Recommended float charge voltage (for standby use)	13.4V
Recommended charge current	≤160A
Allowed max charge current	250A with starting temp of 77°F (25°C)
Discharge	
Discharging temperature range	-4~131°F (-20~55°C)
Output Voltage Range	10.4~14.6V
Recommended discharge current	≤200A
Max continuous discharge current	250A with starting temp of 77°F (25°C)
Surge discharge current	<600A for 30s max with starting temp of 77°F (25°C)
Pulse discharge current	<1200A for 1s max with starting temp of 77°F (25°C)
Reserve cut-off voltage	12.0V±0.05V
Discharge cut-off voltage	10.4±0.1V
Mechanical Characteristics	
Dimensions	Length: 20.3in (516mm)
	Width: 6.4in (163mm)
	Height: 10.0in (254mm)
Mounting Orientation	Upright position only (terminals up)
Weight	Approx. 68lbs (30.8Kg)
Environmental Rating	IP66



Troubleshooting & FAQ

When troubleshooting your battery, one of the most helpful tools is the battery Status Code feature of the Lithionics Battery Monitor App. If the battery shuts down due to a protective BMS feature, please have the Bluetooth app available when resetting the battery to identify the battery info and status code. It can be helpful to screenshot the battery info screen, which will identify the battery state-of-charge, voltage, current, temperature, and status code. The following status code descriptions can be used in correcting the battery fault condition.

Description of Status Codes in the Lithionics Battery Monitor App	
High Voltage State	The battery's voltage is too high, typically 14.8V (3.75V per cell).
Cell Temp High/Low	The battery's internal temperature is outside of the operating limits.
NeverDie® Reserve	The battery is in the NeverDie® Reserve State, allowing access to reserve energy.
BMS Temp High	The temperature of the BMS is too high, typically due to high charge or discharge current.
Reserve Range	The battery's voltage is low (below 12.0V and/or 10%) and should be charged soon.
Low Voltage State	The battery's voltage is very low (below 10.4V) and should be charged immediately.
Battery Overload	The charge or discharge current is over 300A and power will be turned off after 2 minutes.
Power Off State	The battery was turned off by the Power Button.
Overcurrent State	The discharge current has exceeded 600A, and power is now turned off.
Short Circuit Protection	The discharge current has exceeded 1200A, and power is now turned off.
Cell Over-Voltage	One of the battery's cell voltages is too high.
Cell Under-Voltage	One of the battery's cell voltages is too low.
BMS fault	A BMS fault is present.
Cell 1 Balancing	Cell 1 is balancing.
Cell 2 Balancing	Cell 2 is balancing.
Cell 3 Balancing	Cell 3 is balancing.
Cell 4 Balancing	Cell 4 is balancing.

Frequently Asked Questions

- 1. The battery has been charging for a long time, why has it not reached 100%?**
Depending on the charger output, charging could take several hours to complete. To confirm the battery is charging, check the Bluetooth app to verify positive current is going into the battery. The voltage rise during bulk charge stage is very slow, followed by a fast voltage rise at the end of charge to 14.4V. Once the battery reaches 14.4V, the State-of-Charge percentage will calibrate to 100%. If no current is measured, confirm the charger is powered on, programmed correctly, and there are no DC breakers or disconnect switches preventing power from transferring.
- 2. The battery is at 100%, why is it still charging?**
It is normal for the charger to finish the charging cycle for a short period of time after the State-of-Charge percentage calibrates to 100%. A 30-60 minute absorb cycle is recommended as the battery finishes charging and the charging current reduced. The charger should then switch to a float charging mode at the battery resting voltage.
- 3. I have lost battery power, why did the battery turn off?**
The battery has many automatic protections that could cause the battery to turn off. Most commonly, the battery will turn off once you reach the 10% reserve range and just needs to be recharged. Using the Bluetooth app and Status Code can provide you with helpful information for troubleshooting.
- 4. Why is the battery status light flashing?**
The LED flash pattern can indicate if the battery is being charged, in a low voltage state, or experiencing a fault condition. Reference the chart on page 5 for the status light pattern descriptions.

Contact Information

For technical or warranty support please first contact the dealer where the system was purchased.

Additionally, for factory support please send an email with your battery's serial number to Support@LithionicsBattery.com

LITHIONICS BATTERY, 1770 CALUMET ST, CLEARWATER, FL 33765 USA
PH: 727.726.4204 | FAX: 727.797.8046 | WEB: LITHIONICSBATTERY.COM



TECHNICAL MANUAL

For Lifeline® Batteries

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RECORD OF REVISIONS

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Initial Release	10/27/08
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Rev. B	9/09/09
Rev. C	7/18/11
Rev. D	4/14/14
Rev. E	2/02/17
Rev. F	5/06/19



SAFETY SUMMARY

DANGER OF EXPLODING BATTERIES

Lead acid batteries can produce explosive mixtures of hydrogen and oxygen. Take the following precautions:

- Never install batteries in an airtight or sealed enclosure and make sure installation is adequately ventilated.
- Charge batteries in accordance with the instructions given in this manual.
- Keep all sparks, flames and cigarettes away from batteries.
- Connect cables tightly to the terminals to avoid sparks.
- Wear proper eye and face protection when installing and servicing batteries.

DANGER OF CHEMICAL BURNS

Lead acid batteries contain sulphuric acid electrolyte which can cause severe burns to body tissue. Take the following precautions:

- Avoid contact of the electrolyte with skin, eyes or clothing.
- Never remove or damage vent valves.
- In the event of an accident, flush with water and call a physician immediately.

DANGER OF BURNS IF TERMINALS ARE SHORTED

Lead acid batteries are capable of delivering high currents if the external terminals are short circuited. The resulting heat can cause severe burns and is a potential fire hazard. Take the following precautions:

- Do not place metal objects across battery terminals.
- Remove all metallic items such as belt buckles, watches, bracelets and rings when installing or servicing batteries.
- Wear insulating gloves when installing or servicing batteries.
- Use insulating tools when installing or servicing batteries.

DANGER OF THERMAL RUNAWAY

Thermal runaway is a condition in which the battery temperature increases rapidly resulting in extreme overheating of the battery. Under rare conditions, the battery can melt, catch on fire, or even explode. Thermal runaway can only occur if the battery is at high ambient temperature and/or the charging voltage is set too high. Take the following precautions:

- Charge batteries in accordance with the instructions given in this manual.
- Do not install batteries near heat sources or in direct sunlight that may artificially elevate their temperature.
- Provide adequate air circulation around the batteries to prevent heat build up.



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CHAPTER 1 - INTRODUCTION

1.1 Company Background

Concorde Battery Corporation was founded in 1977 and is a manufacturer of premium quality lead acid batteries. Originally, Concorde's main product emphasis was dry charged and gelled electrolyte lead acid batteries. In 1985, Concorde developed its valve regulated, absorbent glass mat [AGM] technology for use in aircraft applications. The success of this technology in the aviation market has been outstanding. Concorde is now the largest manufacturer of valve regulated lead acid batteries for both commercial and military aircraft.

In 1986, Concorde further developed the AGM technology for deep cycle applications. This development effort provided higher energy density (higher capacity) and better cycle life than its gelled electrolyte battery. Concorde soon discontinued the gel product line and concentrated all engineering developments on the AGM product line. In 1987, Concorde began supplying the marine and recreational vehicle market with our deep cycle AGM batteries. Over the years it has been our design expertise, quality and customer focus that has made Concorde a leader in providing the best battery available for this market segment. Concorde is committed to the proposition that the customer deserves the best performing and highest quality product. Our batteries are tailored to the application rather than make the designer/user settle for what is available. It is this commitment – to meet the needs of the customer – that sets Concorde apart.

1.2 Overview of Lifeline® AGM Technology

Lifeline® AGM batteries are valve-regulated, recombinant gas, absorbed electrolyte, lead acid batteries. The cells are sealed with a pressure relief valve that prevents gases within the battery from escaping. The positive and negative plates are sandwiched between layers of glass mat consisting of a blend of glass micro fibers of varying length and diameter. This blend features superior wicking characteristics and promotes maximum retention of the electrolyte. An envelope of micro porous polyethylene surrounds each wrap of glass mat to further protect the plates from shorting. Electrolyte is absorbed and held in place by the capillary action between the fluid and the glass mat fibers. The mat is over 90% saturated with the electrolyte. By design it is not totally saturated with electrolyte, a portion is filled with gas. This void space provides the channels by which oxygen travels from the positive to the negative plates during charging. When the oxygen gas reaches the negative plate, it reacts with lead to form lead oxide and water. This reaction at the negative plate suppresses the generation of hydrogen that otherwise would come off the negative plate. In this manner, virtually all of the gas is “recombined” inside the cell, eliminating the need to add water, resulting in “maintenance free” operation.

1.3 About this Manual

This manual is intended to provide the customer with technical information for selecting, installing, operating, and servicing Lifeline® AGM batteries. The next Chapter provides a detailed description of the product, its design features and materials of construction. Concorde is very proud of this innovative product line and we think you will share our enthusiasm. Chapter 3 provides a comparison of Lifeline® with other lead acid technologies: flooded-electrolyte batteries, gelled-electrolyte batteries, and AGM batteries from other manufacturers. Chapter 4 presents an overview of the battery specifications for the Lifeline® product line; detailed specifications for each model are published separately. Chapter 5 provides instructions for storing, operating and servicing Lifeline® AGM batteries. Chapter 6 gives important safety information. Further technical information can be found in the Appendices. If you have additional questions beyond what is covered in this manual, please contact Concorde Battery Corporation or any Lifeline® distributor.



CHAPTER 2 - BATTERY CONSTRUCTION

2.1 Component Description

Refer to the battery pictorial in Section 2.2 showing a cut away view of the cell and a summary of the features and benefits. A more detailed description of the battery's construction is given below.

GRIDS - The negative grid is made of pure lead calcium alloy. The positive grid is extra thick and is made from a proprietary, pure lead-tin-calcium alloy with special grain refiners. These features improve corrosion resistance of the grid and gives the battery excellent cycling capability and float life.

PLATES – The grids are pasted on state-of-the-art pasting machines to give the highest quality plates with tightly controlled weight and thickness specifications. The lead oxide paste used to make the positive plates is our high-density formula. With time and use, the active material tends to soften and give less discharge capacity. The high density paste formula retards the active material softening and extends battery life.

ABSORBENT GLASS MAT [AGM] SEPARATOR – The AGM is a premium blend of glass micro fibers having an optimum ratio of fine and extra fine fiber sizes. This blend features superior wicking characteristics and promotes maximum retention of the electrolyte. The AGM layer is squeezed to an optimum level of compression during assembly to provide sufficient contact with the surface of the plate over the life of the battery. This compression also promotes retention of the active material if the battery is exposed to shock or vibration conditions.

POLYETHYLENE ENVELOPE – Concorde is the only manufacturer that envelopes the AGM separator with a thin layer of microporous polyethylene. The microporous layer is wrapped around the glass-matted plate and then sealed along the sides to eliminate the possibility of shorts at the edges of the plate (a common failure mode). The microporous polyethylene is more durable and puncture resistant than the AGM material alone and significantly reduces the occurrence of plate to plate shorts.

INTERCELL CONNECTIONS - Massive “over the partition” fusion welds are used which increase the strength of the intercell connection. This minimizes the possibility of open welds and provides a low resistance connection between cells. Other manufacturers use “through the partition” spot welded construction that inserts a weak point into the assembly because of the small cross section area and the difficulty of making a reliable weld and leak proof construction.

HIGH IMPACT, REINFORCED CONTAINER & COVER – The battery container and cover are made of a thick-walled polypropylene copolymer. This material provides excellent impact resistance at extreme low temperatures and minimizes bulging at high temperatures.

COVER-TO-CONTAINER SEAL - The batteries use an epoxy-filled tongue and groove seal between the cover and container. Most other manufacturers heat seal their cover to the container. The epoxy-filled tongue and groove seal is a far stronger than a heat seal and will not separate in high or low temperature extreme applications.



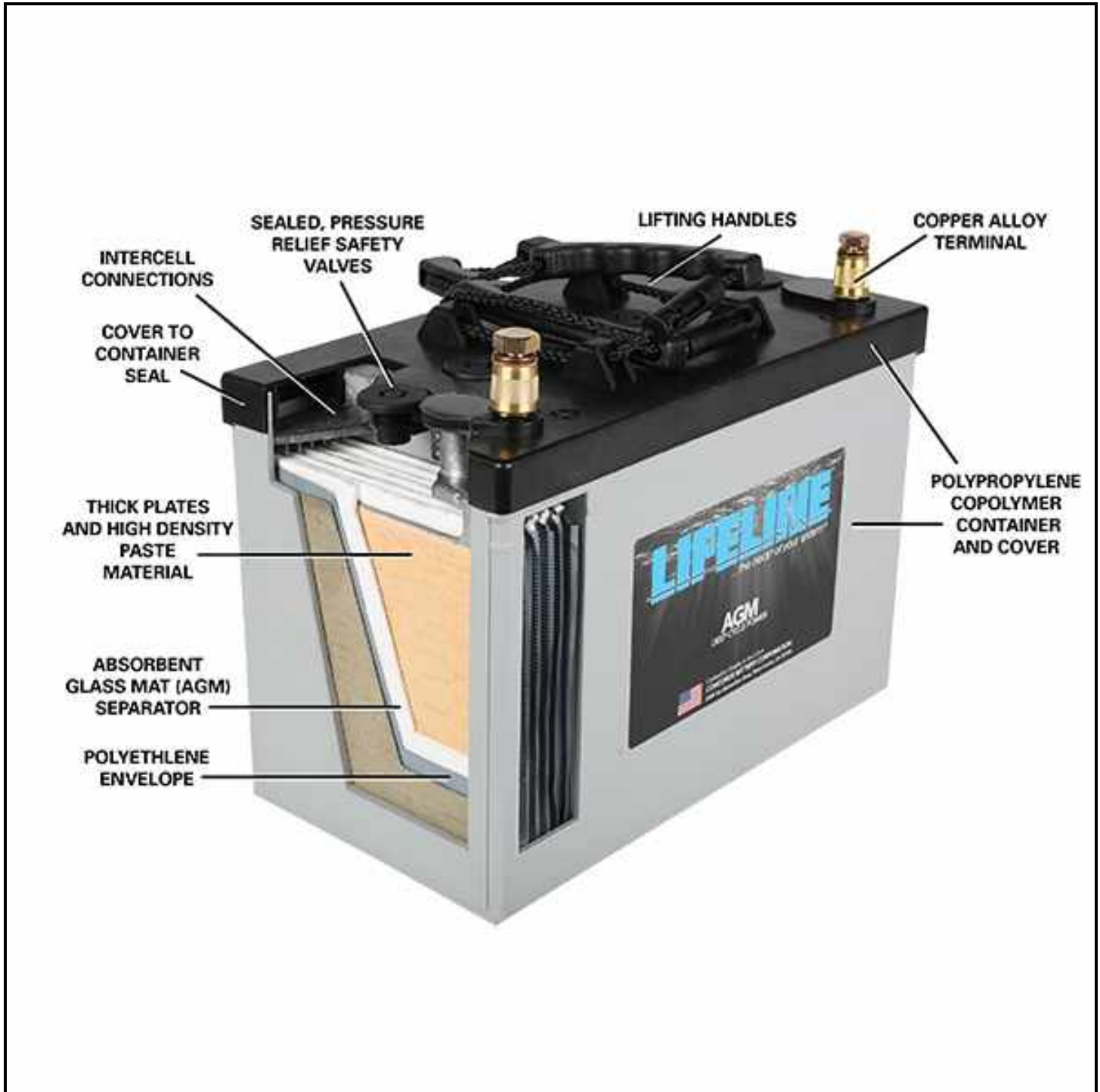
PRESSURE RELIEF SAFETY VALVE - Each cell in the battery employs a pressure relief safety valve. The valve is designed to release excess pressure that builds up over time to vent the small quantity of gasses that do not recombine inside of the battery. Once the pressure is released, the valve automatically re-seals. The gasses that escape are mainly oxygen and some hydrogen, and these gasses rapidly dissipate into the atmosphere.

TERMINALS - Lifeline® AGM batteries are available in a variety of terminal configurations. Most terminal types are made of copper alloy which provide a long lasting, low resistance electrical connection. Additionally, the copper alloy terminals offer increased environmental protection and personal safety in comparison to commonly used lead terminals. Refer to the pictorial in Section 2.3 to see a detailed view of the various terminal types that are available.

HANDLES – Lifting handles are incorporated into all Lifeline® AGM batteries. This provides easier handling for lifting, carrying and installation.



2.2 Battery with Cut Away View





2.3 Terminal Types

Lifeline Battery Terminal Types



M8 Threaded Insert (Copper Alloy)
M6 Threaded Insert for GPL-U1T only



L-Blade Terminal (Solid Copper)
M8 Hardware



Marine Terminal (Copper Alloy)
Positive Terminal with M10 Hardware
Negative Terminal with M8 Hardware



A - SAE Post Automotive (Lead)



CHAPTER 3 - TECHNOLOGY COMPARISON

3.1 Lifeline® versus Flooded Batteries

Flooded-electrolyte lead acid batteries have been around since 1859 and tend to be less expensive than AGM or Gel batteries. However, they have major deficiencies compared to AGM or Gel batteries. For instance, deep cycle flooded lead acid batteries contain antimony in the grid alloy which causes a high rate of self discharge and rapid water loss due to gassing reactions. The escape of hydrogen and oxygen from the battery represents a serious safety hazard if the gasses are not ventilated properly. In flooded batteries, replacing the antimony lead alloy with calcium lead alloy reduces the amount of gassing and water loss, but the cycle life is much lower and they are no longer considered deep cycle batteries.

Electrolyte stratification can occur in all types of flooded batteries. As the battery is discharged and charged, the concentration of acid becomes higher at the bottom of the cell and becomes lower at the top of the cell. The low acid concentration reduces capacity at the top of the plates, and the high acid concentration accelerates corrosion at the bottom of the plates and shortens the battery life. Although stratification can be minimized by raising the charging voltage so that the increased gassing agitates the electrolyte, this will accelerate the water loss and watering frequency.

One other difference is that flooded batteries can not tolerate freezing temperatures when in the discharged state, whereas AGM batteries are resistant to damage by freezing temperatures. The following table provides a side by side comparison of Lifeline® AGM and flooded deep cycle batteries.

Table 3-1. Comparison of Lifeline® AGM Batteries with Flooded Deep Cycle Batteries

Characteristic	Lifeline® AGM Battery	Flooded Deep Cycle Battery
Self-discharge at room temperature	1 to 3% per month – remains stable over life.	5-10% per month when new – increases drastically with age due to antimony contamination of the negative plate.
Water addition	Never.	Frequent – increases dramatically with age due to antimony contamination of the negative plate.
Hydrogen gas emissions	Generally negligible unless severely overcharged.	Significant volume is generated and must be ventilated to prevent explosion.
Electrolyte spillage during storage, shipping and handling	Non-spillable – electrolyte is retained in AGM separator.	Electrolyte spills when battery is tilted, inverted, or cracked.
Electrolyte stratification during operation	No stratification occurs.	Stratification occurs when operated at low charging voltages or in taller batteries.
Tolerance to freezing temperatures	Resistant to damage when frozen.	Battery destroyed when frozen.



3.2 Lifeline® versus Gel Batteries

Gel batteries have been commercially available since the early 1970s and are still offered by some manufacturers. Concorde manufactured gel batteries for many years before developing the AGM technology and, therefore, is aware of inherent deficiencies associated with gel batteries.

The gel product employs a highly viscous, semisolid mixture of silica gel and dilute sulfuric acid in a colloidal suspension as an electrolyte. The electrolyte is difficult to keep homogeneous and the solid silica can separate from the acid, creating a “flooded” battery. Handling and vibration exposure are operational factors that can cause the silica and acid mixture to separate as there is no chemical bond. In high temperature environments, the semisolid electrolyte develops cracks and voids that reduce contact between the plates and causes the battery to lose capacity. This same effect gradually occurs even at normal room temperatures.

By contrast, AGM batteries employ a glass micro fiber mat separator that holds the liquid electrolyte like a sponge. Shrinkage of the separator does not occur as the battery ages and the electrolyte remains in direct contact with the plates. The electrolyte remains immobilized even when the battery is exposed to severe vibration.

Since it is easier to fill a container with a liquid than a semi-solid, AGM batteries require less space between battery plates. The closer plate spacing gives the AGM battery a lower internal resistance, making it more charge efficient and giving better power performance on discharge, especially at low temperatures.

Gel batteries are also more sensitive to charging voltage. If the charging voltage is not controlled within a very tight range relative to the battery’s temperature, the life of the battery will be adversely affected. For example, one manufacturer of gel batteries claims that if the charging voltage is 0.7V higher than the recommended level, the cycle life will be reduced by 60 percent. The reason for this effect is the limited oxygen recombination capability of gelled batteries. Lifeline® AGM batteries are more forgiving in overcharge conditions and their ability to recombine the hydrogen and oxygen gases back into water is more efficient. With Lifeline® AGM batteries, tests have shown that increasing the charging voltage 1.0V above the recommended charging voltage results in only a 23% reduction in the cycle life.

The charge acceptance of gel batteries is also less than that of Lifeline® AGM batteries. This means it takes longer to recharge gel batteries. As an example, tests have shown that when discharged to 50% of rated capacity (fairly common in a deep cycle applications), gel batteries take twice as long to reach full charge compared to Lifeline® AGM batteries.

The following table provides a side by side comparison of Lifeline® AGM and gel batteries:



Table 3-2. Comparison of Lifeline® AGM Batteries with Gel Batteries

Characteristic	Lifeline® AGM Battery	Gel Batteries
Electrolyte Stability	Excellent – AGM acts like a flexible sponge and ensures good contact between electrolyte and plates.	Prone to solid / liquid separation leading to premature failure. Electrolyte loses contact with plates due to cracks and voids as the battery ages, especially at higher ambient temperatures.
High Rate Performance	Excellent due to low internal impedance.	Inferior. Plate spacing must be greater to allow for gel passage during filling. Gel adds to impedance, especially at low temperatures.
Sensitivity to Charging Voltage Levels	Moderately sensitive. Life is somewhat reduced if charged outside of recommended charge voltage levels.	Very Sensitive. Life is greatly reduced if charged outside of recommended charge voltage levels.
Charge Acceptance Rate	Excellent. Battery can be fully charged in 2 hours if high inrush current is available.	Inferior. Must limit inrush current and charge time is at least twice as long to reach full charge.

3.3 Lifeline® versus other AGM Batteries

Lifeline® AGM batteries have been specifically designed for true deep cycle, long service life capability in adverse temperature and handling conditions. Concorde uses extra thick positive plates, high density paste, thick AGM separator layers encased within a microporous polyethylene envelope, thick walled containers with epoxy-sealed covers. A side by side comparison of Lifeline® AGM batteries with typical AGM batteries from other manufacturers is provided in the following table:

Table 3-3. Comparison of Lifeline® AGM Batteries with Other AGM Batteries

Characteristic	Lifeline® AGM Battery	Other AGM Batteries
Positive Grids	Extra thick grids (typically 0.095” or greater) and extra thick plates (typically 0.105” or greater), for long cycle and float life.	Thinner grids, typically 0.045 to 0.060”.
Pasted Plates	High density positive paste for long cycle life.	Lower density, resulting in lower cycle life.
AGM Separator	Extra thick for maximum electrolyte reserve. Premium grade of AGM with extra fine fibers for long life.	Thinner material used. Inferior grade of AGM without the extra fine fiber content.
Microporous polyethylene separators	Envelopes the positive plate to prevent shorting due to shock, vibration and dendrites	Not present, AGM is the only separator protecting the plates.
Intercell connections	Massive over the partition connectors provide a robust, leak proof connection with low voltage loss.	Inferior through the partition welds have less cross-sectional area, provide weaker structural connection, and are leak prone.
Battery Terminals	Copper alloy – low electrical resistance and no exposed lead.	Lead alloy - higher in electrical resistance and user is exposed to lead contamination.
Container	Thick wall for rigid support of cell elements and high compression of AGM separator.	Thinner walls, less support of cell elements and lower compression of AGM separator.
Cover Seal	Cover is epoxied to container – high strength bond for reliable operation at temperature extremes.	Cover is heat sealed (melted) to container – prone to separation and leakage at temperature extremes.



CHAPTER 4 - BATTERY SPECIFICATIONS

4.1 Battery Models

The Lifeline® Series consists of deep cycle as well as engine starting batteries. Capacities of the deep cycle batteries range from 33 to 1200 ampere-hours (rated at the 20-hour rate) and a variety of 2-volt, 6-volt and 12-volt models are available. Ratings of the starting batteries range from 550 amperes to 810 amperes (CCA at 0°F) and these are only available in 12-volt models. Refer to the battery specification sheet (published separately) for a complete listing of the mechanical and electrical specifications for each battery model.

4.2 Terminals

Standard Terminals: The following table shows the standard type of terminal used on each battery model:

Table 4-1. Battery Terminals

Battery Model	Standard Terminal Type
GPL-24T, GPL-2400T, GPL-27T, GPL-2700T, GPL-31T, GPL-3100T, GPL-31XT, GPL-31T-2V	Marine Terminal (Copper Alloy) Positive = M10 and Negative = M8
GPL-4DL, GPL-8DL	L-Blade Terminal (Copper Alloy) with M8 Hardware
GPL-4DA, GPL-8DA	SAE Automotive Post (Lead)
GPL-1400T, GPL-30HT, GPL-4CT, GPL-6CT, GPL-L16T, GPL-4CT-2V, GPL-6CT-2V, GPL-L16T-2V	M8 Threaded Insert (Copper Alloy)
GPL-U1T	M6 Threaded Insert (Copper Alloy)

Optional Terminals: The 2V and 6V models are available with marine terminals on a special order basis.

Terminal Hardware: When requested, batteries are supplied with silicon bronze bolts, nuts and washers as required for installation.

Terminal Torque Values: Use 35 in-lbs / 4.0 nm for M6. Use 70 in-lbs / 7.9 nm for M8 and M10.

4.3 Handles

All batteries include lifting handles, either built into the cover, dual ropes attached to the cover, or a single plastic handle attached to brackets on the sides of the container.

4.4 Definition of Ratings

Capacity ratings are after 15 cycles per BCI specifications and are stated at 77°F (25°C) to 1.75 volts per cell.

4.5 Temperature Range

Storage (when fully charged): -67°F (-55°C) to 122°F (50°C)

Operating: -40°F (-40°C) to 160°F (71°C).

4.6 UL Recognition

All Lifeline® AGM batteries meet the requirements of UL® 1989 (Standby Battery) and are UL recognized under UL File Number MH-17983.

4.7 Shipping Classification

Lifeline® AGM batteries have been tested and determined to comply with the vibration and pressure differential tests in accordance with DOT 49 CFR 173.159(a) and Special Provision A67 of the International Air Transport Association (IATA) Dangerous Goods regulations. As such, they are classified as a “NONSPILLABLE BATTERY” and can be shipped as non-hazardous material by any means. To comply with DOT shipping regulations, the battery must be packaged to protect against short circuits and the battery and outer packaging must be plainly and durably marked “NONSPILLABLE” or “NONSPILLABLE BATTERY”. See Lifeline® SDS (published separately) for additional transportation information.



CHAPTER 5 - COMMISSIONING AND SERVICING INSTRUCTIONS

5.1 Storage

Lifeline® Batteries are charged at the factory before shipment to the distributor. For warranty coverage, batteries need to be properly boost charged while in storage and installed within 12 months of the original factory ship date. Batteries should be stored in the coolest environment available, preferably not exceeding 68°F (20°C). The higher the temperature, the faster the battery will self-discharge and require boost charging. See Appendix C for data on storage time versus temperature.

While in storage, batteries should be boost charged every 90 days or when the open circuit voltage (OCV) drops to 12.5 volts for a 12-volt battery (6.25 volts for a 6-volt battery and 2.08 volts for a 2V battery). This OCV corresponds to approximately 75% state of charge. Boost charge batteries using a constant voltage charger set at 14.4 to 15.0 volts for a 12-volt battery (7.2 to 7.5 volts for a 6-volt battery and 2.40 to 2.50 for a 2 volt battery). The boost charge should be applied until the charging current falls below 0.5 percent of the battery's 20 hour rated capacity (0.5 amps for a 100 Ah battery).

5.2 Installation

Lifeline® AGM batteries are designed to be installed upright (terminal facing upwards). For installation in non-upright orientations, contact Concorde for assistance.

Be sure there is adequate ventilation in the area where the batteries are to be installed. Refer to Section 6.1 for specific safety hazards associated with the emission of hydrogen gas. The space surrounding adjacent batteries should be at least 0.25 inch to permit airflow around each battery.

Batteries may be connected in series (voltage adds, capacity stays the same), in parallel (capacity adds, voltage stays the same), or a combination of series and parallel (both voltage and capacity add). Each of these connection options are illustrated in Figures 5-1 through 5-3, respectively. Be sure to torque the terminal bolts to the values given in Section 4.2.

Always use batteries of the same size and condition in multi-battery installations. Connect batteries using cabling that is sized for the maximum load of the system. The voltage drop on the cables during charging should not exceed 0.2 volts at full output. Protect the battery terminals from shorting during installation. When replacing batteries, it is best to replace the entire set of batteries so they remain balanced.

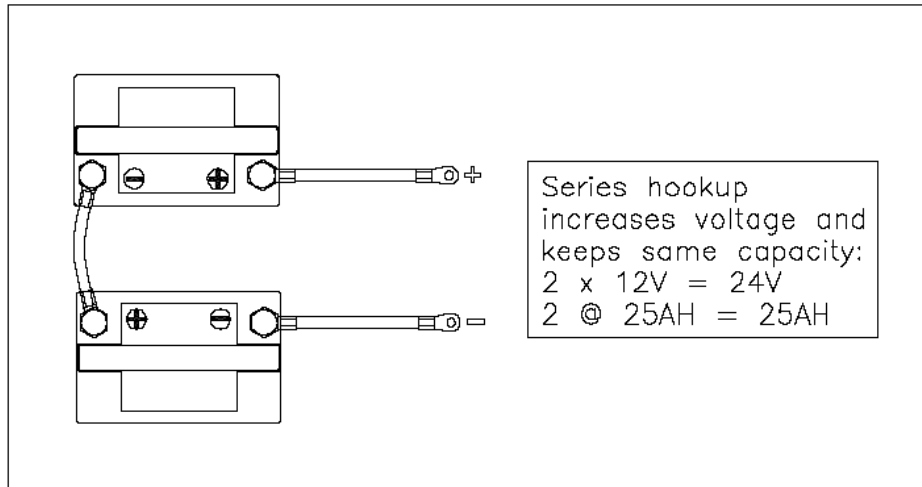


Figure 5-1. Series Connection

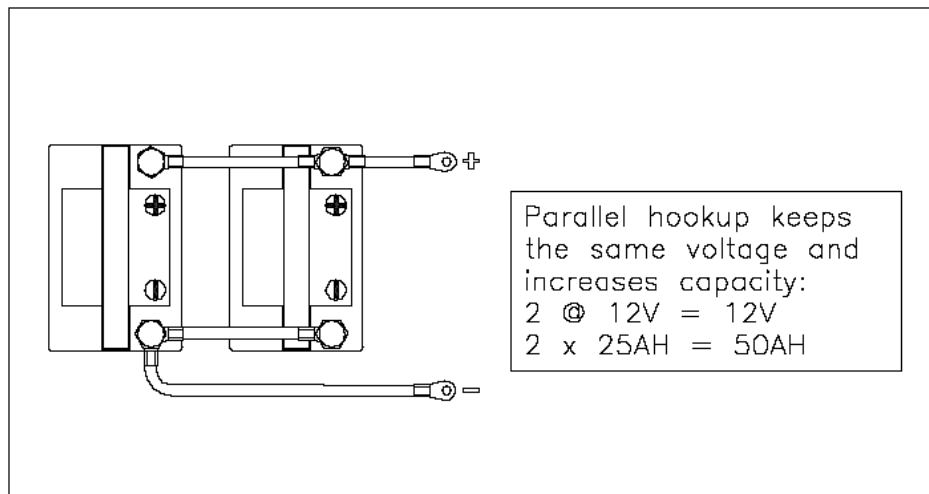


Figure 5-2. Parallel Connection

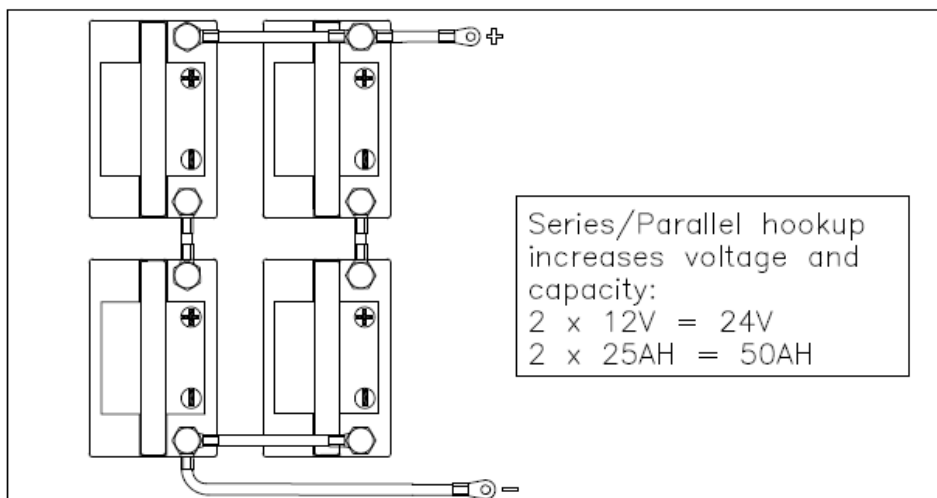


Figure 5-3. Series/Parallel Connection



Connection options for 4-terminal batteries are illustrated in Figures 5-4 through 5-8. For low rate applications (current levels less than 400 amperes), only two of the four terminals need to be connected, but it is still best to use all four terminals for redundancy. For high rate applications (current levels greater than 400 amperes), all four terminals should be connected.

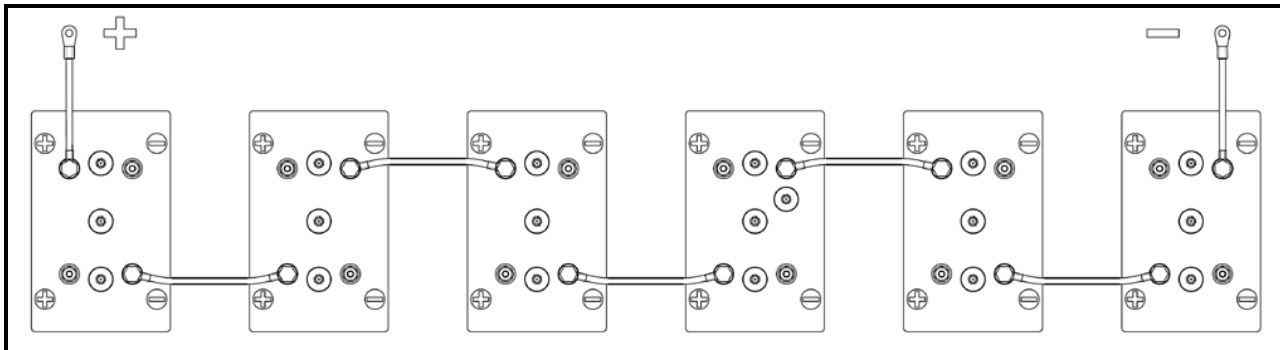


Figure 5-4. Series Connection for 4-Terminal Batteries (Low Rate Applications Only)

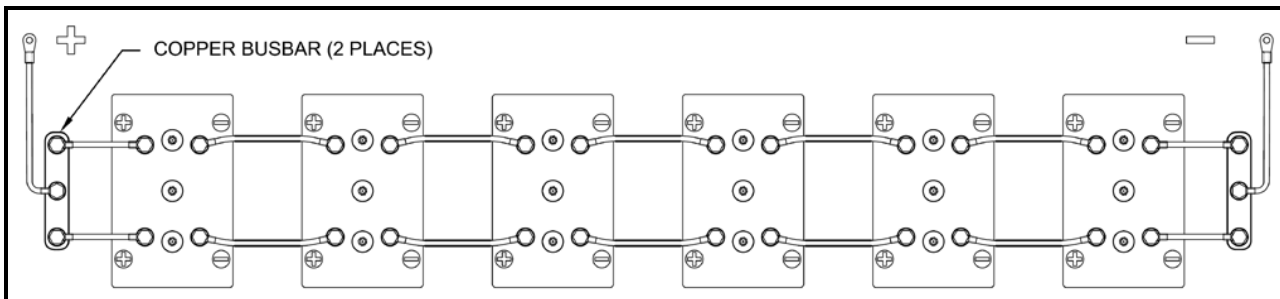


Figure 5-5. Series Connection for 4-Terminal Batteries (Low or High Rate Applications, Option A)

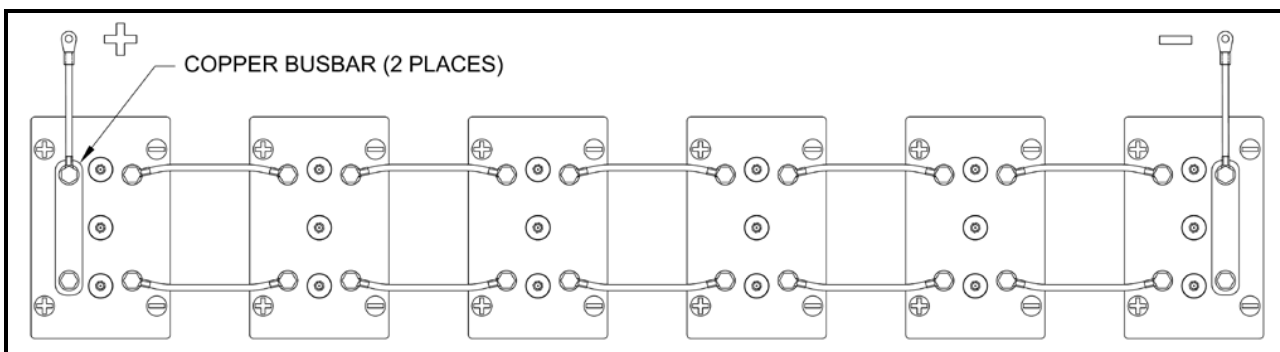


Figure 5-6. Series Connection for 4-Terminal Batteries (Low or High Rate Applications, Option B)

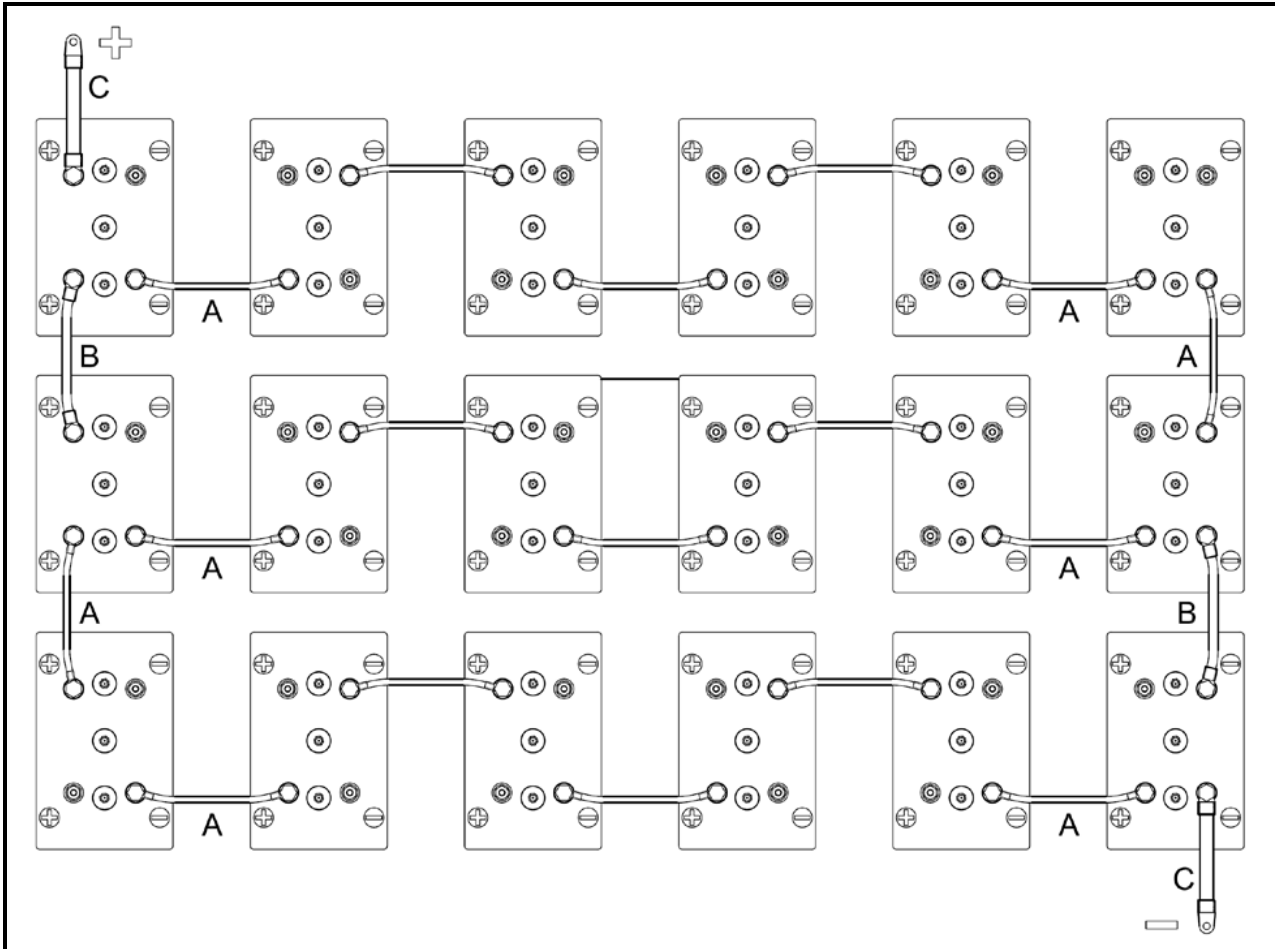


Figure 5-7. Series/Parallel Connection for 4-Terminal Batteries (Low Rate Applications Only)

NOTE: Cables A, B and C carry different current levels and should be sized accordingly. In this example, the current in Cable B is 2 times that of Cable A and the current in Cable C is three times that of Cable A.

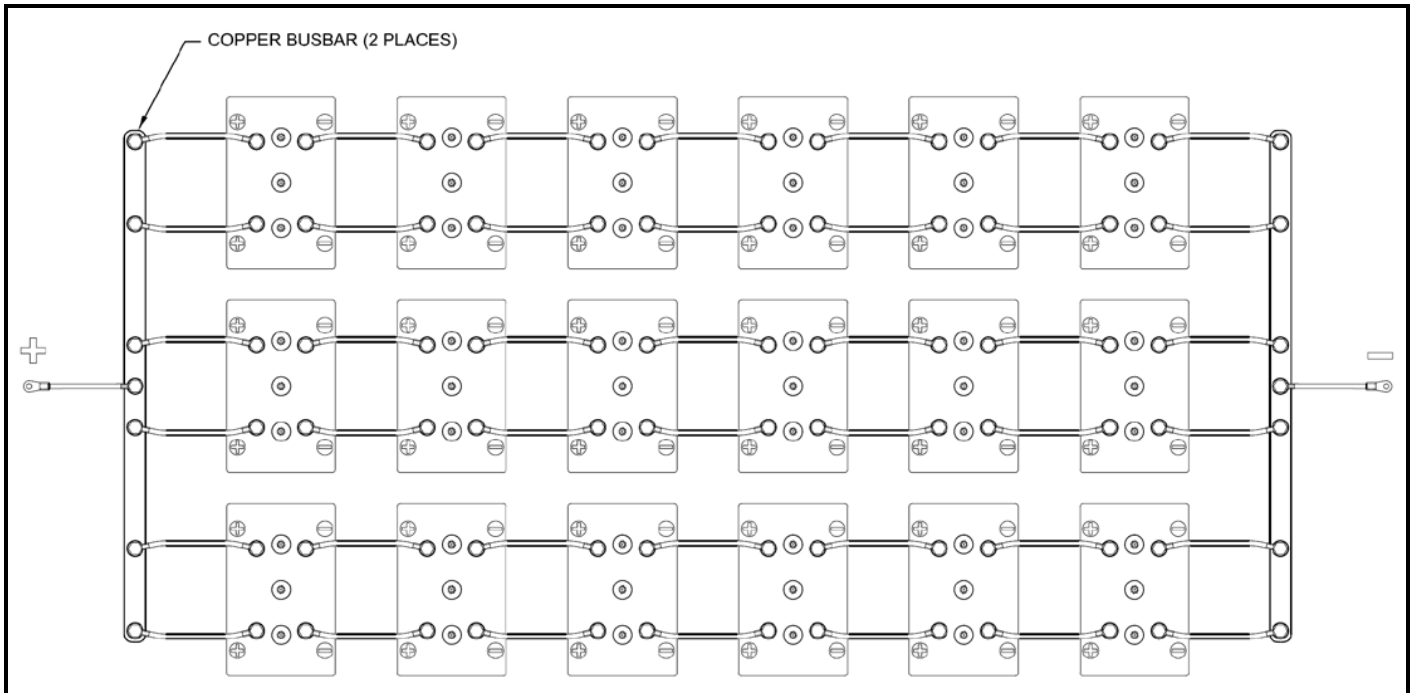


Figure 5-8. Series/Parallel Connection for 4-Terminal Batteries (Low or High Rate Applications)

5.3 Discharging

Discharge data for Lifeline® AGM batteries are given in Appendix C. The capacity delivered by the battery depends on the rate of discharge as well as the battery temperature. The battery will deliver less capacity as the discharge rate increases and less capacity as the temperature is lowered. Graphs are provided in Appendix C to quantify these effects. Peukert plots (Amps vs Time) are also included, along with formulas for calculating the current that can be removed or any discharge time from 0.5 hours to 120 hours. To calculate the discharge time for a specified amperage, these formulas can be inverted as follows:

$$A = C \times T^{-n}$$
$$T = C^{1/n} \times A^{-1/n}$$

(A = Amps, T = Time in hours, C & n are constants specific for each battery model)

In general, batteries should be sized such that the rated capacity is at least twice the capacity required by the load. For example, if 100 Ah is required on average, select at least a 200Ah battery. This approach will limit the average depth of discharge to 50% and will dramatically extend the life of the battery (see chart of Cycle Life versus Depth of Discharge in Appendix C).



5.4 Charging

Charging Lifeline® AGM batteries is a matter of replacing the ampere-hours removed during discharge plus a little extra to make up for charging inefficiency. The ampere-hour input necessary for a full recharge depends on the depth of discharge, rate of recharge, and temperature. Typically, between 102% and 110% of the discharged ampere-hours must be returned for full recharge. If the recharge is insufficient, the battery’s state of charge will gradually “walk down” as it is cycled, resulting in sulfation and premature failure.

The recommended method of charging Lifeline® AGM batteries is to use a 3-stage charging profile. In the first stage, a constant current is applied until the voltage reaches a pre-set limit. The first stage is often called the **Bulk** charging stage.

In the second stage, the voltage is held constant at the same pre-set limit until the charging current tapers to a very low value, at which point the battery is fully charged. The second stage is often called the **Absorption** charging stage. A voltage setting of 14.3 volts ± 0.1 volts (7.15 ± 0.05 volt for a 6-volt battery) should be used when the battery temperature is 77°F (25°C). The battery is considered to be fully charged when the current drops below 0.5% of the battery’s rated capacity (0.5A for a 100Ah battery). The absorption stage will typically last 2 – 4 hours before the current reaches this level.

In the third stage, the charging voltage is reduced to a lower value that minimizes the amount of overcharge, while maintaining the battery at 100% state of charge. This third stage is often called the **Float** charging stage. A float voltage of 13.3 ± 0.1 volts (6.65 ± 0.05 volts for a 6-volt battery) should be used when the battery temperature is 77°F (25°C). The charging voltages at other temperatures can be determined from the following table:

Table 5-1. Charging Voltage at Different Temperatures for a 12 Volt Battery*

Temp °F	Absorption Voltage	Float Voltage		Temp °F	Absorption Voltage	Float Voltage
-40	16.88	15.86		70	14.41	13.39
-30	16.58	15.56		77	14.30	13.30
-20	16.30	15.28		80	14.27	13.25
-10	16.03	15.01		90	14.15	13.13
0	15.78	14.76		100	14.04	13.02
10	15.54	14.52		110	13.95	13.00
20	15.31	14.29		120	13.87	13.00
30	15.10	14.08		130	13.81	13.00
40	14.90	13.88		140	13.76	13.00
50	14.72	13.70		150	13.73	13.00
60	14.56	13.54		160	13.71	13.00

* For a 6 volt battery, divide the voltage by 2. For a 2 volt battery, divide the voltage by 6.

See Appendix C for a chart of charging voltage versus temperature. Most chargers that have automatic temperature compensation use a simplified equation with a linear coefficient. The recommended linear coefficient for Lifeline® batteries is 0.0022V/cell per degree F (0.013V/degree F for a 12V battery).



The following table provides recommended absorption times for Lifeline® Batteries:

Table 5-2 Recommended Absorption Times

Average Depth of Discharge (DOD)	Absorption Time
Less than 30%	2 hours
30 – 50%	3 hours
More than 50%	4 hours

The absorption time may need to be fine-tuned from these values to assure the batteries consistently reach full charge per the criteria given above (charging current is less than 0.5% of battery’s rated capacity).

The charging current during the Bulk stage should be set as high as practical; higher current levels mean faster recharge time and less time for the plates to become sulfated. Due to the low impedance design, Lifeline® batteries can tolerate in-rush current levels as high as 5C (500A for a 100Ah battery). The time to reach full charge at temperatures in the range of 20-30°C (68 to 86°F) can be estimated from the following equation:

$$\text{Charge Time} = [(DOD/100) \times \text{Rated Capacity (Ah)} \div \text{Output of Charger (Amps)}] + \text{Absorb Time}.$$

For example, charging a 100Ah battery at 40% DOD with a 25A charger would take:
 $[(40/100) \times 100 \div 25] + 3 = 4.6$ hours to reach full charge.

If a 10A charger is used, it would take:
 $[(40/100) \times 100 \div 10] + 3 = 7$ hours to reach full charge.

Note that this formula is approximate and the full charge state should be verified using the criteria given above (current drops below 0.5% of rated capacity). If the recharge does not return 102 to 110% of the discharged capacity, the battery’s state of charge will gradually “walk down” as it is cycled leading to premature failure. Therefore, it is important to verify that the battery is not being undercharged.

For repetitive deep cycling applications (deeper than 50% DOD), chargers should have an output current of at least 0.2C (20 Amps for a 100 Ah battery). If the output current is less than this value, the cycle life of the battery may be negatively affected. If a charger with at least 0.2C output is not practical, an alternative charge profile using a low rate constant current stage at the end of the absorption stage will normally improve the cycle life. The constant current stage should be at 0.02C (2 Amps for a 100Ah battery) for no more than one hour.

Some types of battery chargers allow the user to input the Peukert constant to obtain an optimum charging profile. For Lifeline® batteries, the recommended value of the Peukert constant is $n = 1.12$.



5.5 Conditioning

Conditioning should only be done when the battery is showing symptoms of capacity loss due to extended time in a partial or low state of charge condition. This could be caused, for example, by low charging voltage for an extended number of charge cycles, or by repeatedly charging to only 90% state of charge.

NOTE: Some chargers use the term Equalizing Charge instead of Conditioning Charge. An Equalizing Charge is generally applied to flooded lead acid batteries that are susceptible to acid stratification. However, an Equalizing Charge may be used to provide a Conditioning Charge for Lifeline® batteries as described below.

To apply a conditioning charge, first go through the normal charge cycle to bring the battery to full charge. The conditioning charge should then be applied by charging for 8 hours. At 77°F (25°C), the conditioning voltage should be set at 2.58 VPC (15.5 volts for a 12-volt battery). The conditioning voltage at other temperatures is shown in Table 5-2. By using the temperature-compensated conditioning voltage, batteries that are not in controlled temperature environments may be conditioned without bringing them to room temperature. If temperature compensation is not available, it is best to bring the battery as close to room temperature as possible before applying the conditioning charge.

Table 5-2. Conditioning Voltage at Different Temperatures for a 12 Volt Battery*

Temperature °F	Conditioning Voltage	Temperature °F	Conditioning Voltage
-40	18.05	70	15.58
-30	17.75	77	15.48
-20	17.47	80	15.44
-10	17.20	90	15.32
0	16.95	100	15.21
10	16.71	110	15.12
20	16.48	120	15.04
30	16.27	130	14.98
40	16.07	140	14.93
50	15.89	150	14.90
60	15.73	160	14.88

* For a 6-volt battery, divide the voltage by 2. For a 2-volt battery, divide the voltage by 6.

In systems with limited charging output or long time periods between full charge, a routine conditioning charge may be helpful in preventing capacity loss due to sulfation. If a routine conditioning charge is used, the time duration should be less than the 8 hours specified above. As a starting point, a routine conditioning charge may be applied every 3 weeks for 4 hours at the voltage levels given above. The frequency should be fine-tuned to assure the batteries are not being undercharged or over-charged. In most cases, the optimum frequency will be between 2 and 4 weeks.



5.6 Deep Discharge Recovery

Batteries having an OCV less than 1.93 volts/cell (11.6 volts for a 12V battery) are considered deeply discharged. This condition may occur when batteries are stored for long periods of time without boost charging, or when discharged below 100% and not recharged. Batteries in this condition may sometimes be recovered using a constant current charge instead of a constant voltage charge. The deep discharge recovery procedure is given below.

WARNING: This procedure should only be done by a trained technician. Refer to Chapter 6 for safety precautions.

WARNING: This procedure should only be done in a well ventilated area because a significant amount of hydrogen gases and fumes may be released from the battery.

CAUTION: If the battery becomes hot (above 55°C/130°F) during this charge, stop the current and allow the battery to cool to room temperature before continuing.

1. Stabilize the battery at 20-30°C (68-86°F) for at least 24 hours.
2. Charge at a constant current of 5% of rated (24 hour) capacity until the voltage reaches 2.58 VPC (15.5 volts for a 12-volt battery), then continue charging at this rate for an additional 4 hours. Note that the charging voltage may get as high as 3.0 volts/cell, so the power supply must be capable of outputting this level to maintain constant current. This constant current charge may take 16 to 20 hours.

NOTE (1): If the battery voltage exceeds 2.58 volts/cell at the beginning of charge and then drops below 2.58 volts/cell within 2 hours, continue charging at constant current until the voltage reaches 2.58 volts/cell a second time. Then continue charging for an additional 4 hours as specified above.

NOTE (2): If the battery voltage does not reach 2.58 volts/cell within 24 hours, the charge should be terminated.

5.7 Capacity Testing

To determine the actual capacity of a Lifeline® AGM battery relative to its rated capacity, a full discharge test should be performed. Although there are various battery testers available on the market, such as carbon pile testers, impedance meters, conductance meters, and others, these testers are not reliable in determining the battery's actual capacity. To determine the battery's actual capacity relative to its rated capacity, use the following procedure:

1. Stabilize the battery at 68-86°F (20-30°C) for at least 24 hours.
2. Bring the battery to full charge as described in Sections 5.4, 5.5 or 5.6 as applicable.
3. Discharge the battery at a constant current of 25 amperes until the voltage falls to 10.5 volts (5.25 volts for a 6 Volt battery). Record the discharge time in minutes.
4. Compare the measured discharge time to the published 25A rating (reserve capacity minutes) for the battery.
5. If the battery delivers less than 80% of the rated capacity the conditioning procedure given in Section 5.5 should be attempted and the battery capacity should be retested.
6. If the battery delivers less than 50% of its rated capacity, it should be replaced. However, the user should determine the amount of capacity needed for their particular application and adjust the pass/fail threshold accordingly.



5.8 Temperature Considerations

The temperature of the battery has a significant impact on its performance and life capability. Battery capacity is reduced significantly in cold temperatures. For example, a battery that operates continuously at -18°C (0° F.) will only provide about 60% of its normal room temperature capacity. Appendix C provides a chart of capacity versus temperature at various discharge rates.

Battery calendar and cycle life are also affected by temperature. As a rule of thumb, the battery life decreases by 50% for every 10°C rise in temperature. Thus, a battery that lasts 6 years at 25°C will last 3 years at 35°C, 1.5 years at 45°C, and 0.75 years at 55°C. Similarly, a battery that lasts 1000 cycles at 25°C will last 500 cycles at 35°C, 250 cycles at 45°C, and 125 cycles at 55°C.

It should be realized that the temperature of the battery itself and ambient temperature can be vastly different. While ambient temperatures can change very quickly, battery temperature change is much slower. This is due to the large thermal mass of the battery. It takes time for the battery to absorb temperature and it takes time for the battery to relinquish temperature.

If the battery is exposed to cold climates, the state of charge should be kept at a maximum to prevent freezing of the electrolyte. A fully charged battery will not freeze even under the coldest weather conditions, but a discharged battery will freeze even when moderately cold. Table 6-2 gives the freezing point of electrolyte at various states of charge.

Frozen batteries are not capable of charging or discharging except at very low rates, and may be permanently damaged by expansion of the electrolyte. If a battery becomes frozen, it should be thawed by placing it at room temperature for at least 24 hours, and then charged in accordance with Sections 5.4, 5.5 or 5.6 as applicable. However, if the battery container has any evidence of cracking, the battery is no longer serviceable and should not be used.

Table 6-2. Electrolyte Freezing Point at Various Battery States of Charge

Battery State of Charge (%)	Approximate Electrolyte Freezing Temperature
100%	-70°C (-94°F)
75%	-47°C (-53°F)
50%	-25°C (-13°F)
25%	-13°C (9°F)
0%	-6°C (21°F)



5.9 Servicing

Lifeline® AGM batteries do not need electrolyte adjustment as do flooded lead-acid batteries, but periodic servicing is essential to assure continued integrity of the battery system. Servicing should include good record keeping to document the life history of the battery system and to identify whether corrective action needs to be taken.

The following servicing schedule is recommended:

Installation

1. Within the first week of operation, put the battery system on a full charge cycle and record the following parameters (baseline readings):
 - a. Charger amperage output
 - b. Absorption voltage at battery system terminals
 - c. Float voltage at battery system terminals
 - d. Ripple voltage at battery system terminals (see Note 1)
 - e. Voltage of each battery when charger is in float mode (see Note 2)
 - f. Ambient temperature
2. Allow the battery system to discharge until it reaches the low voltage disconnect, and record the following parameters:
 - a. Run time
 - b. Capacity delivered (Ampere-hours)
 - c. Average DC load (amperes)
 - d. Endpoint voltage at battery system terminals
3. After discharging, return the battery to a fully charged condition as soon as possible.

Quarterly

1. Inspect each battery terminal for any corrosion deposits. If present, remove with a wire brush, neutralize with a baking soda solution, dry, and then apply NO-OX-ID grease. If connections are loose or had to be loosened to remove corrosion deposits, re-torque terminal bolts to the values given in Section 4.2.
2. Record the following parameters with the battery on float charge:
 - a. Float voltage at battery system terminals
 - b. Voltage of each battery (see Note 2)
 - c. Ambient temperature

Yearly

1. Put the battery on a full charge cycle and record the following parameters:
 - a. Charger amperage output
 - b. Absorption voltage at battery system terminals
 - c. Float voltage at battery system terminals
 - d. Ripple voltage at battery system terminals (see Note 1)
 - e. Voltage of each battery when charger is in float mode (see Note 2)
 - f. Ambient temperature
2. Allow the battery system to discharge until it reaches the low voltage disconnect, and record the following parameters:
 - a. Run time
 - b. Capacity delivered (Ampere-hours)
 - c. Average DC load (amperes)
 - d. Endpoint voltage at battery system terminals
3. After discharging, return the battery to a fully charged condition as soon as possible.

**NOTES:**

- (1) Excessive ripple voltage will negatively impact battery life. Maximum recommended ripple voltage (peak to peak) is 0.5% of the float voltage setting.
- (2) A large variation of individual float voltages in a new battery system is normal because of variations in oxygen recombination efficiency due to slight variations of acid saturation within the AGM. As the battery ages, the variation should drop to lower values. Excessive variation of float voltages after the first 1-2 months is an indication that the batteries may be out of balance. If individual battery voltage readings during float charge vary by more than 0.10 volt per cell (0.10 volt for 2V batteries, 0.30 volt for 6V batteries, and 0.6 volt for 12V batteries), then a conditioning charge per Section 5.5 is recommended.

5.10 Recycling

Batteries that have reached the end of their service life should be returned to a local or regional collection center for recycling. All local regulations and ordinances must be followed. Never discard Lifeline® AGM batteries in the trash or in a landfill. The recycle rate of lead-acid batteries is close to 100% and this is very good for the environment!



CHAPTER 6 - SAFETY INFORMATION

There are four main safety hazards associated with the use of any valve regulated lead acid (VRLA) battery. These hazards are as follows: a) Release of ignitable gas, b) Exposure to acid, c) Shorting of terminals, d) Thermal runaway. This chapter provides a description of each of these hazards and means to mitigate them.

6.1 Release of Ignitable Gasses

All lead acid batteries, including VRLA batteries, produce hydrogen and oxygen gases during normal charging. Even though VRLA batteries are designed to recombine these gases internally, the recombination efficiency is less than 100%. Small amounts of hydrogen and oxygen are released from the pressure relief valve during charging. Normally, the hydrogen gas dissipates very rapidly and never reaches a concentration level that is hazardous. However, if the battery is installed in an enclosure with minimal airflow, the concentration of hydrogen could build up to a high enough concentration to be of concern. Hydrogen can ignite at concentrations as low as 4% in air. **For this reason, never install a Lifeline® AGM battery in a sealed or an airtight container.**

6.2 Exposure to Acid

All lead acid batteries contain sulfuric acid in the electrolyte, which can cause chemical burns to body tissue. Although Lifeline® AGM batteries are classified as Nonspillable, exposure to the electrolyte is possible under extreme conditions (e.g., if the battery is cracked open or crushed). **In the event that electrolyte is displaced from the battery, avoid contact with the skin, eyes and clothing. In the event of an accident, flush with water and call a physician immediately.**

6.3 Shorting of Terminals

Lifeline® AGM batteries have very low internal impedance and therefore are capable of delivering high currents if the external terminals are short circuited. The resulting heat can cause severe burns and is a potential fire hazard. Accidentally placing metal objects across the terminals can result in severe skin burns. **It is a good practice to remove all metallic items such as belt buckles, watches, bracelets and rings when installing or servicing batteries. As a further precaution, insulating gloves should be worn and only insulated tools should be used when installing or servicing batteries.**

6.4 Thermal Runaway

Thermal runaway is a condition in which the battery temperature increases rapidly resulting in extreme overheating of the battery. Under rare conditions, the battery can melt, catch on fire, or even explode. Thermal runaway can only occur if the battery is at high ambient temperature and/or the charging voltage is set too high. As the battery accepts current, its internal temperature rises. The rise in temperature reduces the battery impedance, causing it to accept more current. The higher current further heats the battery, and so on, causing the battery temperature to “runaway”. An upper limit will eventually be reached when the electrolyte starts to boil, but once the electrolyte has boiled away, the temperature can climb even further to the point of plastic meltdown and possible fire.

As of this writing, Concorde does not know of any Lifeline® AGM batteries that have failed due to thermal runaway. **To preclude the possibility of thermal runaway, the charging instructions in Chapter 5 should be carefully followed, especially if the battery will be subjected to high ambient temperatures. Batteries should not be installed near heat sources or in direct sunlight that may artificially elevate their temperature. Also, there should be adequate air circulation around the batteries to prevent heat build-up.**



APPENDIX A – GLOSSARY OF BATTERY TERMS

- AGM** - Stands for Absorbed Glass Mat. This is the separator system used in all Lifeline® AGM batteries.
- Active Material** - Electrode material which produces electricity during its chemical conversion. In the positive plate it is lead dioxide. In the negative plate, it is sponge lead.
- Ampere** - Unit of electrical current abbreviated as amps or A.
Amps = Watts/Volts or A = W/V.
- Ampere Hour (Ah)** - The capacity of a storage battery is measured in ampere hours. One ampere hour is defined as a current flow of one ampere for a period of one hour. Five ampere hours means a current flow of one ampere for five hours, a current flow of 2.5 amperes for 2 hours, or any multiple of current and time that will result in five. This relationship can be expressed as follows:
Capacity (Ampere hours) = I*T, where I is the current (in amperes) and T is the time (in hours). The capacity of a storage battery is based on a given discharge rate, since the capacity will vary with the rate of discharge.
- Boost Charge** - A charge applied to a battery which is already near a state of full charge, usually of short duration.
- Capacity** - The quantity of electricity delivered by a battery under specified conditions, usually expressed in ampere hours.
- Capacity, Rated** - A designation by the battery manufacturer which defines the performance of a new battery at a defined rate of discharge. For Lifeline® AGM batteries, the rated capacity is based on the 20-hour rate.
- Capacity, Residual** - Capacity remaining at particular point in time and set of operating conditions, usually at a partial state of charge condition.
- Cell Reversal** - Reversing of polarity within a cell in a multi cell battery due to over discharge.
- Charge** - The conversion of electrical energy from an external source, into chemical energy within a cell or battery.
- Charge Rate** - The rate at which current is applied to a cell or battery to restore its capacity.
- Charge Retention** - The ability of a charged cell or battery to resist self discharge.
- Charge, State of** - Ratio of the amount of capacity remaining in a battery to the capacity when fully charged. A battery at 25% state of charge has 25% capacity remaining versus what it could give if fully charged.
- Charger** - Device capable of supplying electrical energy to charge a battery.
- Charging** - The process of converting electrical energy to stored chemical energy. The opposite of discharging.
- Charging Efficiency** - Ratio of the Ampere hours delivered on discharge to the Ampere hours needed to fully charge a battery.
- Conditioning** - A special constant current charge process used to restore a battery's capacity after extended storage periods or deep discharge exposure. Also known as reconditioning.
- Constant Current (CC) Charge** - Charging technique where the output current of the charge source is held constant. Warning! This procedure may damage the battery if performed on a repetitive basis.
- Constant Voltage (CV) Charge** - Charging technique where the output voltage of the charge source is held constant and the current is limited only by the resistance of the battery and / or the capacity of the charge source. Also known as Constant Potential (CP) charge.



- Current** - The rate of flow of electricity. The movement of electrons along a conductor. It is comparable to the flow of a stream of water. The unit of measurement is an ampere.
- Cut Off Voltage** - Battery voltage reached at the termination of a discharge. Also known as end point voltage or EPV.
- Cycle** - One sequence of discharge and charge.
- Cycle Life** - The total number of charge/discharge cycles before the battery reaches end of life (generally 80% of rated capacity).
- Deep Discharge** - Withdrawal of more than 80% of the rated capacity.
- Depth Of Discharge** - The portion of the capacity taken out during a discharge, expressed as a percent of rated capacity.
- Discharge** - The conversion of the chemical energy of a cell or battery into electrical energy and withdrawal of the electrical energy into a load.
- End Of Life** - The stage at which the battery fails to deliver acceptable capacity (typically 80% of nameplate rating).
- Float charge** - A method of maintaining a battery in a charged condition by continuous, long term, constant voltage charging at level sufficient to balance self-discharge.
- Gassing** - The evolution of gas from one or more of the electrode plates in a cell. Gassing commonly results from local action (self discharge) or from the electrolysis of water in the electrolyte during charging.
- Internal Impedance** - Same as Internal Resistance.
- Internal Resistance** - The opposition or resistance to the flow of a direct electric current within a cell or battery; the sum of the ionic and electronic resistance of the cell components. Its value varies with the current, state of charge, temperature, and age. With an extremely heavy load, such as an engine starter, the cell voltage may drop significantly. This voltage drop is due to the internal resistance of the cell. A cell that is partly discharged has a higher internal resistance than a fully charged cell, hence it will have a greater voltage drop under the same load. This change in internal resistance is due to the accumulation of lead sulfate in the plates.
- Open Circuit Voltage** - The voltage of a battery when it is not delivering or receiving power, and has been at rest long enough to reach a steady state (normally, at least 4 hours).
- Overcharge** - The forcing of current through a cell after all the active material has been converted to the charged state. In other words, charging continued after 100% state of charge is achieved. The result will be the decomposition of water in the electrolyte into hydrogen and oxygen gas, heat generation, and corrosion of the positive electrode.
- Self Discharge** - The decrease in the state of charge of a cell or a battery, over a period of time, due to internal electrochemical losses.
- Series Connection** - Voltage of the system is cumulative. Capacity stays the same.
- Shelf Life** - The period of time (measured from date of manufacture) at a specified storage temperature after which the cell or battery needs to be boost charged so it does not suffer permanent capacity loss.
- State Of Charge (SOC)** - The available ampere hours in a battery at any given time relative to its full charge capacity.
- State Of Health (SOH)** - The available ampere hours in a battery when fully charged relative to its rated capacity.
- Sulfation** - Refers to the formation of hard lead sulfate crystals in the plates that are difficult, if not impossible, to reconvert to active material.
- Temperature, Ambient** - The average temperature of the battery's surroundings.



- Temperature, Cell** - The average temperature of the battery's internal components.
- Trickle Charging** - Method of charging in which the battery is either continuously or intermittently connected to a constant current charging source to maintain the battery in a fully charged condition. Not recommended for use with Lifeline® AGM batteries.
- Vent Valve** - A normally closed check valve located in a cell which allows the controlled escape of gases when the internal pressure exceeds its rated value.
- Venting** - A release of gas either controlled (through a vent) or accidental from a battery cell.



APPENDIX B – FREQUENTLY ASKED QUESTIONS (FAQ'S)

1. What does AGM stand for?

It stands for Absorbed Glass Mat, the type of separator used in all Lifeline® AGM batteries.

2. What is the difference between AGM batteries and Gel batteries?

Both AGM and Gel batteries utilize oxygen recombination and pressure relief valves to minimize water loss and allow maintenance-free operation. AGM batteries have the advantage lower internal impedance to support high load currents and have better capacity at low temperatures. Gel batteries can develop air pockets in the gelled electrolyte during operation which can cause local hot spots and burn out the plates. They have inferior performance at high discharge rates and low temperatures. Refer to Chapter 3 for further details.

3. Why should I choose Lifeline® AGM batteries?

Concorde has been supplying Lifeline® AGM batteries to the marine and recreational vehicle marketplace for over 20 years, providing excellent performance, reliability and life. With this long history and wide variety of successful applications, prospective customers are assured that Lifeline® AGM batteries have proven themselves over and over again.

4. What depth of discharge should be used when sizing a battery?

To get the best cycle life, the average depth of discharge should be as low as possible. Concorde recommends the average depth of discharge be no greater than 50% of the battery's 20 hour rating.

5. What is the maximum number of batteries that can be connected in parallel?

There is no theoretical limit to the number of batteries that can be connected in parallel. As more batteries are paralleled together, the risk of one faulty battery affecting the entire battery bank increases. Depending on the criticality of the application, there may be a need to isolate each battery or battery string for fault protection or to allow servicing of individual batteries. This can be accomplished by incorporating additional circuitry in the battery system that includes fuses, circuit breakers, or diodes. For more details on this subject, contact Concorde Battery for technical assistance.

6. May Lifeline® AGM batteries be installed in sealed containers?

NO! Do not install Lifeline® AGM batteries in a sealed container or enclosure. During storage, charging, or discharging hydrogen gas can be released and must be ventilated to prevent the possibility of ignition and/or explosion.

7. What is the best way to charge my battery?

Charge with a 3 stage charger that compensates the voltage setting as the battery temperature changes. See Section 5.4 for further information.

8. What is the best charge voltage setting for outdoor applications if temperature sensing is not available?

NONE! Charging voltage varies widely depending on the battery's temperature and there is no single voltage that will work over a wide temperature range. Batteries will fail prematurely if this is attempted.

9. How can I tell if my battery is fully charged?

For a battery at room temperature, it can be considered fully charged when the charging current falls below 0.5A per 100Ah of rated capacity. The open circuit voltage (after at least 4 hours of rest) will be 2.17 volts per cell or higher (13.0 volts for a 12-volt battery), regardless of the battery temperature.

10. What causes some batteries to have convex or concave end walls?

Lifeline® AGM batteries contain a pressure relief valve (PRV) that prevents excessive pressure buildup when the battery is being charged, and automatically reseals once the pressure is released. A slight bulge in the battery container (convex end walls) can appear when the internal pressure is above the surrounding atmospheric pressure but not enough to open the PRV. Alternatively, the end walls can flex inward (concave end walls) when the internal pressure is less than surrounding atmospheric pressure. Both of these conditions are normal and do not affect the battery's operation



11. Do all the batteries in a series string have to be the same model/size?

Yes. Do not mix different models/sizes of batteries in the same string.

12. Are there any issues with having parallel strings of different battery models/sizes, as long as each string has the same model/size battery in series?

No, since the strings are in parallel they will operate at the same voltage level and will self-regulate. Refer to Section 5.2 for proper installation procedures for parallel strings. Make sure the batteries are all at 100% state of charge before connections are made.

13. Are there any issues with adding a new battery string in parallel with an old string?

No, since the strings are in parallel they will operate at the same voltage level and will self-regulate. Refer to Section 5.2 for proper installation procedures for parallel strings. Make sure the batteries are all at 100% state of charge before connections are made.

14. Is it better to use 2V, 6V or 12V batteries as building blocks to make a 24V or 48V battery bank?

As long as the total voltage and capacity of the bank is equivalent, it doesn't make a lot of difference which voltage is selected for the building block. To minimize the number of parallel connections in higher capacity banks, it is sometimes preferable to use 2V or 6V batteries instead of 12V batteries. However, having just one string of 2V or 6V batteries may not be the best choice because a single point failure in that string would take down the entire bank.

15. How do I know when it is time to replace my battery?

Replace the battery when it no longer is capable of supporting the discharge load for the minimum required run time. See Section 5.7 and/or Section 5.9 for capacity testing procedure. **Note:** short duration load tests and impedance/conductance measurements are not reliable to determine the actual capacity of a battery.

16. Can I replace one or several bad batteries in a series string without affecting the other batteries in that string?

Unless the string is fairly new (less than 12 months year old), replacing only the bad one(s) will cause the other batteries to be under-charged and/or over-discharged, which will negatively affect their performance and remaining life. Therefore, it is best to replace the entire string. However, if it is decided to replace only one or some of the batteries, make sure all the batteries are at 100% state of charge before connections are made.



APPENDIX C – CHARTS AND GRAPHS

Battery Load Voltage vs. DOD

Below are listed the 1 hour, 8 hour, 20 hour and 120 hour load voltages during a discharge cycle to 100% discharge (10.5V endpoint) for a 12V battery at 77°F (25°C).

DOD (%)	1 hr. Rate	8 hr. Rate	20 hr. Rate	120 hr. Rate
10	12.23	12.60	12.65	12.69
20	12.16	12.51	12.55	12.58
30	12.07	12.39	12.42	12.45
40	11.96	12.25	12.28	12.32
50	11.83	12.11	12.15	12.18
60	11.70	11.98	12.02	12.05
70	11.55	11.79	11.83	11.88
80	11.38	11.59	11.61	11.65
90	11.15	11.32	11.34	11.40
100	10.50	10.50	10.50	10.50

NOTE: Multiply by 2X for a 24V battery bank and 4X for a 48V battery bank.

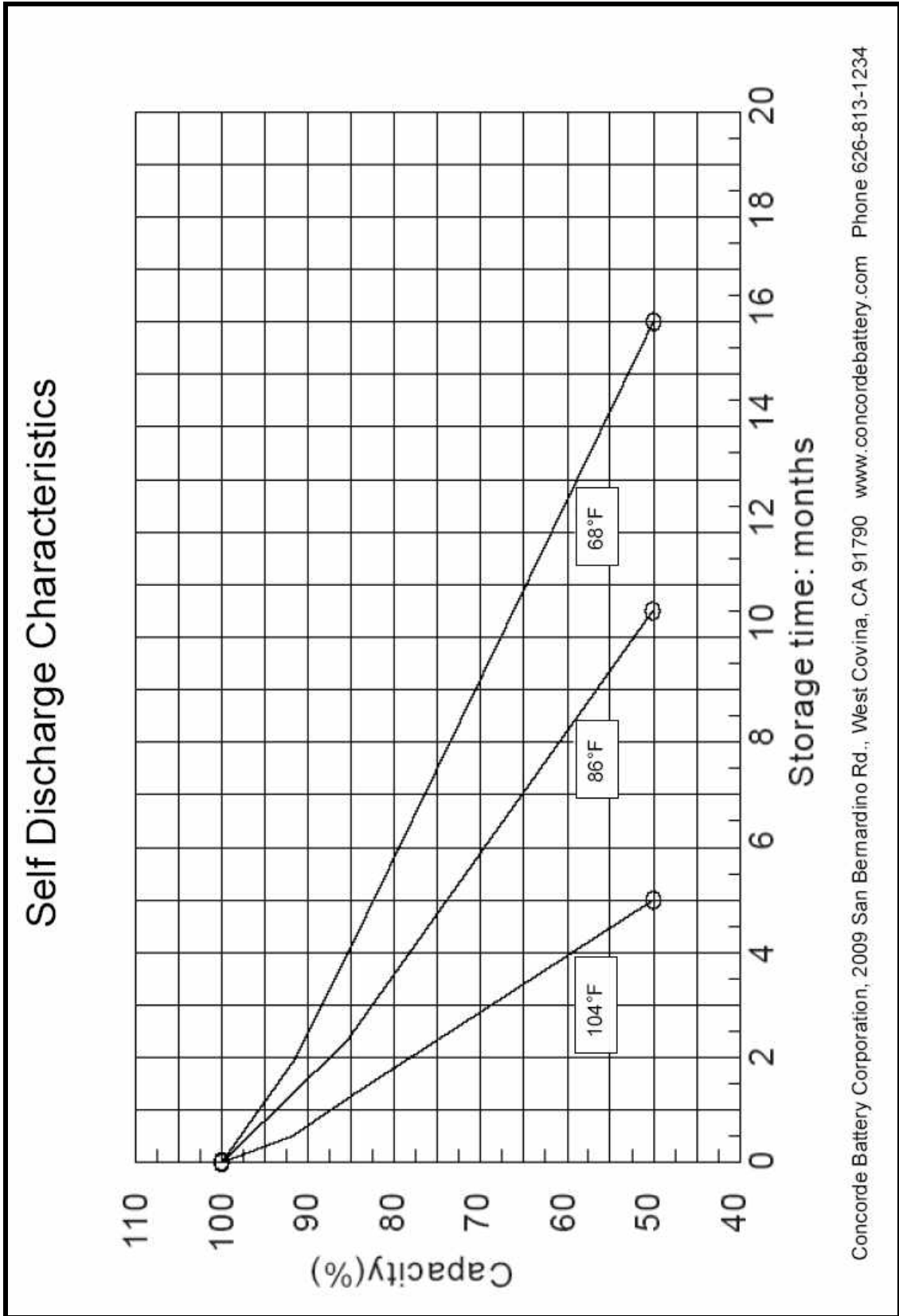
Note that these voltages are approximate and will vary as the battery ages. They are, however, a fair indicator of state of charge and can be used when setting low voltage alarms or disconnects. For example, if the average load is 50A and the battery has a rated capacity of 400 AH at the 8-hour rate, the minimum discharge voltage would be 12.11 volts for a 50% DOD.

SOC (%) vs. OCV

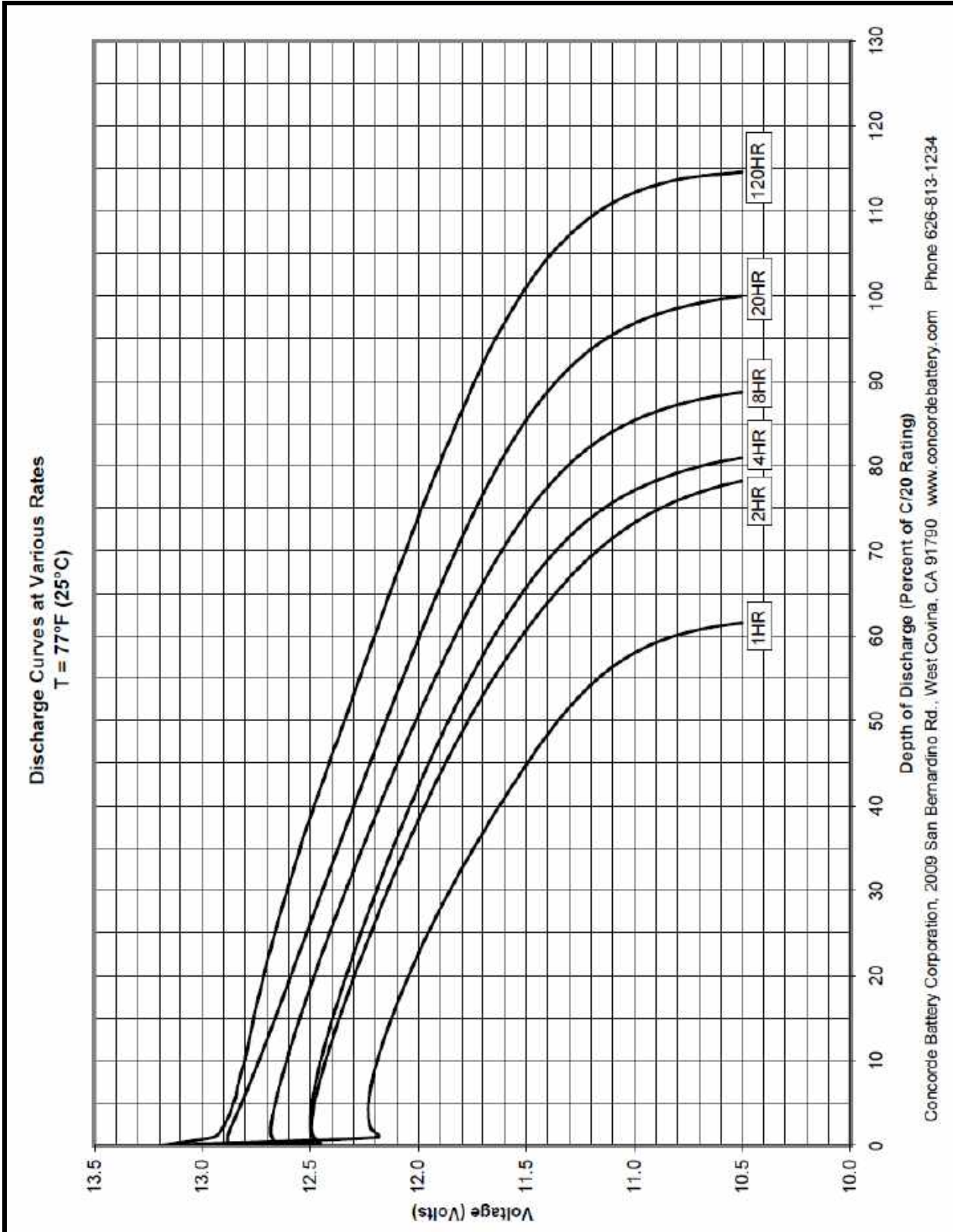
An easy method to estimate the State of Charge (SOC) of the battery is by measuring its Open Circuit Voltage (OCV). This measurement should be made after the battery has been at rest for a minimum of four hours with the battery shut off from its charging source and load. The reference temperature is 77°F (25°C), but the OCV does not change appreciably at other temperatures (temperature coefficient is 0.10 millivolts/cell per °F).

State of Charge (%)	OCV of 2V battery	OCV of 6V battery	OCV of 12V battery	OCV of 24V battery	OCV of 48V battery
100	>2.13	>6.39	>12.78	>25.56	>51.12
90	2.11	6.33	12.66	25.32	50.64
80	2.09	6.27	12.54	25.08	50.16
75	2.08	6.24	12.48	24.96	49.92
70	2.07	6.21	12.42	24.84	49.68
60	2.05	6.15	12.30	24.60	49.20
50	2.03	6.09	12.18	24.36	48.72
40	2.01	6.03	12.06	24.12	48.24
30	1.99	5.97	11.94	23.88	47.76
25	1.98	5.94	11.9	23.76	47.52
20	1.97	5.91	11.82	23.64	47.28
10	1.95	5.85	11.70	23.40	46.80
0	<1.93	<5.79	<11.58	<23.16	<46.32

These voltage levels are applicable for aged batteries. The voltage levels for a new battery will be somewhat higher at a given state of charge. For example, a new battery typically has an OCV of 2.17 volts per cell (13.0 for a 12V battery) or higher at 100% SOC.



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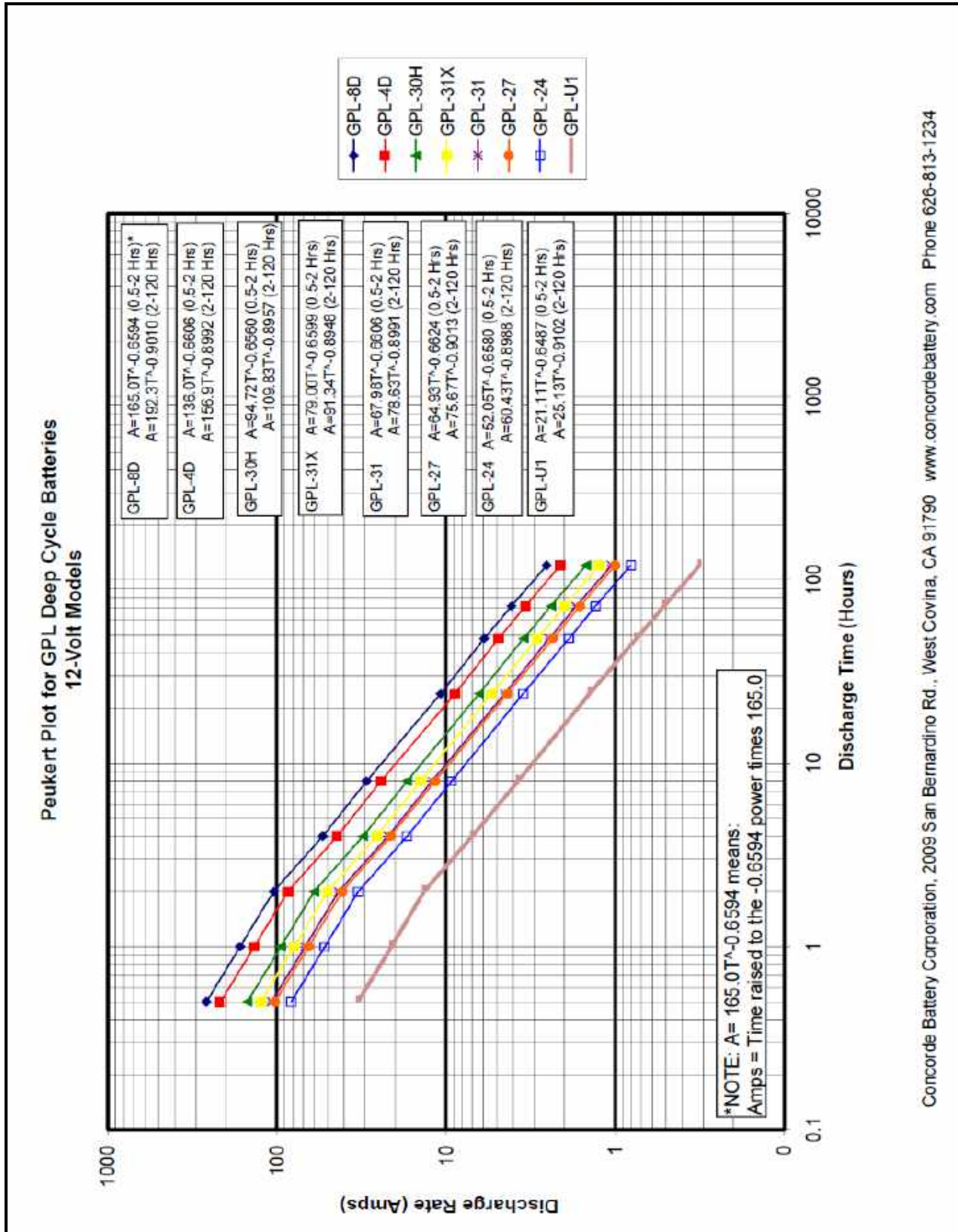


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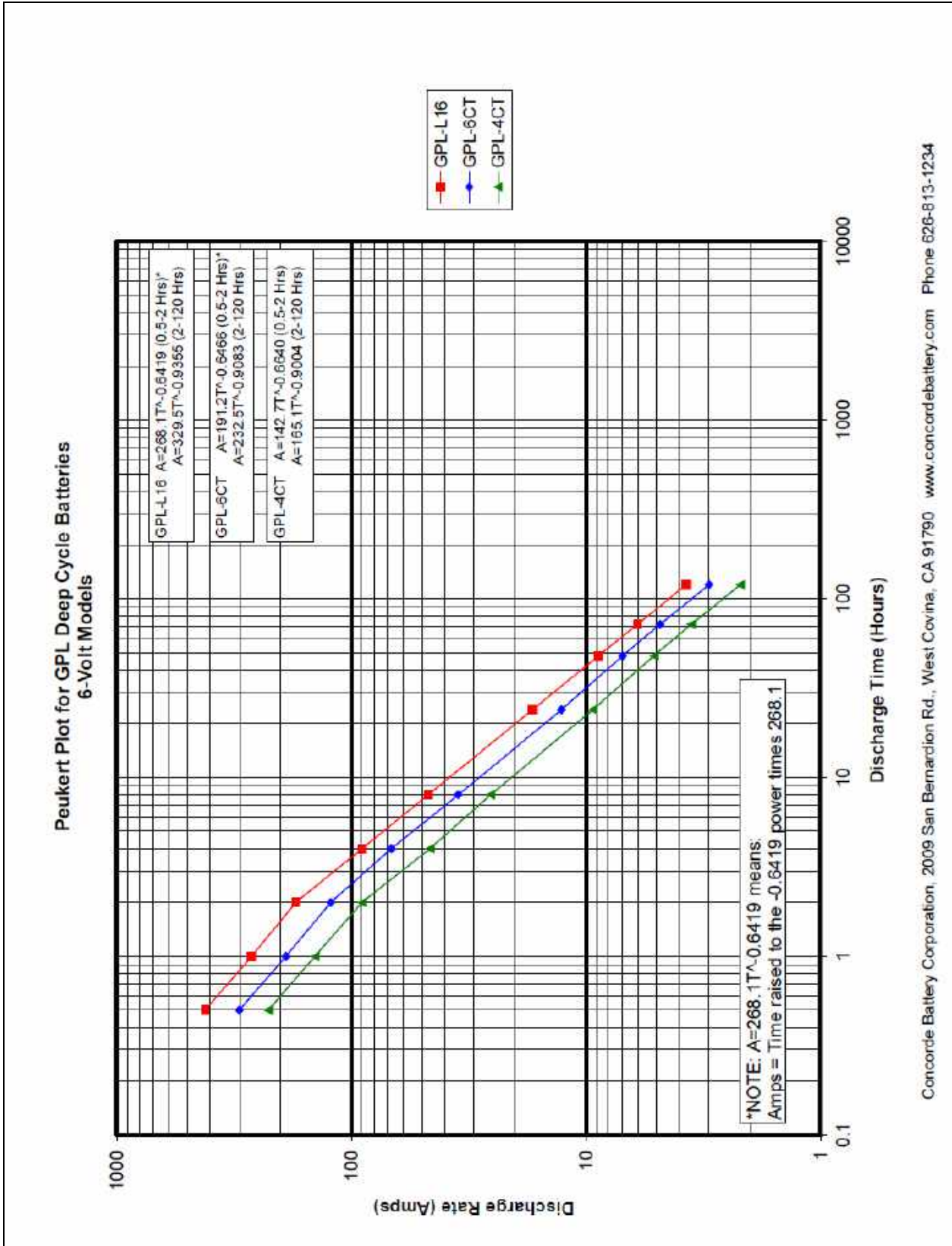
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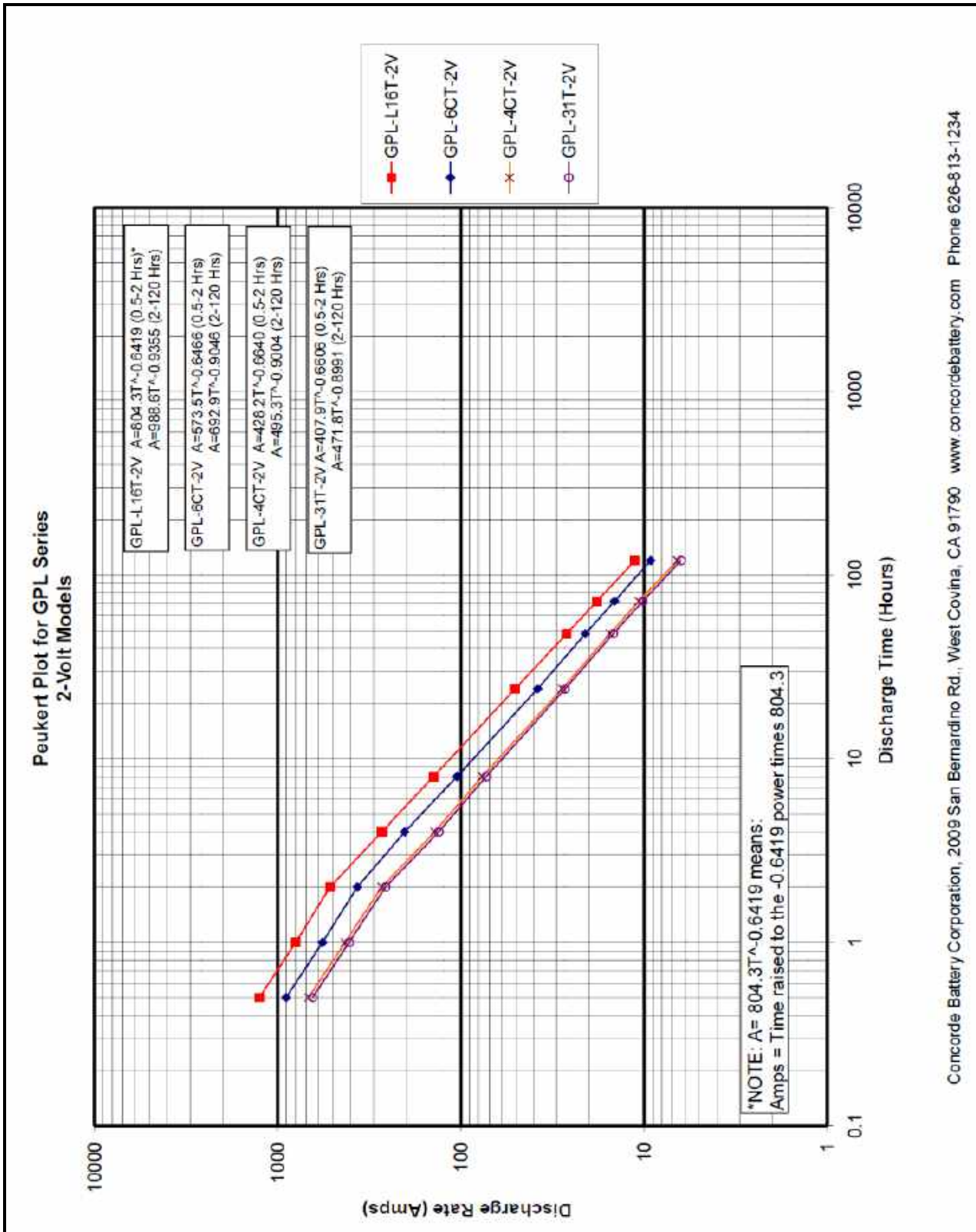
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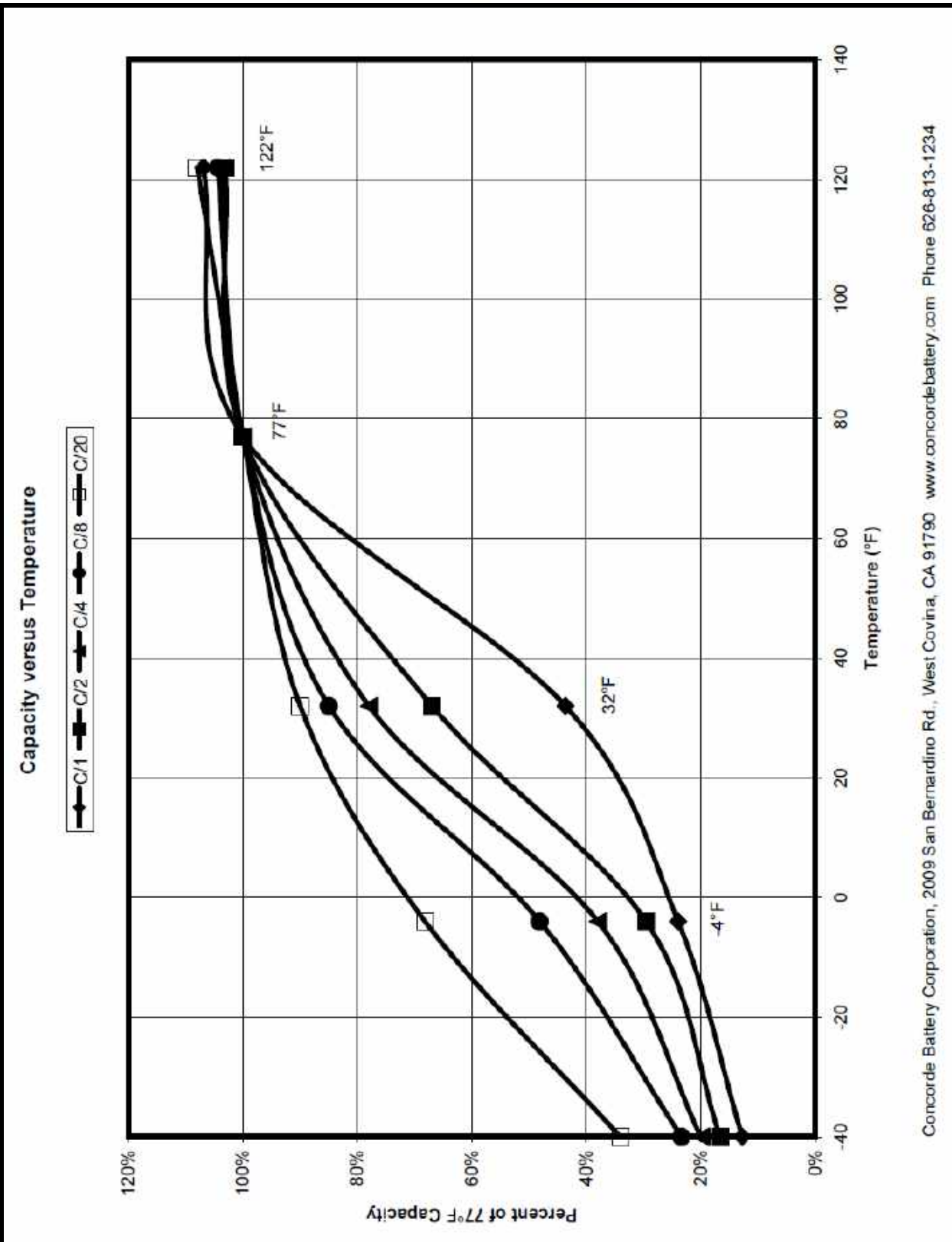
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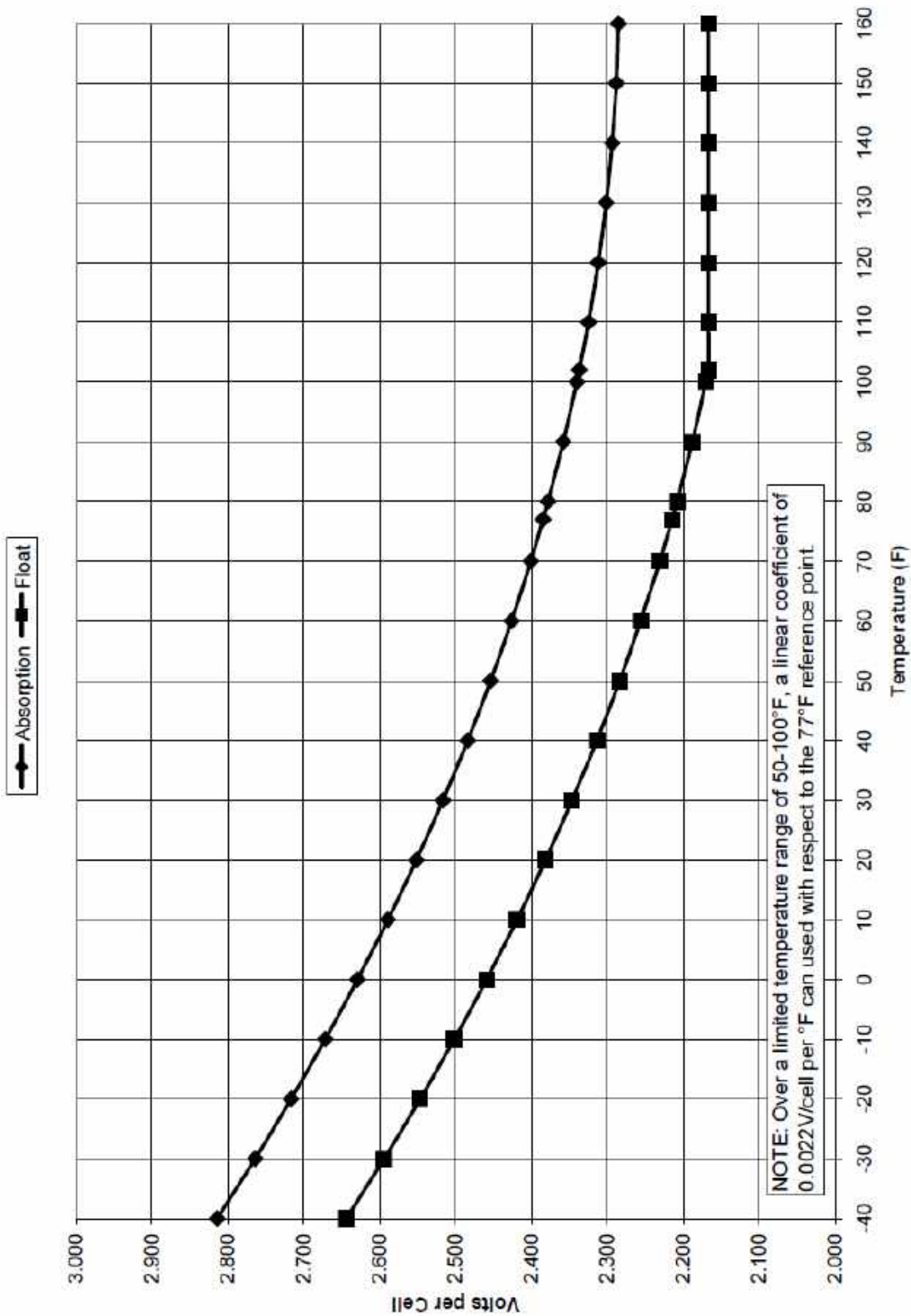
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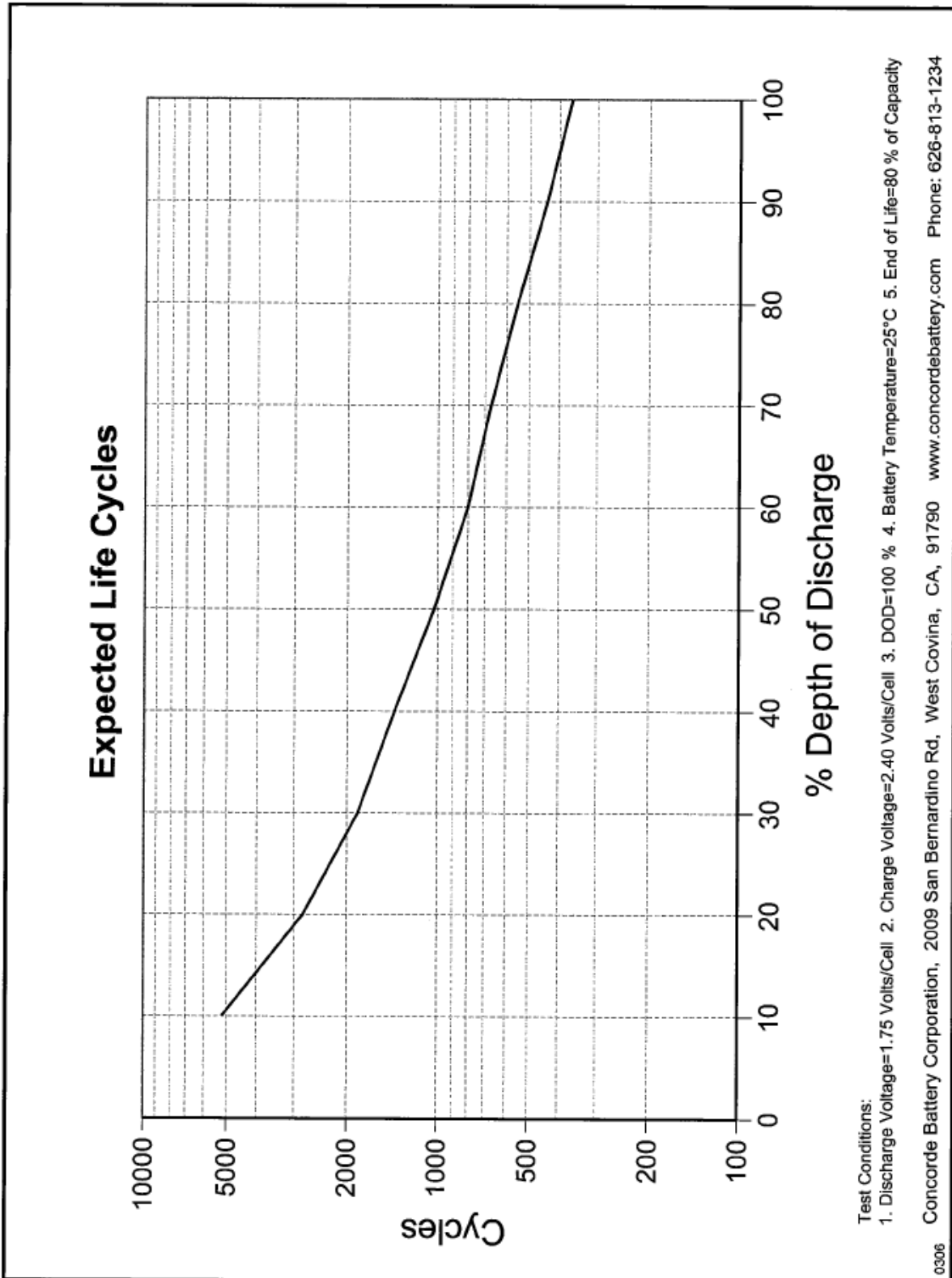


Charge Voltage vs. Temperature



NOTE: Over a limited temperature range of 50-100°F, a linear coefficient of 0.0022V/cell per °F can be used with respect to the 77°F reference point.

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Truma AquaGo® LP Gas Instant Water Heater

Model: Truma AquaGo® basic (DLE60B) *
 Truma AquaGo® comfort (DLE60C) *
 Truma AquaGo® comfort plus (DLE60CP) *

* Patent Pending

⚠ WARNING

If the information in these instructions is not followed exactly, a fire or explosion may result, causing property damage, personal injury, or death.

– Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Evacuate all persons from the vehicle.
- Shut off the gas supply at the gas container or source.
- Do not touch any electrical switch or use any phone or radio in the vehicle.
- Do not start the vehicle's engine or electric generator.
- Contact the nearest gas supplier or certified service technician for repairs.
- If you cannot reach a gas supplier or certified service technician, contact the nearest fire department.
- Do not turn on the gas supply until gas leaks have been repaired.

Installation and service must be performed by a certified service technician, service agency, or the gas supplier.

US

Operating instructions
Installation instructions

Page 2
 Page 25

To be kept in the vehicle.
 This document is part of the water heater.



Conforms to ANSI Std. Z21.10.3
 Certified to CSA Std. 4.3

Sales and Service

Truma Corp.
 825 East Jackson Blvd.
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 Toll Free 1-855-558-7862
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 info@trumacorp.com
 www.truma.net





Truma AquaGo® instant water heater (appliance)

Overview / Designation of parts

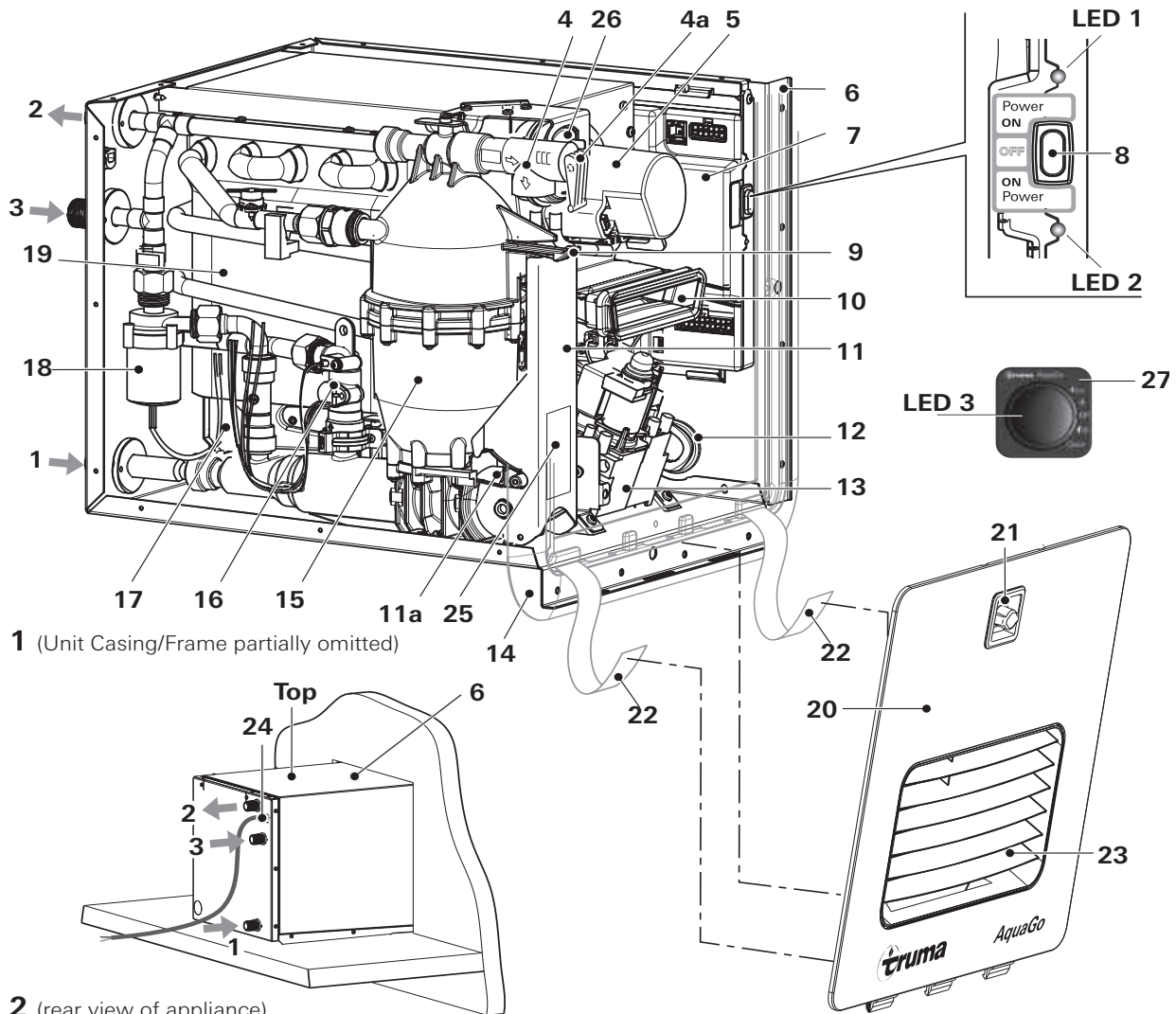


Fig. 1 (Unit Casing/Frame partially omitted)

Fig. 2 (rear view of appliance)

Key

- | | |
|--|--|
| 1 Cold water connection 1/2 in. NPT | 15 Temperature stabilizer |
| 2 Hot water connection 1/2 in. NPT | 16 Water flow sensor |
| 3 Circulation line connection 1/2 in. NPT
(comfort plus model only) | 17 Burner |
| 4 Pressure relief valve | 18 Circulation pump (comfort and
comfort plus models) |
| 4a Test lever | 19 Heat exchanger |
| 5 Flue fan | 20 Access door (assembly) |
| 6 Unit casing | 21 Turn lock |
| 7 Control unit | 22 Webbing |
| 8 POWER switch | 23 Ventilation grille (air inlet, exhaust) |
| 9 Latch | 24 Grommet for 12 V cable (power supply) |
| 10 Flue duct | 25 Type plate |
| 11 Easy Drain Lever | 26 Exhaust pressure switch |
| 11a Water inlet filter | 27 Control panel
(comfort and comfort plus models) |
| 12 Gas pipe grommet (side) | LED 1 Power ON LED – green |
| 13 Gas valve | LED 2 Error code LED – red |
| 14 Cover plate | LED 3 Status LED 3 – yellow |



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Trademark information

Truma AquaGo referred to as AquaGo below.

Intended use

The AquaGo instant water heater (appliance) may be used only to heat water in recreational vehicles (RVs) that are used for recreation, travel, or camping.

RVs are recreational vehicles designed as temporary living quarters for recreation, camping, or travel use. Such vehicles have their own power or are towed by another vehicle.

Prohibited use

Any use other than the intended use (see above) is prohibited.

Examples of prohibited use:

- Use in a marine environment.
- Use as part of a space heating system.
- Use in mobile homes.
- Use in food trucks or roadside food vending vehicles.
- Use in construction trailers.
- Use as a pool heater.

California Proposition 65 lists chemical substances known to the state to cause cancer, birth defects, death, serious illness, or other reproductive harm. This product may contain such substances or such substances may be formed from combustion of fuel (gas) or be components of the product itself.



Consumer Safety Information

Safety symbols and signal words

⚠ This is the safety alert symbol. This symbol alerts you to potential hazards that can kill or hurt you and others.

⚠ DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to address practices not related to physical injury.

i Other important information or tips

Safety behavior and practices

Ensuring a safe operating environment

- **⚠ DANGER** Suffocation through exhaust gases. To ensure dissipation of exhaust gases, operate the appliance outdoors only.
 - Never use in enclosed spaces or tents or breathe in the exhaust gases.
 - If installing an awning, make sure that the exhaust system terminates outdoors.
 - If you park the RV in an enclosed space, such as a garage or repair shop:
 - You must block the fuel supply.
 - You must switch the appliance off at the control panel.

- Use the appliance only with a functioning LP gas and carbon monoxide detector installed in the RV. For installation, operation and function test follow the manufacturer's guidelines.
- Keep the air inlet and exhaust outlet free of obstructions in order to ensure clean combustion.
- **Do not** place articles on or against the appliance. Do not lean any objects against the water heater's access door or place any foreign objects within 2 feet (61 cm) of the access door.
- **Do not** use or store flammable materials near the appliance.
- **Do not** spray aerosols in the vicinity of the appliance while it is in operation.
- **Do not** modify the appliance.

Responsibilities of the operator

- Avoid possible serious health issues caused by electromagnetic radiation. All persons with a pacemaker are prohibited from opening the access door and maintaining the appliance during operation.
- The operator is responsible for the water filled into the appliance and its quality.
- The use of upright gas cylinders from which gas is taken in the gas phase is mandatory for the operation of gas regulators, gas equipment and gas systems. Gas cylinders from which gas is taken in the liquid phase (e. g. for forklifts) must not be used, since this would result in damage to the gas system.
- For your own safety it is absolutely necessary to have the complete gas installation regularly checked by an expert (at least every 2 years). The vehicle owner is always responsible for arranging the gas inspection.



Safe operation

- Use with LP gas (propane) only. Butane or any mixtures containing more than 10% butane must not be used.
- LP tanks must be filled by a qualified gas supplier only.
- The nominal gas system pressure must be 10.5 in. wc.
- Hot water can be dangerous, especially for infants, children, the elderly, or infirm. It can cause severe burns. Therefore:
 - Never actuate the pressure relief valve (Fig. 1 – 4) as long as the appliance is still hot.
 - Never actuate the Easy Drain Lever (Fig. 1 – 11) as long as the appliance is under water pressure and/or still hot.
 - Always check the water temperature before entering a shower or bath.
- How long before hot water causes skin damage?

Temperature °F (°C)	Time before skin becomes scalded
155 (68)	1 second
148 (64)	2 seconds
140 (60)	5 seconds
133 (56)	15 seconds
127 (52)	1 minute
124 (51)	3 minutes
120 (48)	5 minutes
100 (37)	safe bathing temperature

Source: Moritz, A.R. / HERRIGUES, F.C.: Studies of thermal injuries: the relative importance of time and surface temperature in causation of cutaneous burns A. J. Pathol 1947; 23: 695 – 720

- The water pressure on the inlet side must be limited to 65 psi (4.5 bar), otherwise internal components of the appliance will be damaged. On (city) water connections with a pressure higher than 65 psi (4.5 bar) a pressure regulator is strongly recommended.

While driving

- To avoid damage, make sure the access door (Fig. 1 – 20) to the appliance is closed before moving the RV, as follows:
 - Turn lock is engaged.
 - Access door is flush with the cover plate.

- Shut OFF gas and the LP tank when moving the RV. This disables all gas appliances and pilot lights. Gas appliances must never be operated while the vehicle is in motion.
- Shut OFF the appliance when refueling or pumping gas, in multi-storey car parks, in garages or on ferries.
- To avoid damage, make sure no spray water enters the appliance when cleaning the RV, e.g., do not spray directly into the openings/ventilation grille.

Safe handling of malfunctions

- Switch OFF the gas supply and the appliance:
 - if anything seems to be out of the ordinary.
 - if you smell gas.
- **⚠ DANGER** Fire / explosion if you attempt to use an appliance that has been damaged by flooding or if the vehicle has been involved in an accident. A damaged appliance must be repaired by an expert or be replaced.
- Only carry out repairs yourself if the solution is described in the troubleshooting guide of this manual.
- A damaged appliance may have to be replaced with a new one.

Safe maintenance and repair

- Repairs may only be carried out by an expert.
- Children must not carry out maintenance, repair or cleaning work.
- Before accessing terminals, please secure all supply circuits (i.e. 12 V) and ensure that the gas supply is securely turned off.
- Any work involving connection or interconnecting wiring must be carried out by a licensed electrician.



TRUMA AQUAGO COMFORT WATER HEATER

- Only use AquaGo decalcification tablets to decalcify the appliance to avoid damage and the voiding of your warranty. Never use vinegar. Call your local AquaGo dealer or service provider or see www.truma.net for more information.
 - The use of non-Truma-approved substances for decalcification can cause chemical reactions and produce hazardous substances that could enter the drinking water.
- Any alteration to the appliance or its controls can cause unforeseen serious hazards and will void the warranty.
- After a long period of winterization: Flush all hot/cold water hoses and the appliance thoroughly with drinking water before using it.
- Keep the appliance free of foreign objects, e.g., leaves, animals, spiderwebs, and keep the area around free of snow and ice. The appliance will not function properly if the intake air or exhaust terminal is obstructed.

Safety features

The appliance is equipped with the following safety devices:

Flame monitoring

If the flame goes out, the gas supply to the burner is switched off (after 3 failed restarts).

Low-voltage (over-voltage) shutdown

If the voltage drops below 10 VDC (or rises above 16.4 VDC), the appliance shuts off.

Overcurrent protection

If there is a short circuit in the appliance (>10 A), a fuse on the control unit is activated and the appliance is switched off.

Monitoring of the flue fan

If there is a failure of the flue fan, the gas supply to the burner is switched off.

Monitoring of hot water temperature

A water over temperature switch avoids excessively high water temperatures in case of a fault.



Operating Instructions

Read and follow the “Consumer Safety Information” before operating the appliance.

▲ WARNING

Scalding injuries caused by hot water!

Water temperatures over 127°F (52°C) can cause severe burns or scalding and in extreme cases even death.

- Before using the hot water faucet or using the shower, allow the hot water to run until the water temperature no longer increases.
- Test the temperature of the water before placing a child in the bath or shower.
- Do not leave a child or an infirm person in the bath unsupervised.

How the appliance works

The appliance was developed exclusively for use in recreational vehicles (RVs).

The appliance is connected between the vehicle's fresh water supply and its hot water plumbing system.

It is powered by propane and a 12 V power supply. The ventilation grille on the access door allows combustion air to flow into the appliance and exhaust gas to flow out.

When the appliance is switched on, the water will be heated on demand:

- A volume-flow sensor in the appliance detects when the hot water faucet has been opened and the volume flow is greater than approximately 0.4 gallons/min (1.5 liter/min). The burner then starts automatically.
- The burner control continuously adjusts the heater output based on volume flow and inlet water temperature, so that the temperature at the hot water outlet is approximately 120 °F (49 °C). A temperature stabilizer is also installed in the appliance to minimize fluctuations of the outlet temperature.

- After some time the maximum temperature at the faucet or in the shower is reached. The length of time will depend on the model (AquaGo basic, AquaGo comfort and AquaGo comfort plus) and variations in the water plumbing (length of pipes, insulation, circulation line, etc.). Like in a home shower, a comfortable water temperature at the shower head is reached by mixing in cold water.
- When the volume flow is less than approximately 0.4 gallons/min (1.5 liter/min) and the faucet is closed, the burner is automatically switched off.

The AquaGo comfort and AquaGo comfort plus models

are equipped with a circulation pump. The circulation pump as well as the burner are switched on automatically by the control unit in order to keep the water temperature above 102 °F (39 °C) in “COMFORT” mode and 41 °F (5 °C) in “ECO” mode.

NOTICE

Risk of damage in frost conditions.

Refer to “Operation in frost conditions” on page 13.



Pressure relief valve

⚠ WARNING

Scalding injury from hot water and/or tampering with the pressure relief valve!

- Never actuate the pressure relief valve as long as the appliance is still hot.
- Do not place a plug or reducing coupling on the outlet part of the valve.



- The pressure relief valve is a safety component and must not be removed for any reason other than replacement.
- The pressure relief valve is not serviceable; if defective, it must be replaced.
- It must be replaced by a Truma pressure relief valve rated for 100 psi (6.9 bar) that is CSA-certified and registered.
- It must be replaced by a Truma certified service technician.
- Tampering with the pressure relief valve will void the warranty.

The appliance is equipped with a pressure relief valve (Fig. 3) that complies with the standard for Relief Valves for Hot Water Supply Systems, ANSI Z21.22

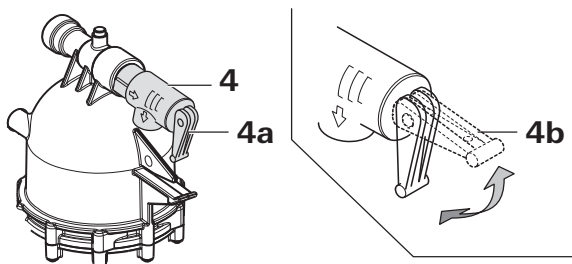


Fig. 3

- 4 Pressure relief valve
- 4a Lever in "valve closed during operation" position
- 4b Lever in "open" position

Access door

Opening the access door

1. Turn the turn lock counterclockwise ↺ into the vertical position.

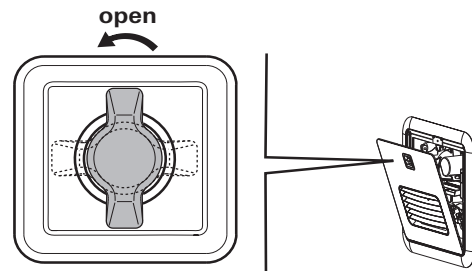


Fig. 4



- The access door can be opened in two different positions:
 - Position ① is the maximum opening width for switching the appliance on or off.
 - Position ② is the starting position for removing the access door.

NOTICE

Damage to the hinge!

- Do not try to remove the access door in Position ①. Position ① is the maximum opening width of the access door.
- Only remove the access door in Position ②.

2. Open the access door to Position ①.

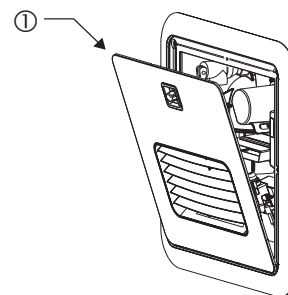


Fig. 5



Removing the access door

1. Open the access door to Position ②.
2. Move the access door upwards to remove it.

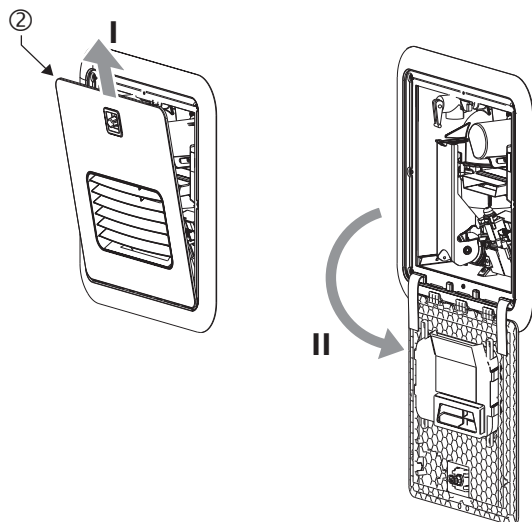


Fig. 6

Closing the access door

NOTICE

Damage to the access door and the RV if the access door is not closed properly!

- Make sure that the access door is flush with the cover plate when closed.

1. If removed, insert the access door into the cover plate.
2. Make sure that the webbing is not pinched between the access door and the cover plate.
3. Press the access door against the cover plate.
4. Turn the turn lock clockwise ↻ into the horizontal position.

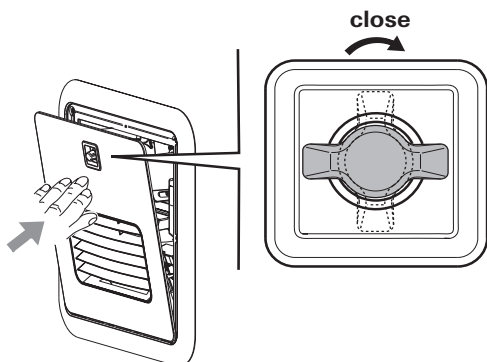


Fig. 7

Starting the appliance

▲ WARNING

Danger of over-temperature and toxic exhaust gases!

- Use with LP gas (propane) only. Butane or any mixtures containing more than 10 % butane must not be used.
- Keep the air inlet and exhaust gas outlet free of obstructions. Do not lean any objects against the water heater's access door or place any foreign objects within 2 feet (61 cm) of the access door.

▲ WARNING

Danger of combustion, personal injury and damage to RV!

- Keep the area around the appliance free from combustible materials, gasoline, and other flammable vapors or liquids.
- Switch the gas supply and the appliance off:
 - if anything seems to be out of the ordinary.
 - if you smell gas.
 - if you move the RV.
 - before entering a gas station.
 - before entering a tunnel.

Inspections before each use

Check the appliance for the following points before each use. In case of damage, contact an authorized Truma service provider and do not operate the appliance.

1. Check for visible damage, e.g., on the cover plate or access door.
2. Provide adequate quantities of propane gas and fresh water.
3. Switch ON and check 12 V power supply of your RV.
4. Check that the access door of the appliance is closed.
5. Keep the appliance free of foreign objects, e.g., leaves, animals, spiderwebs, and keep the area around free of snow and ice. The appliance will not function properly if the intake air or exhaust terminal is obstructed.



Operating procedures

NOTICE

Risk of damage in frost conditions.

In frost conditions, ambient temperatures below 39 °F (4 °C), there is a risk that water in pipes, faucets and appliances could freeze. This can cause considerable damage.

- Before you fill water into appliances and parts that transport water, you must heat the installation area sufficiently so that the water cannot freeze.

Proceed as follows to fill the appliance with water:

1. Close open bypass lines (if present). Insert the water inlet filter or heating cartridge – if removed. 2, 7, 9 – 11.
2. Turn on fresh water supply or switch on water pump.
3. Fill the plumbing system.
 - Open all water-release points, e.g., cold and hot water faucets, showers, toilets.



It is important that you bleed the water system before starting the appliance.

- Once water flows, the plumbing system is vented. Close the water-release points.

4. Start the appliance as follows:
 - Make sure that the LP gas supply is turned on.
 - Switch on the 12 V power supply (RV).
 - Open the access door (refer to “Opening the access door” on page 8).
 - Switch on the appliance at the POWER switch. Refer to “Switching ON the appliance” on page 11.
5. **AquaGo comfort / AquaGo comfort plus:**
 - Select the desired operating mode (refer to “Operating modes (control panel)” on page 11).
 - Close the access door (refer to “Opening the access door” on page 8).

⚠ WARNING

Scalding injuries caused by hot water!

Water temperatures over 127°F (52°C) can cause severe burns or scalding and in extreme cases even death.

- Before using the hot water faucet or using the shower, allow the hot water to run until the water temperature no longer increases.
- Test the temperature of the water before placing a child in the bath or shower.
- Do not leave a child or an infirm person in the bath unsupervised.



- There may be a variation between the temperature delivered from the appliance and the temperature at the faucet due to water conditions or the length of pipe from the appliance.
- The presence of a flow restrictor in the hot water line may limit the water flow.

How to use hot water:

- To obtain the desired water temperature at the faucet or in the shower, mix cold and hot water.
- Particularly when showering, wait until the water temperature has stabilized before entering or allowing other people or animals to enter the shower.



Switching ON the appliance

1. Open the access door (refer to “Opening the access door” on page 8).
2. To switch on the appliance, switch the POWER switch (Fig. 8 – 8) to one of the two “ON” positions.

i Both ON positions on the POWER switch have the same function. Choose your preferred position.

- When the green power ON LED 1 (Fig. 8 – LED 1) is lit, the appliance is switched on.
- If the red error code LED 2 (Fig. 8 – LED 2) is lit / flashes, there is a fault or warning (refer to “APPENDIX A – Error Codes” on page 37).

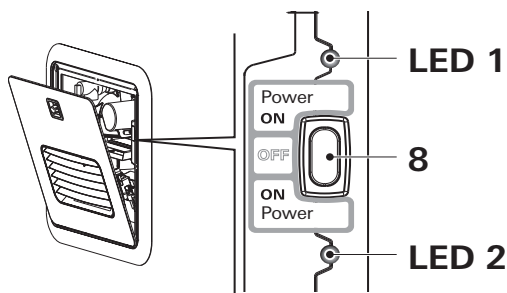


Fig. 8

AquaGo basic

- The operating mode is set automatically to “BASIC”.
- The appliance is now ready for use.
- Water temperature at the outlet is approximately 120 °F (49 °C).

AquaGo comfort / AquaGo comfort plus

- The appliance is now ready for using the control panel inside your vehicle. Refer to “Operating modes (control panel)” on page 11.

Operating modes (control panel)

AquaGo comfort / AquaGo comfort plus

A control panel to select the operating mode (included with the delivery from serial number DLE60X(X)27100000).

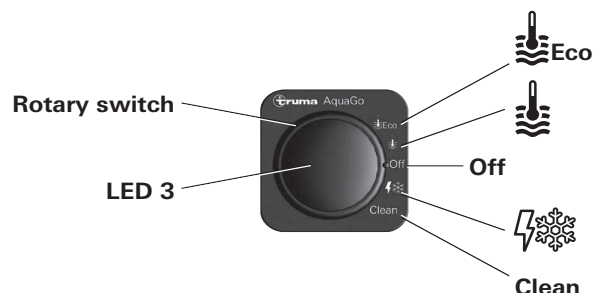


Fig. 9

With the rotary switch (Fig. 9) you can choose between the following operating modes:

Sign	Operating mode / Description
	<p>ECO</p> <p>The appliance is now running in energy-saving mode.</p> <ul style="list-style-type: none"> • Water temperature at the outlet is approximately 120 °F (49 °C). • Prevention of freezing by using propane gas. The temperature in the appliance is automatically kept above 41 °F (5 °C) . • During operation, the yellow status LED 3 is lit.
	<p>COMFORT</p> <p>The appliance is now running in a mode that provides rapid availability of hot water.</p> <ul style="list-style-type: none"> • Water temperature at the outlet is approximately 120 °F (49 °C). • Stand-by heat. The temperature in the appliance is automatically kept above 102 °F (39 °C). • During operation, the yellow status LED 3 is lit.
Off	<p>Stand-by. The appliance is not running in any operating mode.</p> <ul style="list-style-type: none"> • The yellow status LED 3 is off. <p>i To switch off the POWER and gas supply refer to “Switching OFF the appliance” on page 12.</p>



Sign	Operating mode / Description
	<p>ANTIFREEZE</p> <p>Prevention of freezing using 12 VDC electricity:</p> <p>i Operating mode with installed electric antifreeze kit (available as an accessory) and appliance switched on. The temperature in the appliance is automatically kept above 41 °F (5 °C).</p> <ul style="list-style-type: none"> • During operation, the yellow status LED 3 is lit.
Clean	<p>DECALCIFICATION</p> <p>Only AquaGo comfort / AquaGo comfort plus. See “Decalcification” on page 17.</p> <p>i For safety reasons, after 30 seconds the decalcification process cannot be stopped until the system has been rinsed in accordance with the instructions. See “Interrupting decalcification” on page 21.</p>

Switching OFF the appliance

- 1. AquaGo comfort / AquaGo comfort plus**
 - Set the control panel to “Off”.
2. Open the access door (refer to “Opening the access door” on page 8).
3. Switch off the appliance at the POWER switch (Fig. 8).
 - The green Power-ON LED 1 (Fig. 8) extinguishes.
4. Close the access door (refer to “Closing the access door” on page 9).
5. If the appliance is not needed, turn off the gas supply to the appliance.

i If you intend to put the RV into storage or turn off the appliance during freezing temperatures, refer to “Winterizing” on page 14.

Description of the yellow status LED 3 (see Fig. 9 – LED 3)

Signal	Meaning
LED 3 lit	Appliance is switched ON
LED 3 is off	Appliance is switched OFF. Refer to “Switching OFF the appliance” on page 12.
Every 7 s, LED 3 is interrupted for 1 s	The appliance must be decalcified
LED 3 flashes slowly 1 s on, 1 s off	Decalcification mode has been activated
LED 3 flashes quickly	Before you use the water system you must rinse it (refer to step f) “Rinsing the water system” on page 19).
LED 3 flashes 2 x briefly after a break.	There is a fault in the appliance. The exact fault diagnosis must be determined via error LED 2. Refer to “APPENDIX A – Error Codes” on page 37. Risk of freezing if the temperature in the appliance is below 37.4 °F (3 °C).



Operation in frost conditions

(Ambient temperatures below 39 °F (4 °C))

NOTICE

Risk of damage in frost conditions.

In frost conditions, ambient temperatures below 39 °F (4 °C), there is a risk that water in pipes, faucets and appliances could freeze. This can cause considerable damage.

- If the appliance is not to be used in frost conditions, you must winterize the appliance. Refer to “Winterizing” on page 14.
- Winter operation will not protect the RV’s entire water system. Water lines, faucets, water tanks and the external water valves and the vehicle must be heated separately.
- The RV must be designed for winter use/ freezing conditions.
- The water pipes in the RV must be ice-free to operate the AquaGo comfort / AquaGo comfort plus in winter. Otherwise, there is no water flow and the appliance does not start.

Only AquaGo basic

- **NOTICE** Never operate the AquaGo basic in frost conditions, this model must be winterized (refer to “Winterizing” on page 14).

Only AquaGo comfort / AquaGo comfort plus

When the vehicle is standing, to -4 °F (-20 °C)

- The appliance has a built-in thermostat that will start the burner and the circulation pump whenever the temperature in the appliance falls below 41 °F (+5 °C). The burner will automatically shut off when it senses a temperature above 111 °F (44 °C).

- **NOTICE** For the appliance to operate properly, you must ensure a constant supply of power (12 V), propane gas, sufficient water in the system. You must leave the appliance powered “ON”. The operating mode must be “ECO” or “COMFORT”. The water system must be bled so that the circulation pump works.

- **NOTICE** If the vehicle is standing and ambient temperatures are below -4 °F (-20 °C), the appliance must not be operated and must be winterized. To winterize the appliance refer to “Winterizing” on page 14.

While driving (or if there is no gas supply), to -4 °F (-20 °C)

- **NOTICE** Gas must not be used for heating while the vehicle is in motion. Ask your dealer / vehicle manufacturer about options for heating your RV while driving.
- An electric antifreeze kit is available as an accessory (ask your dealer). With this kit, the appliance can be kept frost-free while you are driving or if there is no gas supply (to ambient temperatures of -4 °F (-20 °C)). The electric antifreeze kit includes detailed instructions.
- **NOTICE** While the vehicle is in motion and at ambient temperatures below -4 °F (-20 °C) the appliance must not be operated and must be winterized. To winterize the appliance refer to “Winterizing” on page 14.



Winterizing

NOTICE

Severe damage to the water system components and the appliance!

Any damage caused by freezing or an unsuitable winterizing fluid will not be covered by warranty.

- Follow the recommendations below if the appliance will be stored under freezing conditions or for an extended period of time.
- Winterize the appliance at the start of the winter season or before traveling to a location where freezing conditions are likely.

If your RV is equipped with a bypass around the appliance, separate the appliance from the water system with the bypass.

Winterizing the appliance

To winterize the appliance, you must drain all water from the appliance. To do this we advise the following steps:

- Remove the water inlet filter or heating cartridge. See “Draining the water and cleaning the water inlet filter” on page 15, steps 1 to 8.
- Let water completely drain from the appliance. This can take several minutes.
- Do not insert the water inlet filter or heating cartridge into the appliance during winter – if the appliance is not used.
- **⚠ CAUTION** **Danger of crushing/pinching of fingers when the Easy Drain Lever is closed!** Never put fingers between the Easy Drain Lever and latch.
- Close the Easy Drain Lever and the access door.

Once the water has been drained, the appliance is protected against freezing conditions.

Winterizing the RV with a winterizing fluid



- Winterizing the RV with a winterizing fluid is only possible with an installed bypass kit (not in scope of delivery)
- Refer to “Connection diagrams” on page 31 for all letters referred to in the following description.

Winterizing AquaGo basic / AquaGo comfort

1. Close valves A and B.
2. Open valve C.
3. Drain the appliance (“Draining the water and cleaning the water inlet filter” on page 15).
4. Flush the RV’s water system with a suitable winterizing fluid according to the supplier’s or RV manufacturer’s guidelines.

Winterizing AquaGo comfort plus

1. Close valves A, B and E.
2. Make sure that valve D remains in the closed position.
3. Open valve C.
4. Drain the appliance (“Draining the water and cleaning the water inlet filter” on page 15).
5. Flush the RV’s water system with a suitable winterizing fluid according to the supplier’s or RV manufacturer’s guidelines.
6. Close all faucets (if open).
7. Open valve D.
8. Wait until winterizing fluid has drained. Collect escaping fluid in a suitable vessel.
9. Close valve D.



AquaGo technical data

BTU/h (Nominal input rate)	20,000 – 60,000		
Fuel	LP gas (propane only)		
Fuel inlet pressure	10.5 – 14 in. wc (26.2 – 34.9 mbar)		
Fuel manifold pressure	1.3 – 10 in wc (3.2 – 24.9 mbar)		
Nominal voltage	12 V DC (< 1 V _{pp})		
Power input			
AquaGo basic	< 1.5 A		
AquaGo comfort	< 2.5 A		
AquaGo comfort plus	< 2.5 A		
Water operating pressure	65 psi (4.5 bar) max.		
Standard water outlet temperature	120 °F (49 °C)		
Water volume	0.35 gallons (1.3 liter)		
Ambient temperature			
AquaGo basic	+32 °F...+104 °F (+5 °C...+40 °C)		
AquaGo comfort	-4 °F...+104 °F		
AquaGo comfort plus	(-20 °C...+40 °C)		
Dimensions (without flange and frame)			
	Width	Height	Depth
in.	12.5	12.5	15.5
mm	318	318	394
Dimensions of frame			
Size XS			
in.	15.1	15.5	0.8
mm	384	394	20.2
Standard			
in.	17.7	17.7	0.8
mm	450	450	20.2
Adapter			
in.	20.1	20.1	0.8
mm	510	510	20.2
Installation cutout and depth			
	Width	Height	Depth*
in.	12.8	12.8	17.7 >19.7**
mm	324	324	450 >500**
Weight of unit without access door	(approx.) 34.2 lbs (15.5 kg)		
Weight of access door standard and access door XS	(approx.) 2.9 lbs (1.3 kg)		
Weight of access door adapter kit	(approx.) 5.5 lbs (2.5 kg)		

* Depending on application
** Recommended

Maintenance

Repairs must be performed by a certified service technician. Truma recommends that the appliance be serviced annually by a certified service technician. Verify proper operation after servicing.

⚠ WARNING

High temperatures or repair attempts while the gas supply is turned on may result in scalding injuries!

- Turn OFF the electrical power supply and the LP gas supply before starting maintenance and repair work.
- Allow the appliance to cool down.
- Never actuate the pressure relief valve as long as the appliance is still hot.

⚠ CAUTION

Injuries caused by the Easy Drain Lever!

- Never actuate the Easy Drain Lever as long as the appliance is under water pressure and/or is still hot.

⚠ CAUTION

Sharp edges can cause cuts and injury!

- Always wear protective gloves to avoid injuries from sharp edges during maintenance work.

Draining the water and cleaning the water inlet filter

i To keep the appliance fully functional, clean the water inlet filter at least once a year.

1. **AquaGo comfort / AquaGo comfort plus**
Set the control panel to "Off".
2. Remove the access door (refer to "Removing the access door" on page 9).
3. Switch OFF the appliance at the POWER switch.
4. Open all hot water faucets and wait for cold water. This will ensure that hot water is removed from the appliance before draining.
5. Turn OFF the water supply or switch OFF the water pump.



TRUMA AQUAGO COMFORT WATER HEATER

6. Leave the hot water faucets open in order to depressurize and vent the water system.

⚠ CAUTION

Injuries caused by the Easy Drain Lever!

When the Easy Drain Lever is folded out, it protrudes beyond the side wall of the vehicle.

- When walking past or stooping down, make sure that you and others have sufficient distance.

7. Open the latch with your thumb while pulling the Easy Drain Lever down as far as it will go.
8. Remove the water inlet filter (or heating cartridge) as shown in Fig. 10 and rinse it with clean water.
9. Inspect the O-rings on the water inlet filter (or heating cartridge) for cracks. Change the filter assembly (spare part, refer to "APPENDIX C – Spare Parts (all models)" on page 39) if there are cracks.

⚠ CAUTION

Danger of crushing/pinching of fingers when the Easy Drain Lever is closed!

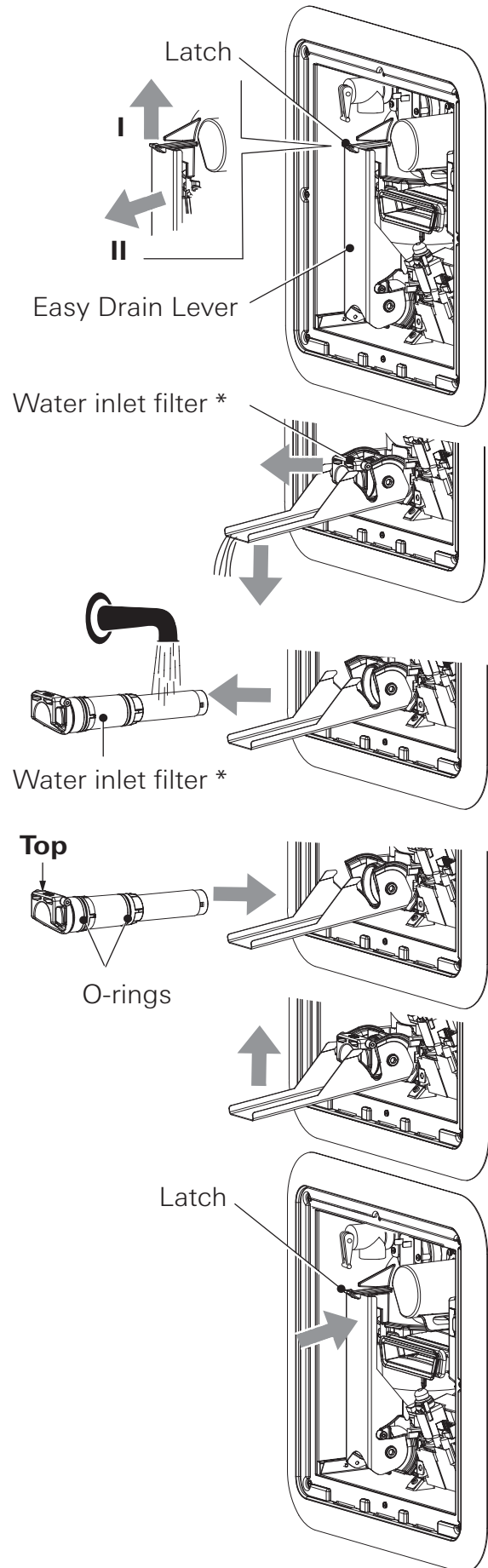
- Never put fingers between the Easy Drain Lever and water inlet filter or latch.

i If, during installation, it is difficult to install the filter cartridge, use a small amount of soap on the O-rings. Never use grease because the O-rings are not resistant to grease.

10. Install the water inlet filter as shown in Fig. 10. Observe the correct installation position and close the Easy Drain Lever until it is locked by the latch.

You can hear a "clicking" sound as the Easy Drain Lever engages.

11. Insert and close the access door (refer to "Closing the access door" on page 9).





Decalcification

NOTICE

Risk of damage in frost conditions.

In frost conditions, ambient temperatures below 39 °F (4 °C), there is a risk that water in pipes, faucets and appliances could freeze. This can cause considerable damage.

- Do not decalcify the appliance in frost conditions.

Decalcification frequency

Lime scale occurs especially as a result of precipitation from “hard” water. The appliance must be decalcified regularly depending on water hardness and hot water consumption.

Recommended decalcification frequency per year

Water hardness mg/l CaCO₃	Very hard >180	1	2	4
	Hard 121 – 180	1	1	3
	Moderately hard 61 – 120	1	1	2
	Soft 0 – 60	1	1	1
	Use*	low	normal	high

* Hot water consumption (approximately)
 low 635 gallons/year 2400 l/year
 normal 1585 gallons/year 6000 l/year
 high 6350 gallons/year 24000 l/year

Decalcification (models **without** control panel)

Models AquaGo basic without control panel:

You can have these models decalcified by a Truma service partner. Please contact the following address:

Truma Corp.
 825 East Jackson Blvd.
 Elkhart, IN 46516
 USA
 Toll Free 1-855-558-7862
 Fax 1-574-538-2426
 info@trumacorp.com
 www.truma.net

Refer to “Decalcification frequency” on page 17 for the decalcification frequency.

Decalcification (models **with** control panel)

AquaGo comfort / AquaGo comfort plus with control panel (included with delivery).

An integrated water consumption meter recognizes (after hot water consumption of approx. 1585 gallons / 6000 l) that decalcification is necessary. The assumed water hardness is “hard” and cannot be changed. The yellow status LED 3 (Fig. 9) indicates that decalcification is necessary (goes off briefly about every 7 seconds).



⚠ WARNING

The use of non original AquaGo decalcification tablets (e.g. vinegar) for decalcification can cause chemical reactions and produce hazardous substances that could enter the drinking water supply.

- **Do not** mix AquaGo decalcification tablets with other substances to avoid chemical reactions and production of hazardous substances.
- Use only AquaGo decalcification tablets to decalcify the appliance to avoid:
 - chemical reactions and production of hazardous substances,
 - damage to your appliance,
 - and the voiding of your warranty.
 - Call your local AquaGo dealer or service provider or see www.truma.com for more information on how to obtain AquaGo decalcification tablets.

Irritation of skin and eyes in case of contact with decalcification agent

Wear protective gloves, eye protection and face protection to avoid contact.

- Never use the water supply in the RV during decalcification
- In case of skin contact with the decalcification agent, immediately rinse the affected area with plenty of water.
- In case of eye contact, hold eyelid open and rinse with running water for 10 – 15 min. Remove contact lenses, if present and easy to do. Continue rinsing. Consult an eye specialist.
- If you swallow the decalcification agent, immediately rinse your mouth and drink plenty of water in small sips. Do not vomit. Consult a doctor.

During decalcification, you must also observe the following

- Damage to the appliance if decalcification is interrupted.
 - You must complete the decalcification process and then rinse thoroughly with clean water.
 - Allow about 3 hours for decalcification. The appliance works on its own for most of this time.
- Sensitive surfaces (e. g. marble) may be damaged through contact with the decalcification agent.
 - Immediately remove splashes of decalcification agent on these surfaces.

a) Preparing for decalcification

i For safety reasons, once the decalcification process has started it must not be stopped until the system has been rinsed (see process f). All operating modes of the appliance are blocked until decalcification has been completed.

Tasks within the RV

- Set the control panel to “Off”.
- Turn OFF the water supply or switch OFF the water pump.
- Open a hot water faucet to relieve pressure in the system.
- On all water faucets attach the warning sign “Caution decalcification in progress” in a clearly visible position. Warning signs are enclosed with the decalcification tablets.



b) Draining the water system

Tasks outside the RV

- Remove the access door (refer to “Removing the access door” on page 9).
- Switch OFF the appliance at the POWER switch.
- Drain the water system and remove the water inlet filter. To do this, refer to “Draining the water and cleaning the water inlet filter” on page 15, Steps 4 to 8.

NOTICE You must use the water inlet filter for decalcification (included with the delivery Fig. 1 – 11a). If you are using an electric anti-freeze kit, it must be removed and be unplugged from the power supply before decalcification (see Fig. 11).

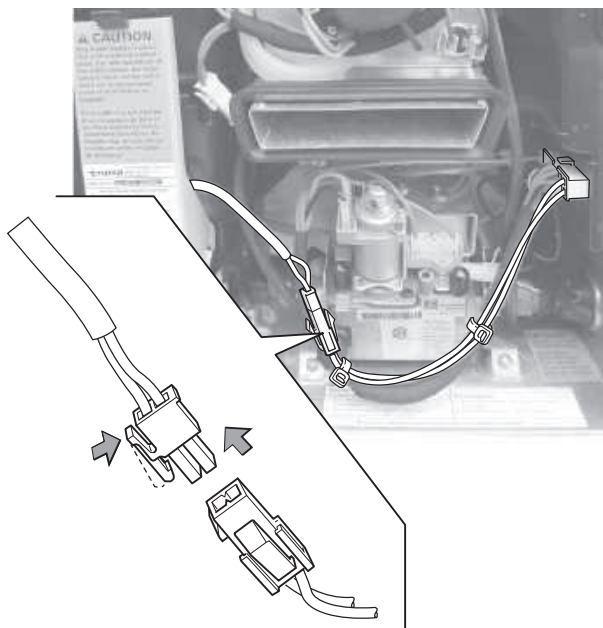


Fig. 11

c) Introducing the decalcification agent

Tasks outside the RV

- **⚠ WARNING** Irritation of skin and eyes in case of contact with decalcification agent. Wear protective gloves, eye protection and face protection to avoid contact.
- Fill the water inlet filter with 6 AquaGo decalcification tablets (content of one blister pack).

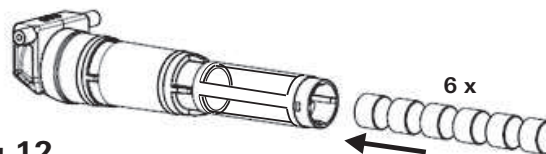


Fig. 12

- Re-insert the water inlet filter. See Step 9 in “Draining the water and cleaning the water inlet filter” on page 15.
- Switch ON the appliance at the POWER switch.

d) Filling the water system

Tasks within the RV

- Turn on fresh water supply or switch on water pump
 - **i** The decalcification tablets dissolve in water quickly (approx. 10 minutes). So that the decalcification agent is not rinsed out, when filling, run the water only as long as necessary. The decalcification tablets color the water slightly red.
- Fill the water system.
 - Open all water-release points, e.g., hot water faucets, showers, toilets.
 - Once water flows uniformly, the water system is vented.
 - Close the water-release points.

i You must bleed the water system thoroughly otherwise the circulation pump cannot circulate the decalcification solution.



e) Starting decalcification

Tasks within the RV

- Set the control panel to "Clean".
- If decalcification does not start, switch the appliance on at the POWER switch.



- Decalcification takes about 3 hours (during this time, you do not have to do anything).
- Decalcification is indicated by a slow flashing (1 s on, 1 s off) of the status LED 3 (Fig. 9) on the control panel.
- During decalcification, the control panel must remain set to "Clean".
- Decalcification is complete when the status LED 3 (Fig. 9) flashes quickly on the control panel.

f) Rinsing the water system



- You will need about 8 gallons (30 liters) of water to rinse the water system.
- Dispose of (used) decalcification solution in accordance with local laws and regulations.

Tasks within the RV

- Open all water-release points, e.g., hot water faucets, showers, toilets.
- Run the water until the status LED 3 (Fig. 9) on the control panel goes out.
- Set the control panel to "Off".
- Close all water-release points.
- Turn OFF the water supply or switch OFF the water pump.
- Open a hot water faucet to relieve pressure in the system.



To make sure that the appliance and the water pipes contain no decalcification agent, empty the water system again and refill it.

Tasks outside the RV

- Switch the appliance OFF at the POWER switch (red error code LED 2 (Fig 8) flashes before it switches off).
- Drain the water system (refer to "Draining the water and cleaning the water inlet filter" on page 15, steps 4. to 8.).
- Install the water inlet filter* referring to step 9.
 - * or antifreeze cartridge if electric antifreeze kit is installed.
- Switch ON the appliance at the POWER switch.
- Insert and close the access door (refer to "Closing the access door" on page 9).



You have to switch the appliance off and on to unblock decalcification and enable further operation.

g) Filling the water system

Tasks within the RV

- Turn on fresh water supply or switch on water pump.
- Fill the water system.
 - Open all water-release points, e.g., hot water faucets, showers, toilets .
 - Once water flows evenly, the water system is vented.
 - Close the water-release points.
- Before you use the water system and the appliance, check the color of the water at all faucets:
 - Slightly red -> rinse again.
 - Clear -> decalcification is finished.
- Remove the warning signs "Caution decalcification in progress".



Interrupting decalcification

i Decalcification is indicated through slow flashing (1 s on, 1 s off) of the status LED 3 (Fig. 9) on the control panel.

- Decalcification can be interrupted by switching the control panel to “Off”.
 - Decalcification is interrupted after about 2 s.
 - The status LED 3 (Fig. 9) on the control panel flashes quickly.
- **⚠ WARNING** Irritation of skin and eyes in case of contact with decalcification agent. Wear protective gloves, eye protection and face protection to avoid contact.
- First you must take out the water inlet filter and remove any AquaGo decalcification tablets that it may contain.
 - To take out the water inlet filter, see “Draining the water and cleaning the water inlet filter” on page 15.
 - Dispose of AquaGo decalcification tablets in accordance with local laws and regulations.
- Before you use the water system again, you must rinse it (see step f) “Rinsing the water system” on page 19) and fill it with water (see step g) “Filling the water system” on page 20).

Accessories

Electric antifreeze kit *

Truma offers an electric antifreeze kit (part no. 77400-01) that keeps the appliance frost-free to -4 °F (-20 °C) while you are driving or if there is no gas supply. To operate the kit, you need a 12 VDC (120 W) power supply from the vehicle’s on-board system. Ask your dealer.

* For AquaGo comfort / AquaGo comfort plus.

AquaGo decalcification tablets

Truma offers decalcification tablets (part no. 77300-01) to decalcify AquaGo comfort / AquaGo comfort plus.

Truma rear installation gas connection kit

Truma offers a rear installation gas connection kit (part no. 77000-37500) if installation from the back of the appliance is required.

AquaGo comfort upgrade kit

Truma offers a kit (part. no. 77000-00005) to upgrade from AquaGo basic to AquaGo comfort.



Troubleshooting

Problem	Potential cause	Resolution
No hot water at the faucet	Gas supply is turned off or interrupted.	Check and/or turn on gas supply.
	Gas tank is empty.	Refill/replace the gas tank.
	The appliance is switched off.	Switch on the appliance according to instructions (refer to "Operating procedures" on page 10).
	Fresh water supply is turned off.	Open the fresh water supply.
	Power supply to the appliance is switched off.	Switch on power supply to the appliance.
	Defect in the appliance.	LED 2 flashes red (refer to "APPENDIX A – Error Codes" on page 37) and contact a certified service technician if necessary.
Boiling noises	Too much lime scale in the AquaGo instant water heater.	The appliance must be decalcified (refer to "Decalcification" on page 17).
Hot water temperature too low.	Gas flow to the appliance is too low (gas inlet pressure < 10.5 in. wc).	Consult vehicle documentation to determine if the gas supply is capable of providing the necessary volume of gas for the appliance. Contact a service technician to verify that the gas installation is suitable.
	Volume flow of hot water is too high and/or the temperature of cold water reaching the appliance is too low.	Turn down hot water at the faucet or in the shower in order to reduce flow rate. Potentially retrofit a flow rate throttle in the water system. This must be performed by a certified service technician.
	Too much lime scale in the appliance.	The appliance must be decalcified (refer to "Decalcification" on page 17).



Problem	Potential cause	Resolution
Water escaping at pressure relief valve.	Water pressure in water system too high.	Adjust the water pump pressure to a maximum of 65 psi (4.5 bar). If the water system is connected to a central water supply higher than 65 psi (4.5 bar) (rural or urban connection), a pressure reducer must be used. Install a pressure reducer (e.g. Truma pressure reducer) at the fresh water supply.
	Water cannot expand in the water system.	Contact the vehicle manufacturer about retrofitting a pressure compensation element.
	Lime or dirt under the pressure relief valve seat.	Allow the appliance to cool and then slowly raise the test lever (Fig. 3 – 4a) to flush the water system and attempt to force dirt or foreign matter out of the pressure relief valve seat. Replace pressure relief valve. This must be performed by a Truma certified service technician.
Water escaping at water inlet filter	Lime or dirt under the O-ring seats.	Clean the O-rings and their corresponding sealing surfaces with clean water.
AquaGo comfort / AquaGo comfort plus		
The yellow status LED 3 is off although an operating mode was selected.	Power switch is OFF.	Switch ON the appliance at the POWER switch.
	Power supply to the appliance is switched off.	Switch on the power supply to the appliance.
	Power supply was interrupted.	Reset by switching OFF at the control panel, waiting 2 seconds and then switching on again.

If none of the measures in the troubleshooting chart proves successful, please contact your dealer, the Truma Service Center at 1-855-558-7862 or one of our authorized service partners.



TRUMA Gerätetechnik GmbH & Co. KG
("TRUMA")

"AquaGo" MANUFACTURER LIMITED WARRANTY

(September 2014)

This limited warranty pertains solely to the "AquaGo" (the "Product") manufactured by TRUMA and sold through its affiliates and dealers in North America.

TRUMA warrants subject to the below stated conditions that the Product will be free from defects in material and workmanship, and will perform in accordance with the technical specifications set forth in the description of the Product for a period of twelve (12) months for newly manufactured parts from the original date of purchase. The original purchaser is advised to register the Product within two (2) months of purchase with **www.truma.net** in order to receive an extended warranty of an additional twelve (12) months. This limited warranty shall only apply if the Product was properly installed according to the installation instructions provided and in compliance with applicable codes.

During the warranty period, TRUMA will repair or replace, at its own discretion and costs, the defective Product or parts or components of such Product reported to TRUMA and which TRUMA determines was defective due to a warranty defect. Costs of diagnosis for a warranty defect are borne by TRUMA. Other costs of diagnosis are not included in this warranty. At the discretion of TRUMA, the replacement of the Product or parts or components thereof (i) may be newly manufactured, (ii) may be assembled from new or serviceable used parts that are equivalent to new parts in performance, or (iii) may have been previously installed.

The customer shall not attempt to repair the Product or resolve the problem without the prior consent of TRUMA. Any attempt by the customer to repair the Product or resolve the problem without the prior consent of TRUMA will void this warranty.

This limited warranty does not cover any defects attributable in whole or in part to (i) non-TRUMA products and services and / or alterations of out-of-specification supplies, (ii) accidents, misuse, negligence or failure of the customer to follow instructions for the proper use, care and cleaning of the Product, (iii) damages caused in gas pressure regulation systems due to foreign substances in the gas (i.e. oil, plasticizers), (iv) external factors (e.g., fire, flood, severe weather), (v) failure of proper transport packaging, or (vi) failure by the purchaser to comply with TRUMA's installation and user manual regarding the Product.

All warranty claims must be reported to TRUMA's authorized warranty service center in the United States: Truma Corp Service Center, **825 East Jackson Blvd., Elkhart, IN 46516, toll free: (855) 558-7862, fax: (574) 538-2426, service@trumacorp.com, www.truma.net**

The purchaser shall provide the following information regarding the potential warranty claim (i) serial number of the defective device, (ii) proof of purchase, (iii) purchaser's contact information.

EXCEPT AS EXPRESSLY STATED AND SET FORTH HEREIN, THERE ARE NO WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT AND NO SUCH WARRANTIES OR REPRESENTATIONS SHALL BE IMPLIED UNDER ANY APPLICABLE LAW, IN EQUITY OR OTHERWISE, INCLUDING WITHOUT LIMITATION, A WARRANTY OF MERCHANTABILITY, A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER WARRANTY WHICH MAY BE IMPLIED UNDER COMMON LAW OR UNDER THE UNIFORM COMMERCIAL CODE OF ANY STATE OR OTHER JURISDICTION OF THE UNITED STATES OF AMERICA.

Unless further limited herein, the entire liability of TRUMA and the customer's exclusive remedy for damages from any cause related to or arising out of a warranty defect, regardless of the form of action, whether in contract or in tort, will not exceed the amount of the purchase



price for each purchase order for the Product which is the subject matter or directly related to the causes of action asserted.

Unless prohibited under applicable state law, in no event will TRUMA, its agents, subcontractors, affiliates, suppliers and employees be liable for (a) any incidental, indirect, special or consequential damages, including, but not limited to, loss of use, revenue, profits or savings, substitute rental or for any other reason, even if TRUMA knew or should have known of the possibility of such losses or damages, (b) claims, demands or actions against the customer by any person, except as provided by applicable law.

Installation Instructions

Read, observe, and follow these safety instructions to avoid injuries during installation or operation.

Safety behavior and practices

- Installation and service must be performed by an authorized Truma recommended installer, service agency, or OEM. Improper installation, alteration, service, or maintenance can cause property damage, personal injury, or loss of life.
 - Do not attempt installation as a Do-it-Yourself project.
- Install in recreational vehicles (RVs) only.
 - Install the appliance on an exterior wall, with the access door opening to the outside.
 - Install the appliance in the shown orientation.
- Switch off the vehicle's on-board power supply during installation and when connecting the appliance.
- Close the vehicle's gas supply during installation and when connecting the appliance.
- Always wear protective gloves to avoid injuries from sharp edges during installation and maintenance work.
- Handle the appliance only by lifting or grabbing the metal casing or cover plate. Never lift or grab the appliance by any of its delicate interior components.
- Make sure that all combustion air is supplied from outside the RV. DO NOT draw air for combustion from occupied spaces.



TRUMA AQUAGO COMFORT WATER HEATER

- Make sure that all exhaust gases are directed outside of the RV.
 - Protect building materials from exhaust gases.
 - Never direct the exhaust gases to any outdoor enclosed spaces, such as a porch.
- Any alteration to the appliance or its controls can cause unforeseen serious hazards and will void the warranty.
- DO NOT alter the appliance for a positive grounding battery system.
- DO NOT shorten the power cable or remove the sticker that indicates polarity.
- DO NOT perform a hi-pot test on the appliance unless the electronic ignition system (circuit board) has been disconnected. A hi-pot test applies a very high voltage between two conductors.
- DO NOT use a battery charger to supply power to the appliance, even when testing.
- If the vehicle requires welding, DO NOT connect the 12 V DC power to the appliance. Electrical welding will cause serious damage to the appliance controller.


United States and CANADA

This appliance must be installed in accordance with local codes or, in the absence of local codes, the Standard for Recreational Vehicles, ANSI A119.2/NFPA 501C or CAN/CSA-Z240 RV.

Selecting a suitable location

The appliance is designed to be installed on a floor or a fixed platform with access to water. Electrical connections are established at the back. Gas access is from the side or from the rear.

The appliance is designed exclusively for installation on an outside wall of a RV.

 Installation of the water heater on the back of a trailer is not advised because of high pollution caused, e.g., by dirty and wet roads.

▲ WARNING

Risk of poisonous exhaust gases due to improper installation!

- Make sure that the appliance is installed as described below.
- DO NOT install the appliance in any location where the vent may be covered or obstructed when any door on the RV is opened or due to the design of the RV or due to special features of the RV such as slide-out, pop-up, etc.
- DO NOT install on a swing door.
- DO NOT install the appliance in such a way that the cover plate is less than
 - 1 foot (30 cm) from each side and top of any window, slide-out or opening into the RV,
 - 6 feet (1.8 m) from any mechanical air supply inlet or
 - 3 feet (91 cm) from any gas tank connection or ventilation.
- Maintain a minimum clearance from combustible materials on sides, top, floor and rear (0 in.).
- Provide room for access to rear of appliance for servicing.



Preparing for installation

⚠ CAUTION

Sharp edges can cause cuts and injury!

- Always wear protective gloves to avoid injuries from sharp edges during installation work and while handling the appliance.

Preparing the installation site

1. Make sure that the appliance is in contact with the vehicle floor or a platform with adequate weight-bearing capacity when installed.
2. To install on a carpeted area, install a metal or wood panel under the appliance that extends at least 3 in. (7.6 cm) beyond the width and depth of the appliance.
3. If escaping water may damage components or the vehicle, install a collection pan below the appliance. Direct the flow of water from the pan to outside the vehicle.
4. Make sure that the front edge of the opening is surrounded by a solid frame to firmly anchor the appliance. If needed, build an appropriate frame (Fig. 13) with the following dimensions:

Width	a =	12.75 in. (324 mm)
Height	b =	12.75 in. (324 mm)
Depth	c =	>17.7 in. (450 mm)

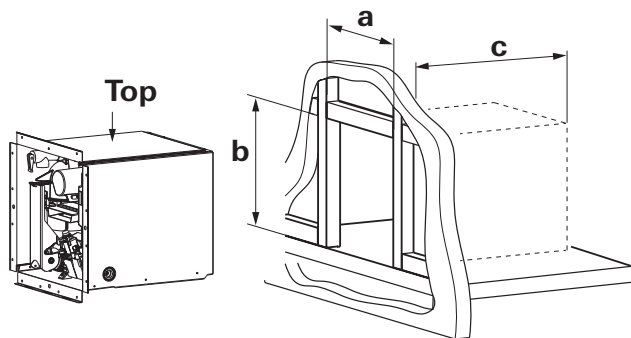


Fig. 13



- The required depth “c” depends on how the water hoses, electrical connection cable, and gas line are installed. The depth “c” must be determined for the particular situation before installation.
- The corners of the rough opening must be at right angles. The exterior wall opening must be the same dimensions with no rounded corners.
- An access door adapter kit is available for replacing existing water heaters, with a large cut-out in the outer wall of the RV. The adapter plate must be installed before the appliance is installed. The access door adapter kit includes detailed installation instructions.

5. Make sure you have suitable screws ready:

- Without access door adapter kit

In order to securely fasten the appliance and the cover plate, the screws must be suitable for the chosen frame material and have a diameter of 0.138 in. (#6) to 0.164 in. (#8).

- **NOTICE** Never use countersunk screws to secure the cover plate, as it will be damaged (tear). Use pan head screws.
- For the length of the screws follow the screw manufacturer’s guidelines.

- With access door adapter kit

You must use the 22 screws 0.164 (#8) x 0.51 in. (4.2 x 13 mm) that are included with the access door adapter kit.

- 14 x for fixing: appliance with adapter plate.
- 8 x for fixing: cover plate with adapter plate.



Preparing the gas connection

⚠ WARNING

Risk of explosion due to improper installation of the gas connection!

- Make sure that the operating pressure of the gas supply corresponds to the operating pressure of the appliance 10.5 – 14 in. wc (26.2 – 34.9 mbar).

For correct installation, you must also observe the following:

- The gas connection (SAE 45° Flare Male – SAE J512, 5/8 in. – 18) is located inside the appliance.
- Make sure that the gas line to the appliance is able to supply the maximum required quantity of gas ($\geq 60,000$ BTU/h), without the gas pressure on the gas connector of the appliance falling below 10.5 in. wc (26.2 mbar).
- Consider the space needed to lay the gas line and integrate the appliance when planning the installation space.
- Guide the gas line into the installation space so that the appliance may be removed and reinstalled if service or repairs are needed.
- Allow sufficient length and flexibility in the gas line for connection or disconnection of the gas line.
- Reduce the number of separation points in the gas line to the technically required number.
- Avoid separation points in the gas line in spaces used by people.
- Ensure that the gas connection from the vehicle is in place before installing the appliance.

– Gas side connection

⚠ DANGER

Risk of explosion due to improper installation of the gas side connection!

- Use rigid metal 3/8 in. pipes (corresponds to 1/2 in. (12.7 mm) outside diameter) for the side gas connector of the appliance to the gas system of the RV.
- In exceptions, flexible gas hoses may be used for the side gas connector. The following 4 conditions must be met:
 1. Guidelines, laws or regulations allow the use of flexible gas hoses in this application.
 2. The flexible gas hoses are **certified** for this type of application.
 3. The flexible gas hoses can be inspected easily over their entire length.
 4. New flexible gas hoses are used for the installation.

The gas line is guided into the appliance from the side. A hole with a gas pipe grommet (side) is provided in the unit casing for this purpose.

- Slide the appliance carefully into the installation space until the installation frame makes contact.
- Make sure that the gas line connects vertically with the appliance's gas connection and without tension.
- If the connection is OK, push the gas line back. It will be connected in a later step.

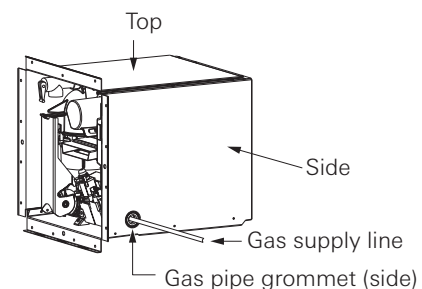


Fig. 14



– Gas rear connection

⚠ DANGER

Risk of explosion when using flexible gas hoses with a gas rear connection.

- Flexible gas hoses can leak due to the high temperatures in the appliance.
- You must use rigid metal 3/8 in. pipes (corresponds to 1/2 in. (12.7 mm) outside diameter) for a gas rear connection.

Truma offers a rear installation gas connection kit (part no. 77000-37500) if installation from the back of the appliance is required.

Scope of delivery:

- A brass elbow with a 45° SAE flare style fitting,
- a plug,
- a gas pipe grommet (rear) and
- a cable tie are included.

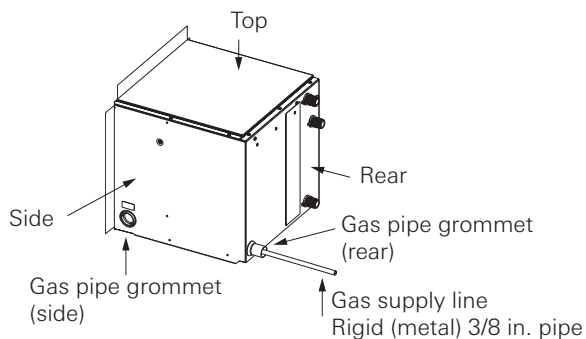


Fig. 15

- Open the pre-punched hole on the rear side of the appliance.
- Insert the gas pipe grommet (rear) into this hole (pay attention to the direction).

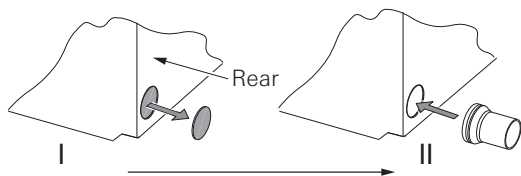


Fig. 16

Preparing the water connection

All water connections on the appliance are 1/2 in. NPT male connections.



- Use only pressure pumps in the water system, not immersion pumps, as air in the water system could cause malfunctions.
- The network of lines must be planned before installation (refer to “Connection diagrams” on page 31).
- Keep the length of the water pipes as short as possible.
- Because of the risk of frost, install water pipes only in adequately heated areas of the RV.
- Avoid thermal bridges.
- Install water pipes in a rising direction so that air in the pipes can escape.
- For AquaGo comfort plus protect the circulation line against heat loss with sufficient insulation material.

- Use a suitable connector with a seal for connecting the water to the appliance.
- Use of flexible water hoses of at least 1/2 in. diameter is preferred.
- Make sure that all water hoses are installed without kinks.
- Make sure that the water connections from the vehicle are in place before installing the appliance.



TRUMA AQUAGO COMFORT WATER HEATER

Preparing the 12 V DC electrical connection

All electrical connections must be made in compliance with all national, regional or local electrical codes.

⚠ WARNING

Risk of a short circuit and hazardous situations due to improper installation of the electrical connection!

- Use only insulated terminals for all electrical connections.
- The positive line must be protected with a 7.5 A fuse (exclusively dedicated to the appliance) near the battery's positive terminal.
- The power supply cable must have a diameter of at least:
 - 16 AWG (1.5 mm² MWG) for up to 40 ft (12 m) length (bidirectional)
 - 14 AWG (2.0 mm² MWG) for up to 66 ft (20 m) length (bidirectional)
- Establish the 12 V DC electrical connections according to the connection diagram, see "Electrical connection for all models" on page 31.
- To ensure reliable operation:
 - Provide a constant voltage supply.
 - Filter any AC spikes or voltage surges.
 - The AC voltage ripple must not exceed 1 Vpp.
- Make sure that the electrical connections from the vehicle are in place before installing the appliance.

Mounting the control panel

Only AquaGo comfort / AquaGo comfort plus

- **NOTICE** **Damage to the control panel from wetness and moisture.** You must install the control panel at a place inside the RV that is protected against moisture and wetness.
- Install the control panel (Fig. 17- 27) where it can be seen easily.
 - A 9 m control panel cable (27a) is included with the delivery.
- Drill a 2 1/8 in. (54 mm) diameter hole.
- Insert the plug (27b) on the control panel (27) until it clicks into place.
- Clamp the control panel cable (27a) in the cable duct of the control panel.
- **NOTICE** **Damage to the control panel cable at temperatures above +60 °C.** Do not install the control panel cable on or fix it to hot components.
- Slide the control panel cable to the back and lay it to the appliance.
- Fix the control panel with 4 screws (27d).
- Install the cover frame (27e).

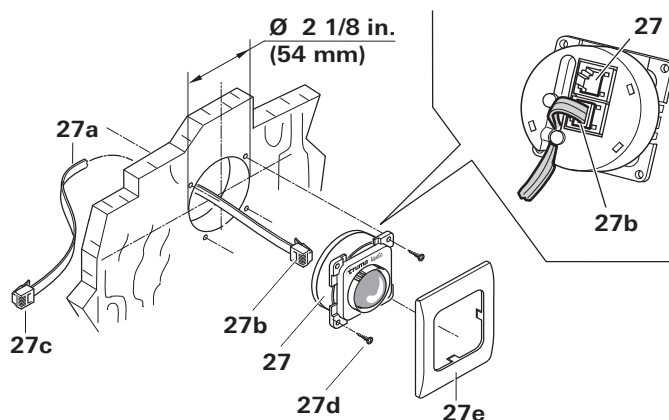


Fig. 17



Connection diagrams



- The drawings are not intended to describe a complete system. It is up to the certified service technician to determine the necessary components for and configuration of the particular system being installed (for example, an additional surge protector).
- The drawings do not imply compliance with state or local code requirements or regulations. It is the certified service technician's responsibility to make sure that the installation is fully compliant with all state or local code requirements or regulations.

Model AquaGo basic / AquaGo comfort

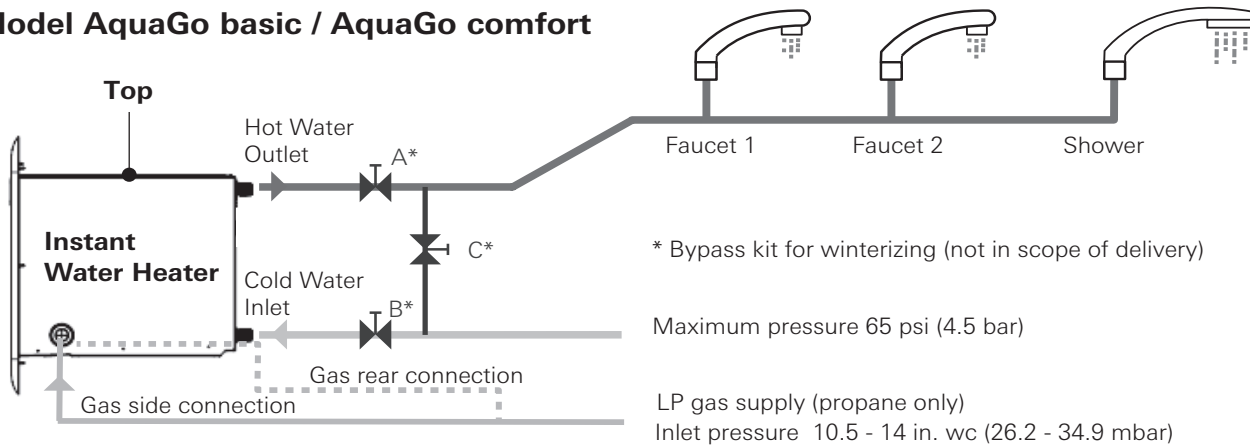


Fig. 18

Model AquaGo comfort plus

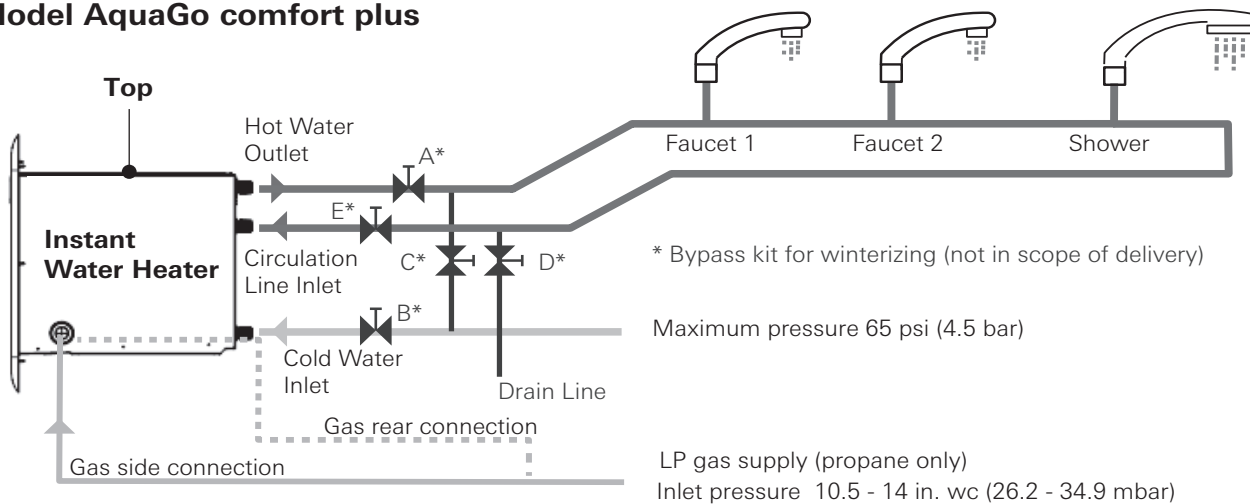


Fig. 19

Electrical connection for all models

Maximum length of the power supply cable (including cables for the optional switch):

- for 16 AWG or 1.5 mm² MWG: max. 40 ft (12 m) (bidirectional)
- for 14 AWG or 2.0 mm² MWG: max. 66 ft (20 m) (bidirectional)

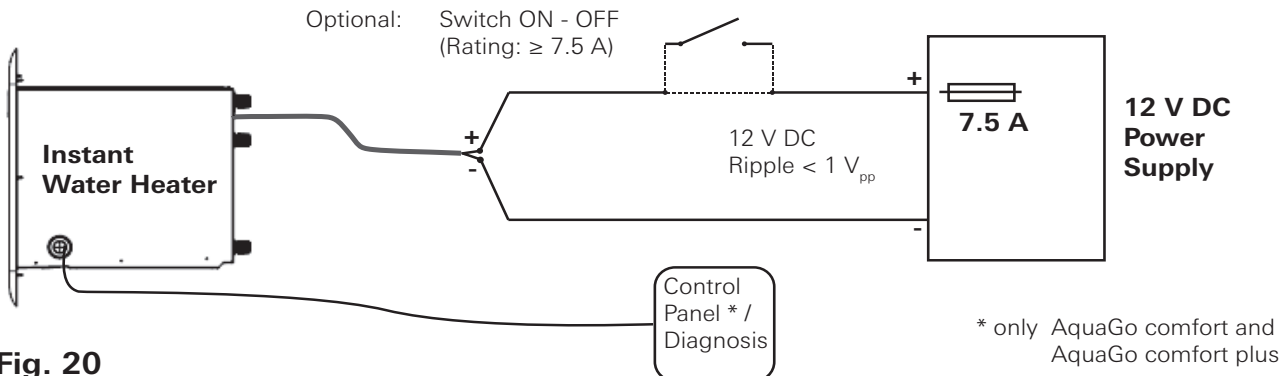


Fig. 20



Installing the appliance

Before installation, read "Preparing for installation" on page 27 and the following.

⚠ CAUTION

Sharp edges can cause cuts and injury!

- Always wear protective gloves to avoid injuries from sharp edges during installation work and while handling the appliance.

- Slide the appliance carefully into the installation space until the installation frame makes contact.

- **NOTICE** **Damage to the appliance and/or the RV!** Do not use adhesive sealing material (e.g. silicone) for the watertight seal. Otherwise damage may occur when the appliance is moved during servicing.

- The appliance must be installed with a watertight seal with the outer skin of the vehicle.

To achieve the watertight seal:

- Pull the appliance out \approx 2 in. (5 cm).
- Apply an adequate amount of watertight sealing material to the entire flange area of the installation frame and at the corners, see gray marking in Fig. 21.
- Slide the appliance carefully into the installation space until the installation frame makes contact.

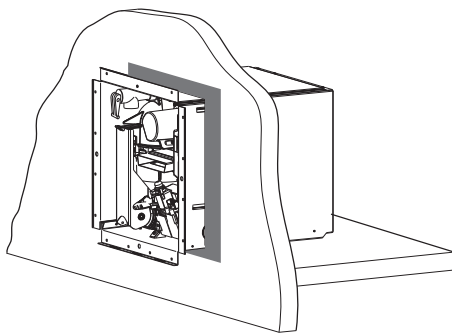


Fig. 21

- Screw the appliance into the vehicle's frame with the prepared 14 screws. See 5. "Make sure you have suitable screws ready:" on page 27.

- Make sure that the unit casing corners are 90 degrees square so that the cover plate/access door fits properly.

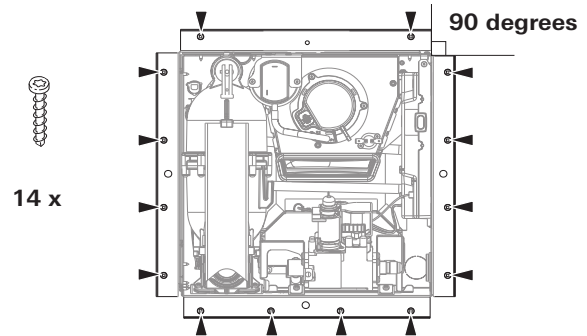


Fig. 22

- Immediately remove all excess sealing material.

- **⚠ WARNING** **Risk of death from poisoning and significant damage to the RV due to exhaust gas and leaking water!**

- Make sure that there is a tight seal and that no exhaust gas or water can enter the RV.

- Check and make sure that there is a tight seal.

- Fasten the cover plate to the appliance (see Fig. 23):

- Position the cover plate.
- Screw the cover plate only loosely. Start with screw 1.
- Align the cover plate.
- Evenly tighten all 8 screws.

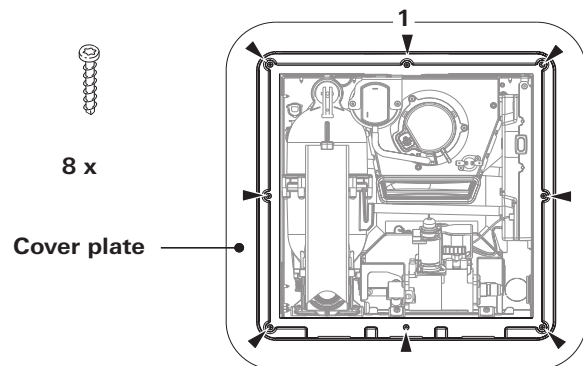


Fig. 23

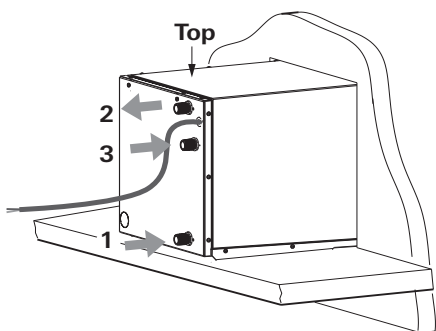


Fig. 24

- **NOTICE** **Damage to the appliance and the connections!**
 - Make sure that no gas lines, water hoses or electrical lines are kinked or pinched.
 - When establishing the water connections, observe the installation instructions and torques specified by the manufacturer.
- Connect the hose for cold water (1) at the bottom of the appliance.
- Connect the hose for hot water (2) at the top of the appliance.
- **Model AquaGo comfort plus only:** Connect the hose for the circulation line (3).
- Check all connections for water leaks.
 - Repair leaks as needed.
 - Repeat check for water leaks and take any necessary steps to repair the leaks at all water connections.
- Connect the electrical lines with the proper polarity to the 12 V DC power supply (refer to “Electrical connection for all models” on page 31). Install a 7.5 A fuse exclusively dedicated to the appliance (see Fig. 20).

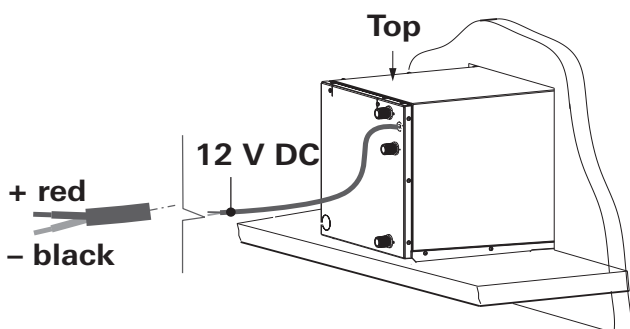


Fig. 25

Gas connection

▲ WARNING

Risk of explosion or poisoning due to improper installation!

- Permit only a certified service technician to perform installation.
- Make sure that the manual shut-off valve in the gas line of the appliance is closed.
- Make sure that the gas line is centered and tension-free when it enters the grommet so that the gas line will not abrade the grommet.
- Make sure that the gas line has an SAE 45° Flare Female connector.

Additional rules for the appliance gas connector.

- Make sure that the gas line is free of dirt, chips, etc.
- Never use pipe dope on a flare fitting. The flare fitting is a dry seal.

Connecting the gas line (gas side connection)

- **Only AquaGo comfort / AquaGo comfort plus (with control panel)**
 - Feed the control panel cable (approx. 10 in. (25 cm)) from outside through the gas pipe grommet (side).
 - Attach the control panel cable to the control unit.
 - Hook the control panel cable on to the clip.
- Guide the prepared gas line through the gas pipe grommet (side).
- Screw the gas line’s union nut (wrench size 3/4 in. (19 mm)) onto the appliance’s gas connection so it is finger-tight.



TRUMA AQUAGO COMFORT WATER HEATER

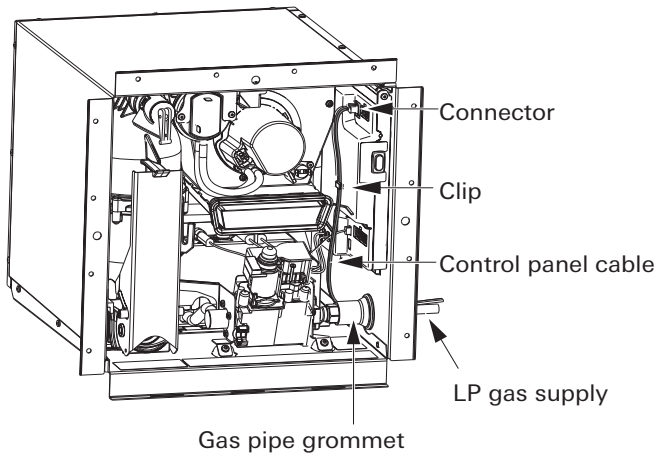
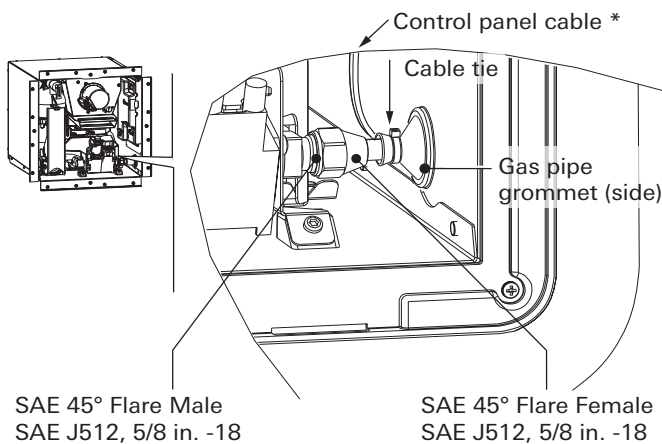


Fig. 26

- **NOTICE** Gas valve may be damaged during tightening! Use a second wrench to counterhold at the square end (wrench size 11/16 in. (18 mm)).
- Use a torque wrench to tighten the union nut (nominal torque 15 lb-ft (20 Nm)).
- **WARNING** Risk of poisoning and/or explosion! Improper tightening of the cable tie could result in gas/exhaust entering the RV.
- Close the cable tie so that the gas pipe grommet (side) tightens the gas pipe passage (see Fig. 27).

i A cable tie is provided with the appliance. You will find it fixed to the gas valve.



* AquaGo comfort / AquaGo comfort plus

Fig. 27

Connecting the gas line (gas rear connection)

- Remove the gas pipe grommet (side).
- Slide the prepared gas pipe through the gas pipe grommet (rear) from behind so that the elbow fitting can be mounted.

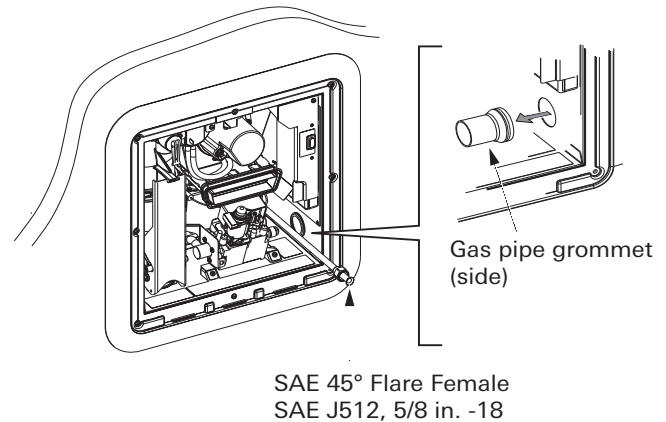


Fig. 28

- **NOTICE** Gas line may be damaged during tightening! Use a second wrench to counterhold at the square end (wrench size 9/16 in. (14 mm)).
- Mount the elbow union (45° SAE flare style) on the gas pipe in the direction shown (see Fig. 29).
- Use a torque wrench to tighten the union nut (nominal torque 15 lb-ft (20 Nm)) (brace against the elbow union with wrench size 9/16 in. (14 mm)).

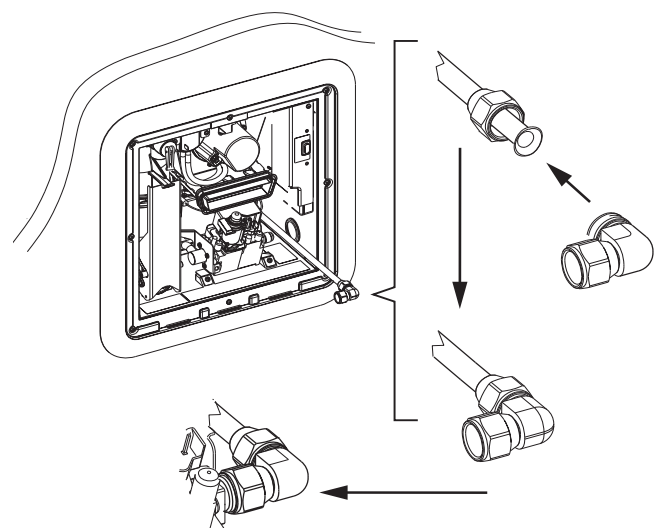


Fig. 29



- Screw the gas line's union nut (wrench size 3/4 in. (19 mm)) onto the appliance's gas connection so it is finger-tight.
- **NOTICE** Gas valve may be damaged during tightening! Use a second wrench to counterhold at the square end (wrench size 11/16 in. (18 mm)).
- Use a torque wrench to tighten the union nut (nominal torque 15 lb-ft (20 Nm)).
- **WARNING** Risk of poisoning and/or explosion! Improper tightening of the cable tie could result in gas/exhaust entering the RV.
- Close the cable tie so that the gas pipe grommet (rear) tightens the gas pipe passage (see Fig. 30).

i A cable tie is provided with the rear installation gas connection kit.

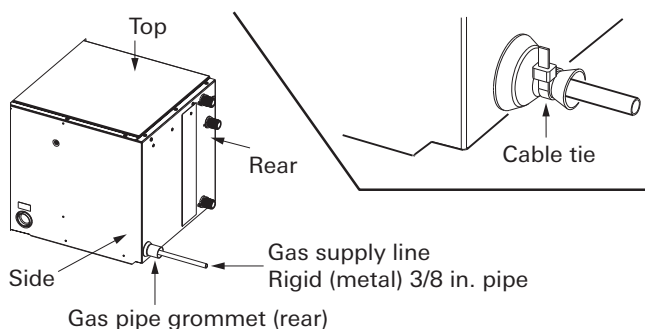


Fig. 30

- **Only AquaGo basic (without control panel):**

– Close the side hole with the plug.

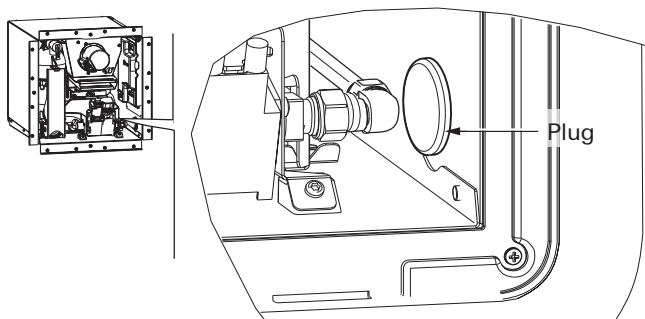


Fig. 31

- **Only AquaGo comfort / AquaGo comfort plus (with control panel)**

– **NOTICE** Damage to the control panel cable at temperatures above +60 °C.

Do not install the control panel cable through the rear gas pipe connection. You must feed the control panel cable through the hole on the side.

– Slide the side gas pipe grommet on to the control panel cable (bush points towards hole). The control panel cable must protrude by about 25 cm.

– **WARNING** Risk of poisoning and/or explosion! Improper tightening of the cable tie could result in gas/exhaust entering the RV. Close the cable tie so that the side gas pipe grommet tightens the control panel cable passage.

– Fix the side gas pipe grommet to the control panel cable with a cable tie.

i A cable tie is provided with the appliance. You will find it fixed to the gas valve.

– Attach the control panel cable to the control panel.

– Hook the control panel cable on to the clip.

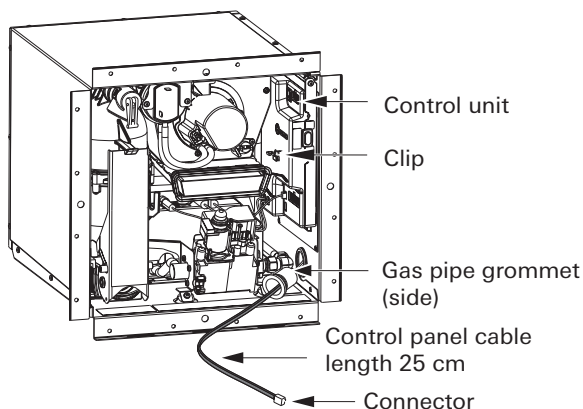


Fig. 32



TRUMA AQUAGO COMFORT WATER HEATER

- Install the side gas pipe grommet with the control panel cable in the side hole.

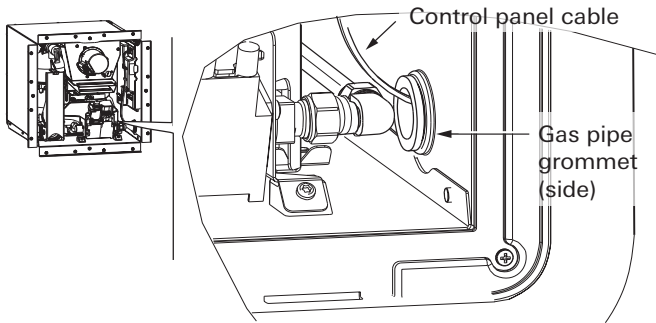


Fig. 33

Functional check

1. Start the appliance (refer to “Starting the appliance” on page 9).
2. Check the appliance for proper functionality.



If faults occur during operation of the appliance, refer to “Troubleshooting” on page 22.

3. Provide operating and installation instructions to the vehicle owner.

The appliance is now ready for normal operation.

Checking for gas leaks

▲ WARNING

Risk of death and personal injury through fire and/or explosion!

- DO NOT use matches, candles or other sources of ignition when checking for gas leaks.
- After the gas supply is connected, check for gas leaks at all gas connections. Use a gas leak detection liquid.

1. Turn OFF the electrical power supply
2. **NOTICE** **Damage to the appliance from test pressure higher than 60 in. wc (150 mbar). Ensure that the test pressure is lower than 60 in. wc (150 mbar).**
3. Turn on the gas.
4. Check the appliance and all gas connections for gas leaks with leak detection liquid.
 - Bubbles indicate a gas leak that must be repaired.
5. Repair gas leaks as needed.
6. Repeat check for gas leaks at all gas connections.



APPENDIX A – Error Codes

If the appliance malfunctions, LED 2 (refer to “Overview / Designation of parts” on page 2) will flash to indicate the malfunction. There are short and long intervals of flashing. The flashing will repeat every 3 seconds.

1. Note the flashing intervals and check the list below.
2. Reset the appliance:
 - Switch off the appliance. / – Wait 5 seconds / – Switch the appliance on again.
3. If an error code is still displayed, contact an authorized Truma service center.

Error code	Flash code s = short = 0 l = long = 1	Error	Description
1	s,s,s,s,s,s,l	Flame not detected	There is a flame-detection error at the burner because the flame was not detected after release of gas and ignition. Important: The system indicates this error only after three attempts at intervals of approximately 30 seconds.
2	s,s,s,s,s,l,s	Error at over temperature switches (EOS, BOS)	The exhaust over temperature switch (EOS) or burner over temperature switch (BOS) is open/unplugged.
3	s,s,s,s,s,s,l	Error at exhaust pressure switch (EPS)	The EPS did not close when the flue fan was actuated because the fan did not push enough air through the exhaust channel. A cause could be, e.g., blocking of the exhaust channel or a faulty switch. OR The EPS is closed even though the flue fan is not running. Cause is a defective EPS or flue fan.
4	s,s,s,s,l,s,s	Error at water over temperature switch (WOS)	The WOS opened at a water temperature of over 185 °F (85 °C).
5	s,s,s,s,s,l,s	Flame detected at incorrect time	There is an error in flame detection of the burner because the flame was detected – before ignition or – before the release of gas or – after the gas was switched off.
6	s,s,s,s,l,l,s	Error in the safety circuit for gas valve	There is a heating request but gas cannot be released. One of the switches WOS, EOS, BOS, EPS is open/unplugged.
7	s,s,s,s,l,l,l	Error of burner MCU internal RAM	Error detected in the burner MCU's internal safety monitoring feature (safety variables are no longer correct or RAM/STACK was overwritten by mistake).
9	s,s,s,l,s,s,l	Malfunction of water outlet temperature sensor WOT	Water outlet temperature sensor WOT – has a short circuit or – is open/unplugged.
10	s,s,s,l,s,l,s	Error in the safety circuit	There is a heating request but gas is not released because a valve-actuation signal was not activated.
11	s,s,s,l,s,l,l	Error of MCU watchdog gas release	There is a heating request but the MCU watchdog does not release the gas path.
12	s,s,s,l,l,s,s	Internal error	
13	s,s,s,l,l,s,l	Short circuit shut-off valve	Short circuit detection in the gas valve (shut-off part) detected a current > 1000 mA and shut off.
16	s,s,s,l,s,s,s	Malfunction of the MCU	Internal error of the control unit.
20	s,s,s,l,s,l,s	Malfunction of water inlet temperature sensor WIT	Water inlet temperature sensor WIT – has a short circuit or – is open/unplugged or – the temperature of the sensor is colder than 14 °F (-10 °C).
21	s,s,s,l,s,l,s	Malfunction of circulation line temperature sensor WCT	Circulation line temperature sensor WCT – has a short circuit or – is open/unplugged or – the temperature of the sensor is colder than 14 °F (-10 °C).
22	s,s,s,l,s,l,s	Malfunction of gas valve, modulation section	Error at gas valve, modulation level, because - the modulator has a short circuit or - is open/unplugged.
23	s,s,s,l,s,l,l	Voltage is too high	The main power supply's voltage detector measured a voltage level of >16.4 V.
24	s,s,s,l,s,s,s	Voltage is too low	The main power supply's voltage detector measured a voltage level of <10 V.
25	s,s,s,l,s,s,l	Flue fan current consumption error	The current detector for the flue fan has measured a current outside the permitted limits.
26	s,s,s,l,s,l,s	Circulation pump current consumption error	The current detector at the circulation pump has measured a current outside the permitted limits.
27	s,s,s,l,s,l,l	Water circulation pump is running dry.	The circulation pump does not generate water flow. The water system may not be filled or not sufficiently vented. The circulation pump tries (20 times) to generate a water flow every 30 s (if successful, the error is reset).
28	s,s,s,l,l,s,s	Too low gas pressure.	Gas supply (in vehicle) to the appliance insufficient.
29	s,s,s,l,l,s,l	Too high heat power required.	You are trying to use more hot water than the appliance can supply.
30	s,s,s,l,l,l,s	Risk of freezing.	Temperature in the appliance below 27 °F (3 °C).
31	s,s,s,l,l,l,l	Decalcification finished.	–
32	s,s,l,s,s,s,s	Current too low.	Current in the antifreeze kit too low (e.g. cable break).
33	s,s,l,s,s,s,l	Current too high.	Current in the antifreeze kit too high (e.g. short circuit).



APPENDIX B – Functional Diagram

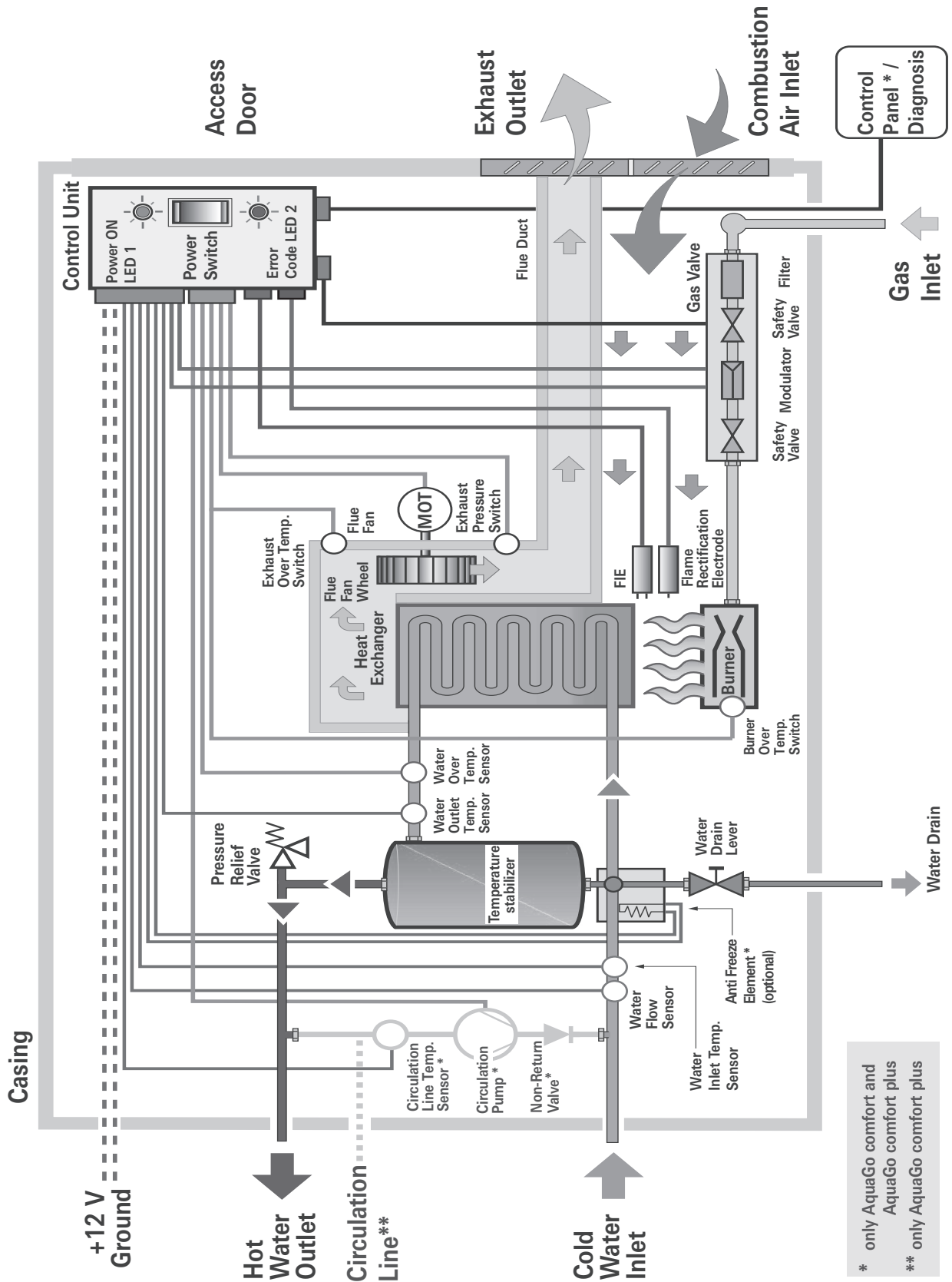


Fig. 34



APPENDIX C – Spare Parts (all models)

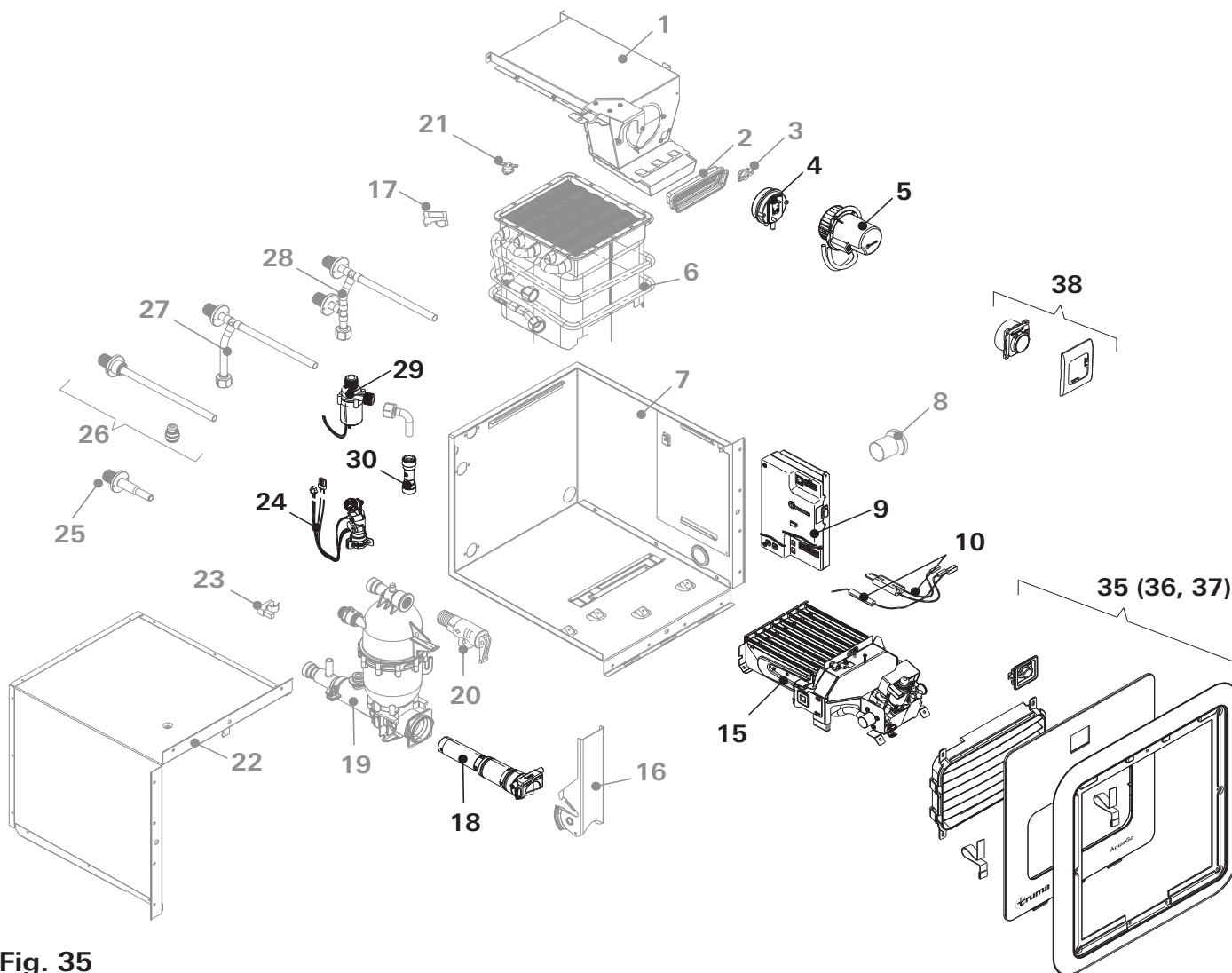


Fig. 35

Item Ref.	Part no.	Component
1	NYA	
2	NYA	
3	NYA	
4	77000-90100	Exhaust Pressure Switch
5	77000-00208	Flue Fan Assembly
6	NYA	
7	NYA	
8	NYA	
9	77000-00113	Control Unit Assembly
10	77000-91300	Electrodes
11	NYA	
12	NYA	
13	NYA	
14	NYA	
15	77000-90400	Burner Assembly
16	NYA	
17	NYA	
18	77000-90800	Filter Assembly
19	NYA	
20	NYA	

Item Ref.	Part no.	Component
21	NYA	
22	NYA	
23	NYA	
24	77000-90500	Flow Sensor Assembly
25	NYA	
26	NYA	
27	NYA	
28	NYA	
29	77000-90600	Circulation Pump
30	70020-03500	Non-Return Valve Assembly
31	NYA	
32	NYA	
33	NYA	
34	NYA	
35	77001-01	Access Door Standard
36	77101-01	Access Door Adapter (not shown)
37	77201-01	Access Door XS (not shown)
38	77000-00089	Control panel
39	77000-00114	Sticker set (not shown)



APPENDIX D – Electrical Connection Diagram

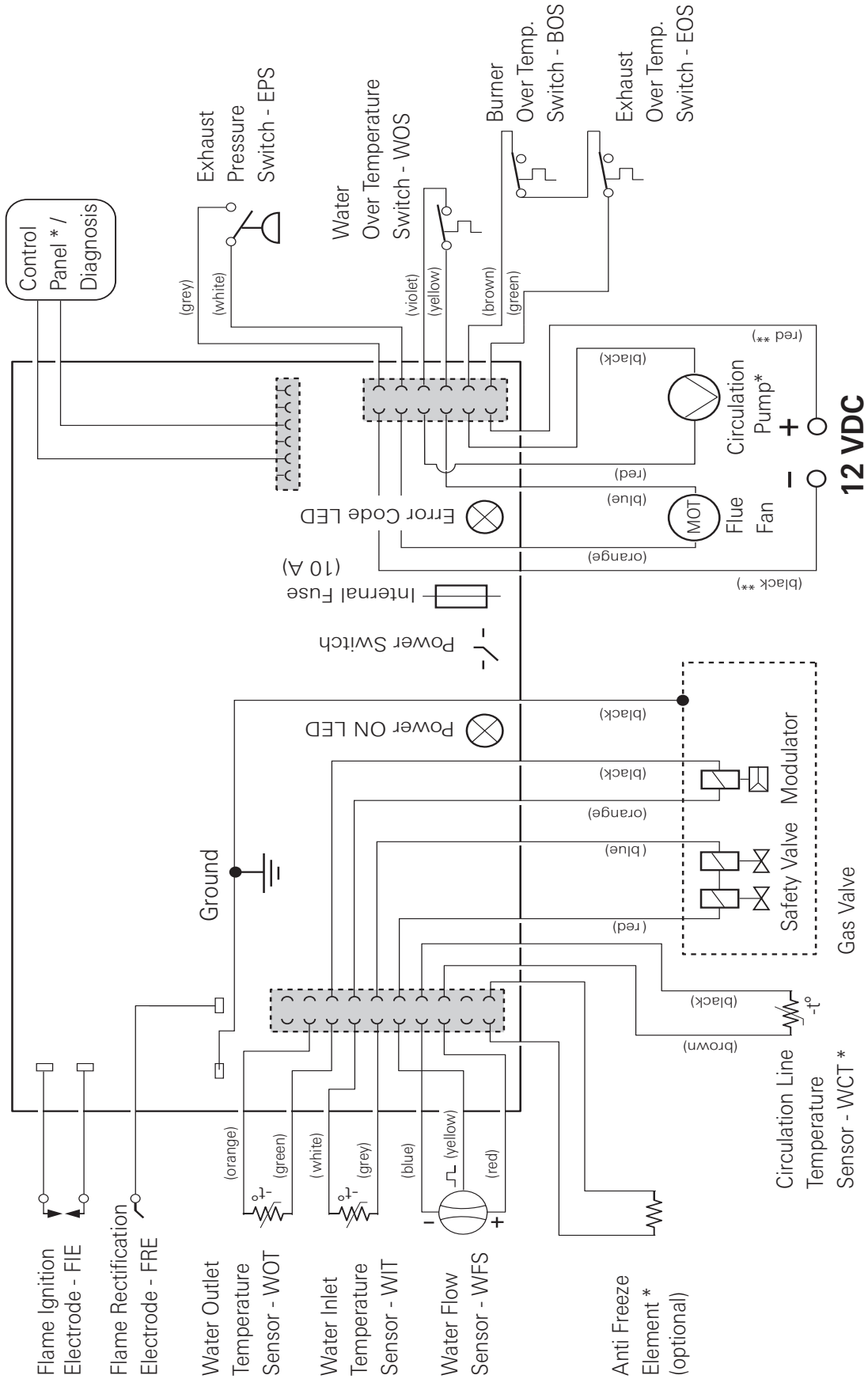


Fig. 36

* only AquaGo comfort and AquaGo comfort plus

If any of the original wire as supplied with the water heater must be replaced, it must be replaced with wire 18 AWG (** 16 AWG) - 105 °C - UL1015, or equivalent

18 AWG or 1 mm² MWG (** 16 AWG or 1.5 mm² MWG)



APPENDIX E – Notes for painting the access door and cover plate

Important Information

▲ Observe all safety notes/instructions for painting the access door and cover plate.

The following parts (see Fig. 38) may be painted:

- The white cover plate
- The white outer surfaces of the access door

Material of the parts:

- The parts are made from a polycarbonate material.
- Check whether the paint to be used is suitable for polycarbonate.
- For optimum adhesion of the paint it may be necessary to apply a primer to the surfaces that will be painted.
- **NOTICE** Use of unsuitable paints may damage the parts. Follow the recommendations of the paint manufacturer.

The following parts (see Fig. 37) must not be painted:

- The black ventilation grille
- The turn lock
- The webbings

Work before painting

i In order to simplify painting and reduce the work for masking, the turn lock and the ventilation grille can be removed/disassembled.

Please follow the steps below to remove the ventilation grille and the turn lock:

1. Open the access door.

2. Remove the ventilation grille:

- Using a Torx T-15 remove the 4 screws securing the ventilation grille to the access door.
- After removing the screws, depress the four (4) clips on the side of the ventilation grille and remove it as shown in Fig. 37.

3. Remove the turn lock:

To remove the turn lock, depress the four (4) clips and remove it as shown in Fig. 37.

4. Mask the ventilation grille opening from the back side (side with waffle pattern).

5. Close the access door and fix it in the closed position for painting.

- This can be done with the help of tape that joins the flue fan and the edge of the turn lock opening (see Fig. 38 for this detail).
- Remove any tape that hangs over the edge by more than 0.12 in. (3 mm).
- Finally mask the turn lock opening with tape (hatched area). Take care not to exceed 0.12 in. (3 mm) from the edge (this is the area that will be covered by the turn lock).

6. Paint the access door and the cover plate.

Work after painting

7. Remove all masking.

8. Assemble the ventilation grille and the turn lock in the reverse order. Make sure that they are installed in the right direction.

9. Ensure turn lock operates correctly (if unsure: see "Closing the access door" on page 9).



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Painting a detached access door

i If necessary for masking or painting, the access door can be detached temporarily.

- Remove the four (4) screws that fix the webbings.
- Fix the webbings again after painting.

⚠ WARNING

Danger of personal injury or damage to the recreational vehicle.

Unsecured webbings cause the access door to become loose and it may fall off when you are driving the RV.

- After painting, the webbings must be fixed firmly to the access door with the original screws.

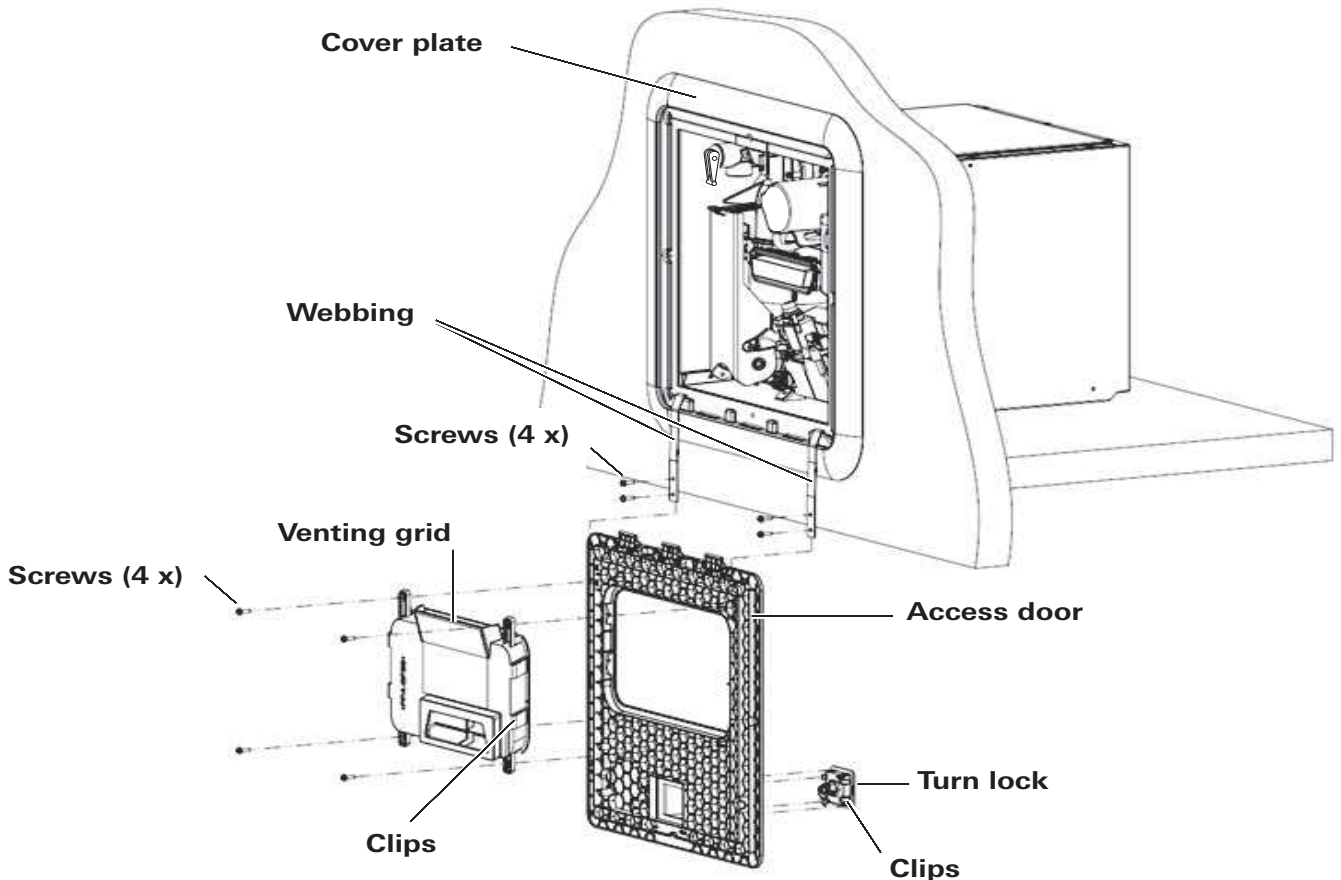


Fig. 37

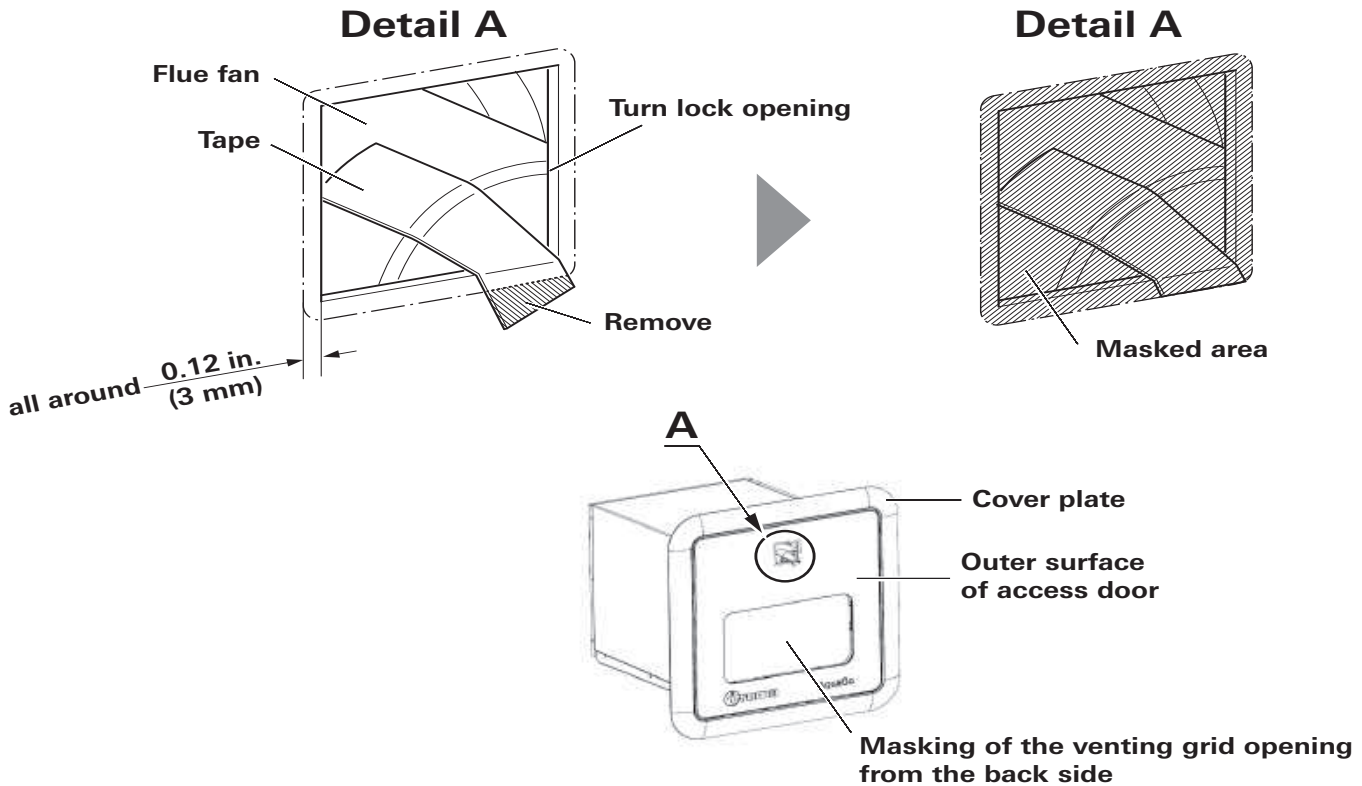


Fig. 38



TRUMA AQUAGO COMFORT WATER HEATER

USA In case you encounter any problems, please contact the Truma Service Center at 855-558-7862 or one of our authorized service partners. For details see www.truma.net.

Please have the model number and serial number (on water heater's type plate) handy when you call.

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Electric antifreeze kit

AquaGo™

US

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CA, MX ▶






Intended use

The Truma electric antifreeze kit* keeps the Truma AquaGo™ instant water heater frost-free to -4 °F (-20 °C) while you are driving or if there is no gas supply. To operate the Truma antifreeze kit you need a 12 V (minimum 120 W recommended) power supply from the RV's on-board system.

* For AquaGo™ comfort / AquaGo™ comfort plus


 The Truma electric antifreeze kit protects only the water in the Truma AquaGo instant water heater against freezing. The Truma electric antifreeze kit will not protect the RV's entire water system. Water lines, faucets, water tanks and the external water valves and the vehicle must be heated separately.


Safety Information


The operating instructions supplied with the Truma AquaGo™ instant water heater are part of these installation and operating instructions for the Truma electric antifreeze kit.

Read and follow all of this information to avoid injuries during installation and operation.

Safety symbols and signal words

 This is the safety alert symbol. This symbol alerts you to potential hazards that can kill or hurt you and others.

 **CAUTION** indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

 **NOTICE** is used to address practices not related to physical injury.



i Other important information or tips

Installation and service must be performed by an expert. Improper installation, alteration, service or maintenance can cause property damage, personal injury or loss of life.

California Proposition 65 lists chemical substances known to the state to cause cancer, birth defects, death, serious illness or other reproductive harm. This product may consist of such substances or such substances may be formed from components of the product.

3

Scope of delivery

Quantity	Component
1	Electric antifreeze kit cartridge (heating cartridge)
1	Adapter cable
1	Plug
1	Holder
2	Cable ties (not shown)
1	Installation/Operating instructions for the Truma electric antifreeze kit

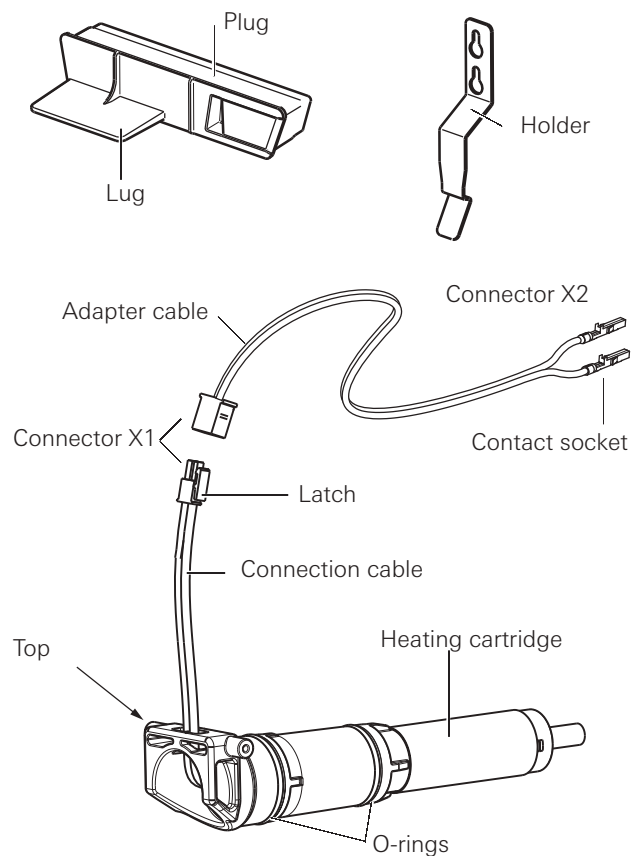


Fig. 1

Installation instructions

i You will find more information about the following in the operating instructions for the Truma AquaGo™ instant water heater:

- Operation
- Access door
- Draining the water

Preparing for installation

1. Remove the access door.
2. Switch OFF the Truma AquaGo™ instant water heater at the POWER switch and at the control panel (set Operating mode to OFF).

Installing the holder

3. Attach the holder to the rear side of the access door, as shown in Figure 2.

4. Clamp the plug beneath the holder, as shown in Figure 3.

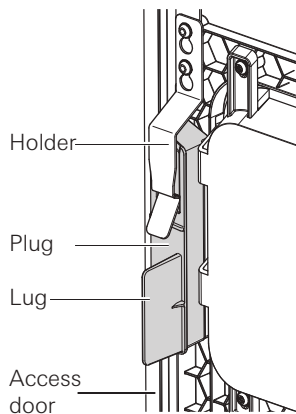


Fig. 3

Installing the heating cartridge

1. Turn OFF the water supply or switch OFF the water pump.
2. Open a hot water faucet and leave it open in order to depressurize and vent the water system.

- Undo the two screws of the webbing about 1/10 inch (2.5 mm).
- Position the holder below the screws.
- Tighten the screws.

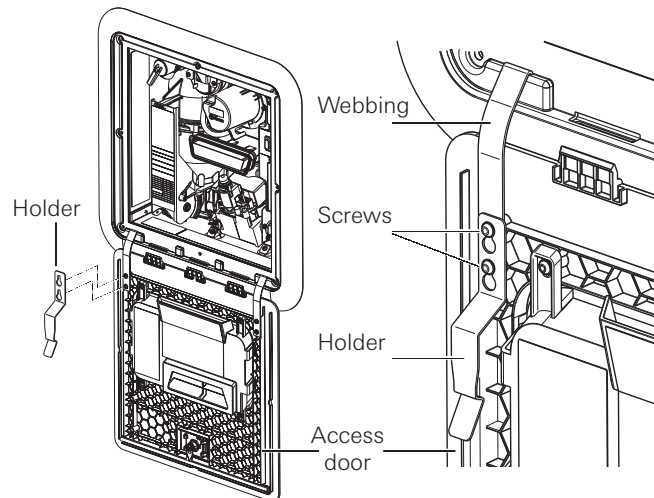


Fig. 2

3. **⚠ CAUTION Injuries caused by the Easy Drain Lever!** When the Easy Drain Lever is folded out, it protrudes beyond the side wall of the vehicle.
 - When walking past or bending over, make sure that you and others have sufficient distance.
4. Open the latch with your thumb while pulling the Easy Drain Lever down as far as it will go.
5. Remove the water inlet filter as shown in Fig. 4a and rinse it with clean water.

i Keep the water inlet filter in a safe place. When you decalcify the Truma AquaGo™ instant water heater, you will need it for the Truma AquaGo™ decalcification tablets.

6. Inspect the O-rings on the heating cartridge for cracks. Replace the heating cartridge if there are cracks.



7. **⚠ CAUTION** Danger of crushing/pinching of fingers when the Easy Drain Lever is closed!

- Never put fingers between Easy Drain Lever and water inlet filter or latch.

i If during installation, it is difficult to install the heating cartridge, use a small amount of soap on the O-rings. Never use grease, because the O-rings are not resistant to grease.

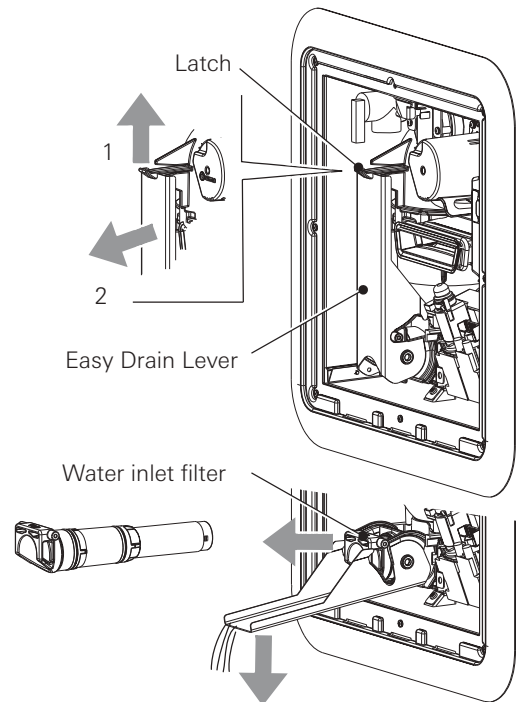


Fig. 4a

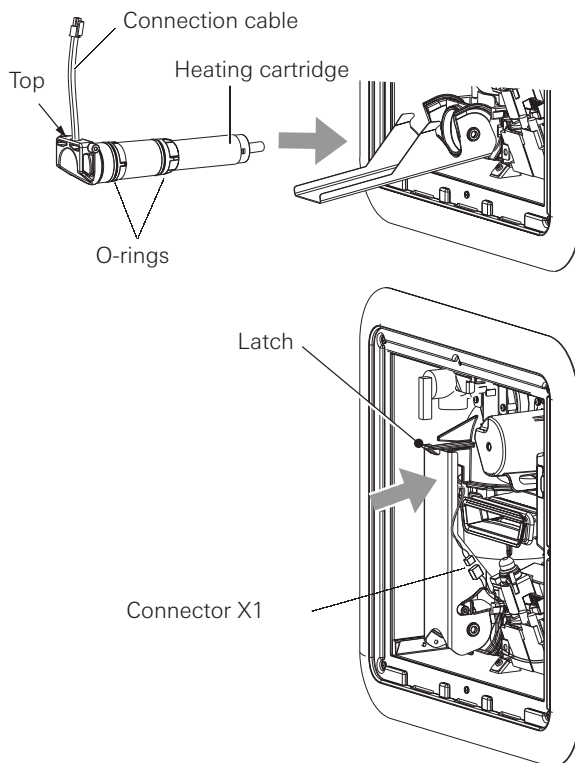


Fig. 4b

7

8. **⚠ CAUTION** Risk of a short circuit!

- Lay the connection cable upward so that it is not jammed when the Easy Drain Lever is closed.

9. Install the heating cartridge as shown in Fig. 4b. Observe the correct installation position and close the Easy Drain Lever until it is locked by the latch. You can hear a “clicking” sound as the Easy Drain Lever engages.

Electrical installation (“adapter cable”)

1. **NOTICE** Damage to the contact sockets resulting from incorrect installation.
 - During installation, you must align the contact sockets as shown in Figure 5.
 - Remove the socket housing from the control unit (press the lock).

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TRUMA ELECTRIC ANTIFREEZE KIT

2. Slide the contact sockets (see Figure 5) into the socket housing (openings 1 and 11) until they lock in place. You do not have to bother about the plus and minus poles.
3. After installation, lightly pull the adapter cable to make sure that the contact sockets are locked in place.
4. You must attach the socket housing to the control unit again when you have removed it. It must lock in place.
5. Lay the adapter cable and fix it in place with the 2 cable ties, as shown in Figure 5.
6. Connect the connection cable to the adapter cable (see Figure 5).

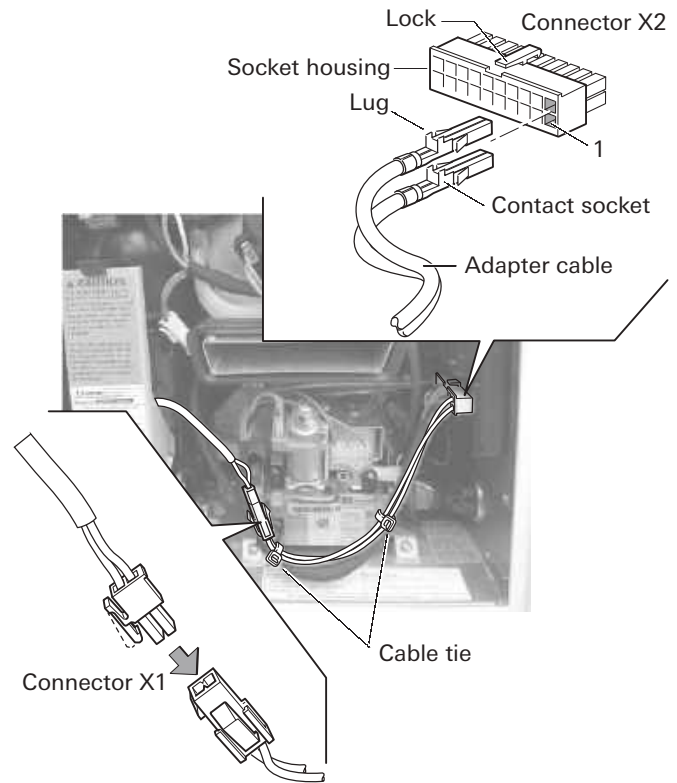


Fig. 5

7. Installation is complete.

9

Operating instructions

For proper operation, you must observe the following:

- **Gas must not be used for heating while the RV is in motion.**
- With this electric antifreeze kit, the Truma AquaGo™ instant water heater can be kept frost-free while you are driving or if there is no gas supply (to ambient temperatures of -4 °F (-20 °C)).
- At ambient temperatures below -4 °F (-20 °C) the Truma AquaGo™ instant water heater must not be operated and must be winterized.



You will find more information about the following in the operating instructions for the Truma AquaGo™ instant water heater:

- Operation
- Operating modes
- Winter operation / winterizing
- Troubleshooting
- Access door
- Draining the water

Start-up

1. Remove the access door.
2. Switch OFF the Truma AquaGo™ instant water heater at the POWER switch and at the control panel (set Operating mode to OFF).
3. Allow the Truma AquaGo™ instant water heater to cool down
4. **NOTICE** Risk of damage in frosty conditions without plug!



- Never operate the electric antifreeze kit without an installed plug in the flue duct. (The plug prevents cold air from flowing through the heat exchanger).
5. Remove the plug from the holder and close the flue duct with it (see Figure 6).
 6. You may have to connect the connection cable to the adapter cable (see Figure 5).

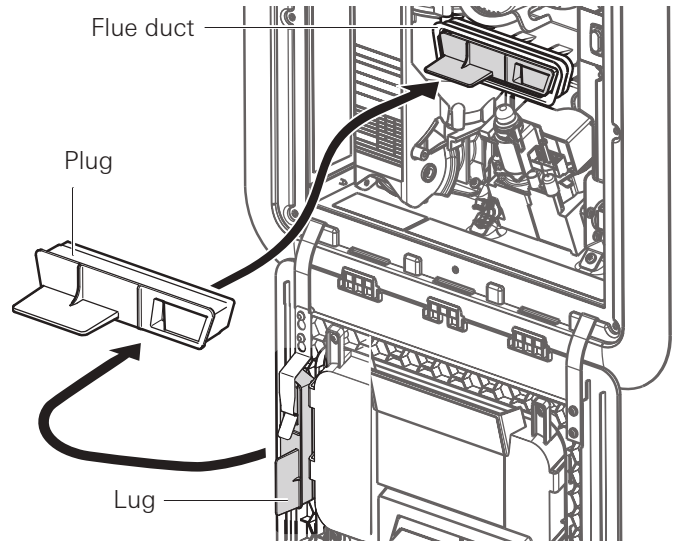


Fig. 6

7. To operate the antifreeze kit, fill the Truma AquaGo™ instant water heater with water and switch it on. (See “Winter operation” in the operating instructions for the Truma AquaGo™ instant water heater.)
 - Close open bypass lines (if present).

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- Turn on fresh water supply or switch on water pump.
- Fill the water system.
- **NOTICE Malfunction of the electric antifreeze kit due to air in the water system**
 - Vent the water system so that the circulation pump in the Truma AquaGo™ instant water heater works.
- Open all water-release points, e.g., cold and hot water faucets, showers, toilets.
- Once water flows uniformly, the water system is vented. Close the water-release points.

10. Check the position of the plug. You must be able to see the lug through the venting grid – as shown in Figure 7.

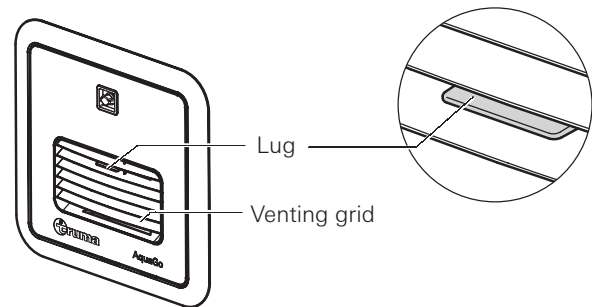


Fig. 7

8. Switch ON the Truma AquaGo™ instant water heater at the POWER switch.
9. Insert and close the access door.

11. Select operating mode ANTIFREEZE (see Figure 8).

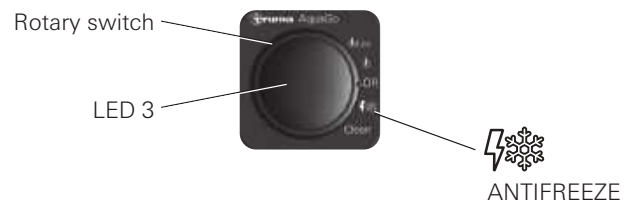


Fig. 8

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TRUMA ELECTRIC ANTIFREEZE KIT

- During operation, the yellow status LED 3 (see Fig. 8 - LED 3) is lit.

Troubleshooting

Problem

The Truma AquaGo™ instant water heater does not start in gas mode.

Remove the plug from the flue duct and clamp it beneath the holder (see Figure 9).

The yellow status LED 3 is not lit.

Check the connection on connector X1. You may have to disconnect it and connect it again.

The yellow status LED 3 is flashing.

See "Description of the yellow status LED 3" in operating modes (control panel) in the operating instructions for the Truma AquaGo™ instant water heater.

Potential cause

– The plug is blocking the flue duct.

– The heating cartridge is not attached or is defective.

– There is a malfunction.

If none of the measures in the troubleshooting chart proves successful, please contact your dealer, the Truma Service Center on 1-855-558-7862 or one of our authorized service partners.

Change over to gas mode

i If you change the Truma AquaGo™ instant water heater back to gas mode, the heating cartridge can remain in the Truma AquaGo™ instant water heater.

1. Remove the access door.
2. Switch OFF the Truma AquaGo™ instant water heater at the POWER switch and at the control panel (set Operating mode to OFF).
3. Remove the plug from the flue duct and clamp it beneath the holder (see Figure 9).

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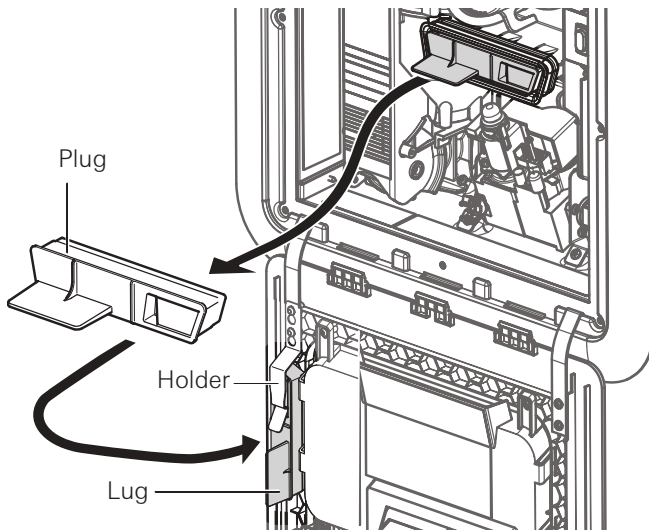


Fig. 9

4. Switch ON the Truma AquaGo™ instant water heater at the POWER switch.
5. Insert and close the access door.

6. The Truma AquaGo™ instant water heater is now ready for using the control panel inside your vehicle.

Dismantling the electric antifreeze kit

For decalcification you must use the water inlet filter (included with the delivery of the Truma AquaGo™ instant water heater).

1. Remove the access door.
2. Switch OFF the Truma AquaGo™ instant water heater at the POWER switch and at the control panel (set Operating mode to OFF).
3. Turn OFF the water supply or switch OFF the water pump.
4. Open a hot water faucet and leave it open in order to depressurize and vent the water system.

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5. Remove the plug from the flue duct and clamp it beneath the holder (see Figure 9).
6. Unplug the connector X1 (see Fig. 10).

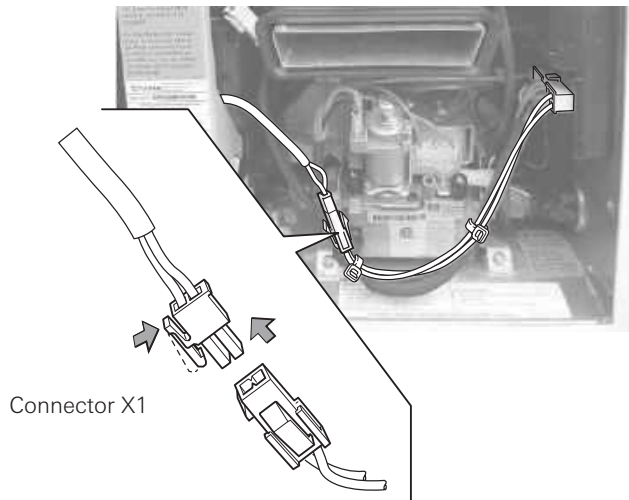


Fig. 10

7. **⚠ CAUTION Injuries caused by the Easy Drain Lever!** When the Easy Drain Lever is folded out, it protrudes beyond the side wall of the vehicle.
 - When walking past or bending over, make sure that you and others have sufficient distance.
8. Open the latch with your thumb while pulling the Easy Drain Lever down as far as it will go.
9. Remove the heating cartridge as shown in Fig. 11a and rinse it with clean water.

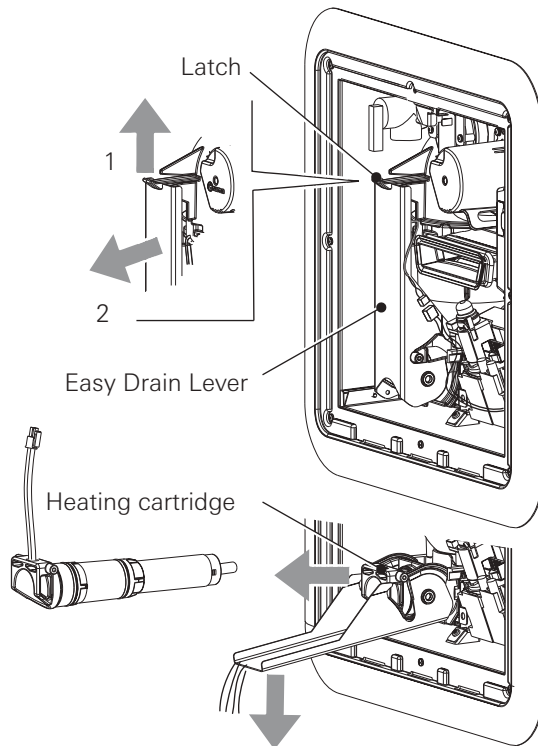


Fig. 11a

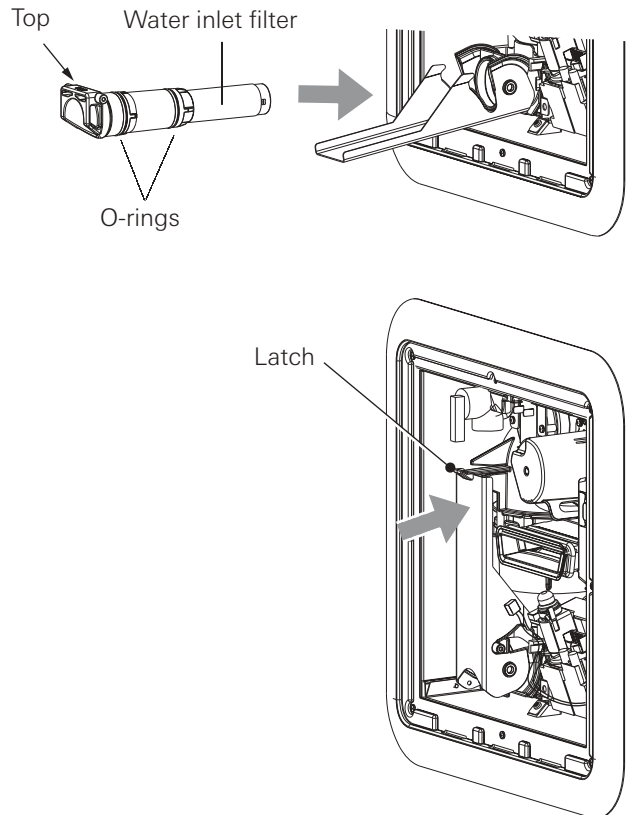


Fig. 11b



TRUMA ELECTRIC ANTIFREEZE KIT

10. If you now want to decalcify the Truma AquaGo™ instant water heater, the removal of the electric antifreeze kit is complete.

i You can find more information about decalcification in the operating instructions for the Truma AquaGo™ instant water heater in “Decalcification (models with control panel)”.

11. Inspect the O-rings on the water inlet filter for cracks. Replace the water inlet filter if there are cracks.

12. **⚠ CAUTION** **Danger of crushing/pinching of fingers when the Easy Drain Lever is closed!**

- Never put fingers between Easy Drain Lever and water inlet filter or latch.

i If during installation, it is difficult to install the heating cartridge, use a small amount of soap on the O-rings. Never use grease, because the O-rings are not resistant to grease.

13. Install the water inlet filter as shown in Fig. 11b. Observe the correct installation position and close the Easy Drain Lever until it is locked by the latch.

You can hear a “clicking” sound as the Easy Drain Lever engages.

14. Insert and close the access door.

15. Removal of the electric antifreeze kit is complete. You can find information about operation of the Truma AquaGo™ instant water heater in “Operating procedures” in the operating instructions for the Truma AquaGo™ instant water heater.

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Technical data

Nominal voltage	12 VDC
Nominal current	5 A
Ambient temperature	-4 °F...+104 °F (-20 °C...+40 °C)
Dimensions	
Width	2.8 inch (72 mm)
Height	2.0 inch (50 mm)
Depth	9.1 inch (230 mm)
Weight (approx.)	0.5 lbs (220 g)

TRUMA Gerätetechnik GmbH & Co. KG
("TRUMA")

“Electric antifreeze kit” MANUFACTURER LIMITED WARRANTY

(September 2014)

This limited warranty pertains solely to the “electric antifreeze kit” (the “Product”) manufactured by TRUMA and sold through its affiliates and dealers in North America.

TRUMA warrants subject to the below stated conditions that the Product will be free from defects in material and workmanship, and will perform in accordance with the technical specifications set forth in the description of the Product for a period of twelve (12) months for newly manufactured parts from the original date of purchase. This limited warranty shall only apply



if the Product was properly installed according to the installation instructions provided and in compliance with applicable codes.

During the warranty period, TRUMA will repair or replace, at its own discretion and costs, the defective Product or parts or components of such Product reported to TRUMA and which TRUMA determines was defective due to a warranty defect. Costs of diagnosis for a warranty defect are borne by TRUMA. Other costs of diagnosis are not included in this warranty. At the discretion of TRUMA, the replacement of the Product or parts or components thereof (i) may be newly manufactured, (ii) may be assembled from new or serviceable used parts that are equivalent to new parts in performance, or (iii) may have been previously installed.

The customer shall not attempt to repair the Product or resolve the problem without the prior consent of TRUMA. Any attempt by the customer to repair the Product or

resolve the problem without the prior consent of TRUMA will void this warranty.

This limited warranty does not cover any defects attributable in whole or in part to (i) non-TRUMA products and services and / or alterations of out-of-specification supplies, (ii) accidents, misuse, negligence or failure of the customer to follow instructions for the proper use, care and cleaning of the Product, (iii) damages caused in gas pressure regulation systems due to foreign substances in the gas (i.e. oil, plasticizers), (iv) external factors (e.g., fire, flood, severe weather), (v) failure of proper transport packaging, or (vi) failure by the purchaser to comply with TRUMA's installation and user manual regarding the Product.

All warranty claims must be reported to TRUMA's authorized warranty service center in the United States: Truma Corp Service Center, **825 East Jackson Blvd., Elkhart, IN 46516, toll free: (855) 558-7862, fax. (574) 538-2426, service@trumacorp.com, www.truma.net**

The purchaser shall provide the following information regarding the potential warranty claim (i) serial number of the defective device, (ii) proof of purchase, (iii) purchaser's contact information.

EXCEPT AS EXPRESSLY STATED AND SET FORTH HEREIN, THERE ARE NO WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT AND NO SUCH WARRANTIES OR REPRESENTATIONS SHALL BE IMPLIED UNDER ANY APPLICABLE LAW, IN EQUITY OR OTHERWISE, INCLUDING WITHOUT LIMITATION, A WARRANTY OF MERCHANTABILITY, A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER WARRANTY WHICH MAY BE IMPLIED UNDER COMMON LAW OR UNDER THE UNIFORM COMMERCIAL CODE OF ANY STATE OR OTHER JURISDICTION OF THE UNITED STATES OF AMERICA.

Unless further limited herein, the entire liability of TRUMA and the customer's exclusive remedy for damages from any cause related to or arising out of a warranty defect, regardless of the form of action, whether in contract or in tort, will not exceed the amount of the purchase price for each purchase order for the Product which is the subject matter or directly related to the causes of action asserted.

Unless prohibited under applicable state law, in no event will TRUMA, its agents, subcontractors, affiliates, suppliers and employees be liable for (a) any incidental, indirect, special or consequential damages, including, but not limited to, loss of use, revenue, profits or savings, substitute rental or for any other reason, even if TRUMA knew or should have known of the possibility of such losses or damages, (b) claims, demands or actions against the customer by any person, except as provided by applicable law.



TRUMA ELECTRIC ANTIFREEZE KIT

US In case you encounter any problems, please contact the Truma Service Center at 855-558-7862 or one of our authorized service partners. For details see www.truma.net.

CA En cas de problème, veuillez communiquer avec le Service après-vente (SAV) Truma au 855-558-7862 ou avec l'un de nos partenaires de service autorisés. Pour plus de détails, visitez www.truma.net.

MX En caso de que se presente algún problema, rogamos se comuniquen con el Centro de Servicio postventa Truma en el 855-558-7862 o con uno de nuestros distribuidores de servicio autorizados. Para más información, visite www.truma.net.

Manufacturing / Fabrication / Producción

Truma Gerätetechnik GmbH & Co. KG
Wernher-von-Braun-Straße 12
85640 Putzbrunn
Germany / Allemagne / Alemania
www.truma.com

Please have the model number and serial number (on water heater's type plate) handy when you call.

Ayez à portée de la main les numéros de modèle et de série (indiqués sur la plaque signalétique du chauffe-eau) au moment de votre appel.

Tenga a mano el número de modelo y el número de serie (en la placa de características del calentador de agua) cuando se comuniquen con nosotros.

Service / service / servicio

Truma Corp
825 East Jackson Blvd.
Elkhart, IN 46516
USA / États-Unis / EE.UU.
Toll Free / Sans frais / Sin coste
1-855-558-7862
Fax / Télécopieur / Fax
1-574-538-2426
service@trumacorp.com / www.truma.net

77000-00127 - 00 - 03/2016



FURRION

4.3" Vision S Camera System
Systeme de caméra Vision S de 4.3 po
Sistema de cámara Vision S de 4.3"

Instruction Manual
Manuel d'instructions
Manual de instrucciones



- * *The packing contents may be different based on the kit you purchased. Please take the actual product as standard.*
- * *Le contenu de l'emballage peut être différent en fonction de la trousse achetée. Veuillez prendre le produit réel en référence.*
- * *Es posible que los contenidos del embalaje sean diferentes según el kit que haya comprado. Tome el producto real como estándar.*

Model/Modèle/Modelo: FOS43TASK/FOS43TASR
 FOS43TASE/FOS43TASF



Welcome

English

Thank you for purchasing this Furrion® Vision S Camera System. Before operating your new product, please read these instructions carefully. This instruction manual contains information for safe use, installation and maintenance of the product.

Please keep this instruction manual in a safe place for future reference. This will ensure safe use and reduce the risk of injury. Be sure to pass on this manual to new owners of this product.

The manufacturer does not accept responsibility for any damages due to not observing these instructions.

If you have any further questions regarding our products, please contact us at support@furrion.com



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English



Important Safety Instructions

English

READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLING OR USING THE SYSTEM

This product is intended to assist in safe driving and to allow the driver to have a broader view while the vehicle is in reverse.

You, as the driver, are solely responsible for the safe operation of your vehicle and the safety of your passengers according to your local traffic regulations. Do not use any features of this system to the extent it distracts you from safe driving.

Your first priority while driving should always be the safe operation of your vehicle. Furrion cannot accept any responsibility for accidents resulting from failure to observe these precautions or safety instructions.

1. This product utilizes high voltage. Any unauthorized modifications or damage to the product may result in electrical shock. Handle all components with care. Inspect regularly for damage to components and cabling.
2. You are responsible for ensuring the installation of this product does not void or affect the vehicle manufacturer's warranty. Furrion is not liable in full or in part for improper installation resulting in loss or damage to your property, or for voiding all or part of the vehicle manufacturer's warranty.
3. Do not apply excessive force to any of the components contained within this kit. Excessive force used before, during or after installation that results in a damaged or nonfunctional part will void all warranties.
4. Please follow the procedures in this instruction manual. Improper installation or modification of this product will void all warranties.

Many jurisdictions have laws and regulations relating to the use of cameras and some do not allow for the obstruction of information contained on a license plate. Before using this product, it is the buyer's responsibility to

be aware of and comply with any applicable laws and regulations that apply to license plates or may prohibit or limit the use of cameras.

Electrical Safety

- A battery or 12V DC electrical system presents a risk of electrical shock or burn. Ensure all power sources are isolated before installation.
- Insulate unconnected wires with vinyl tape or similar.
- Use insulated tools when working with a power supply.

Caution

- There are no serviceable parts in the Furrion Wireless Observation Camera System. Do not disassemble or attempt any repairs.
- There are no fuses or disconnects in the Furrion Wireless Observation Camera System. Install external fuses/breakers as required.

Installation

- Installation and wiring of this product require specialist skills. To ensure proper and safe installation, please seek a specialist technician.
- Only use supplied or recommended parts.
- Use watertight connectors for the camera power supply cable to power source.
- Connect the camera to a 12-24V DC circuit using 18AWG or larger cables.
- Ensure correct polarity of DC power supply to the camera.
- To reduce the risk of fire, connect the camera only to a circuit provided with a maximum branch-circuit over current protection device.
- Do not route wiring in areas that may get hot.
- Take necessary precautions when working at elevated levels.



Important Safety Instructions

English

Use

- Electrical appliances and overhead power lines can affect the wireless signal.
- Do not place the monitor in a location where it might hinder field of vision while driving.
- Consideration should be given to any airbags when installing the monitor. Do not place the monitor where it might hinder the airbag or become hazardous if the airbag is deployed.

Care

- Do not wash the vehicle with an automatic car wash or high pressure water. This may damage the camera.
- Clean the LCD screen with a microfiber cloth. Do not use coarse or abrasive materials.
- Do not use alcohol or ammonia based products to clean the LCD screen. Only use specialist screen cleaning products.
- Use a wet cloth to clean the camera lens. A dry cloth may scratch the camera lens.

FCC Statement

The equipment complies with RF exposure limits. This module is limited to installation in mobile or fixed applications. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: The Grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF Exposure

The device has been evaluated to meet general RF exposure requirement. To maintain compliance with FCC's RF exposure guidelines, this equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.



Important Safety Instructions

English

IC Statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

RF Exposure

The device has been evaluated to meet general RF exposure requirement. To maintain compliance with RSS-102 — Radio Frequency (RF) Exposure guidelines, this equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.



Product Overview

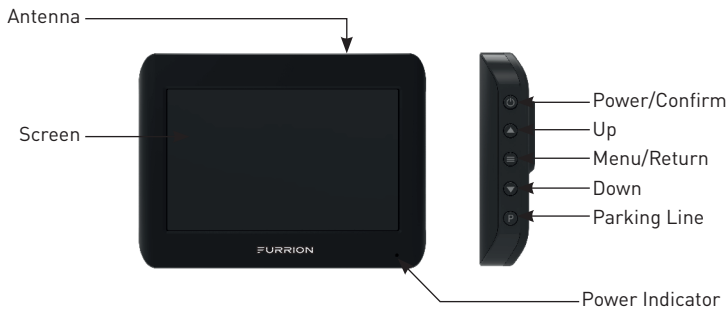
Product Description

The Furrion Vision S Camera System is designed to assist the driver by providing a clear and wide image of the area behind the vehicle whenever the vehicle is shifted into reverse. Never rely solely on this product to ensure the area is clear of children and/or obstructions. Use your monitor and look both ways. This product is not intended to replace existing safety procedures, but rather to add an additional safety tool for your vehicle.

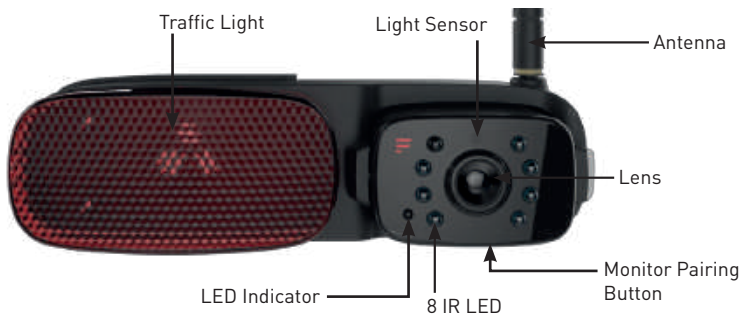
CAUTION: Do not back up your vehicle while watching the monitor screen. Always look in the direction the vehicle is traveling. Use the monitor as an aid to ensure there are no children or obstructions. The image on the monitor is not designed to show distance and may be misleading. The actual distance is less than appears in the monitor. The range of the image is limited. Be aware of blind spots.

English

Monitor



Rear Camera





Getting Started

English

The camera and monitor need to be paired the first time you are using your Vision S Camera System.

NOTE: Ensure both the camera and monitor has power supplied during pairing and setting processes. *(The vehicle may need to be running.)*

Activate the Monitor

In off mode, press the button on the right of the monitor to turn on the monitor. In on mode, press and hold the button to activate the monitor.

There are four options that allow you to set the wireless vehicle rear observation system before operating.

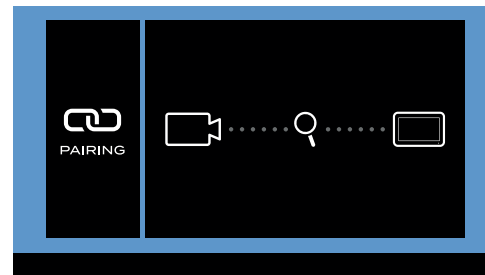
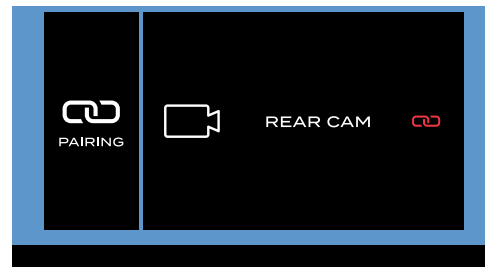


Pairing the Camera and Monitor

1. Use or button to highlight **PAIRING** menu, then press to enter the next page.




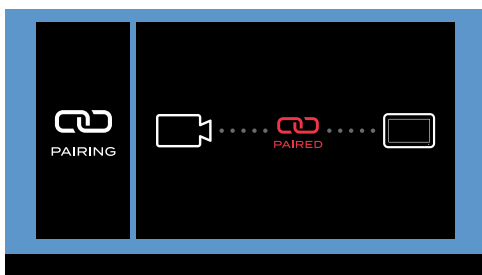
2. Press the “**MONITOR PAIRING**” button at the bottom of selected camera to pair.




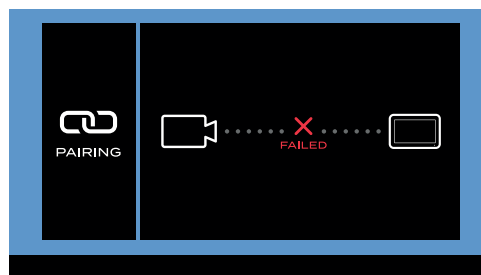


Getting Started

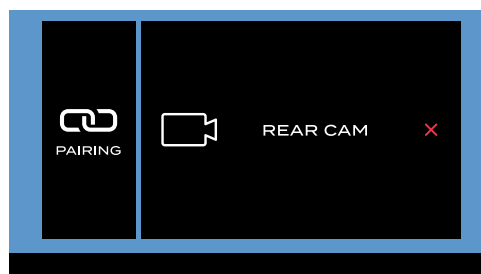
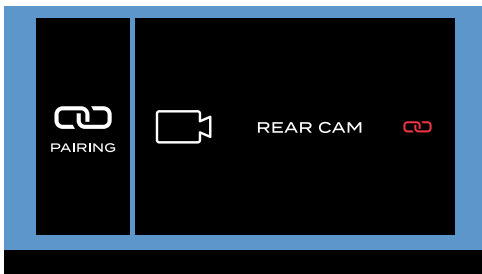
- Once paired successfully, a red  icon will appear after the device list.



- An  icon indicates pairing failed, repeat steps 2 and 3 to pair again.



English



- Repeat steps 1 to 4 to pair the other cameras.
- Refer to "**Camera Settings**" section for detail settings of the camera.



Installation

English

READ THIS MANUAL BEFORE INSTALLATION

NOTE: We have included all of the items needed for most standard installations, but all vehicles are different. We recommend you review your vehicle completely before starting.

What's in the Box

Make sure you have the following items included in the packaging. If any item is damaged or missing, contact your dealer.

- Monitor x 1
- Windshield Stand x 1
- Camera (different by model)
- Monitor Power Cable x 1
- Warranty Card x 1
- Instruction Manual x 1

NOTE: The contents included may be different based on the kit you purchased. Please take the actual product as standard.

Monitor Installation

Choose a monitor location in your vehicle that does not block your view and complies with local laws for safe driving. Do not place in an area where it might interfere with driving.

WARNING: To prevent the risk of electric shock or fire, during installation, remove the key from the ignition and isolate the 12V or 24V power source.

1. Clean the mounting area where you are going to install the monitor with a cleaner that does not leave a residue.
2. Remove the protective film from the bottom of the suction cup.
3. Carefully position the suction cup on the windshield and rotate the locking arm downwards to affix securely. (Fig. 1)

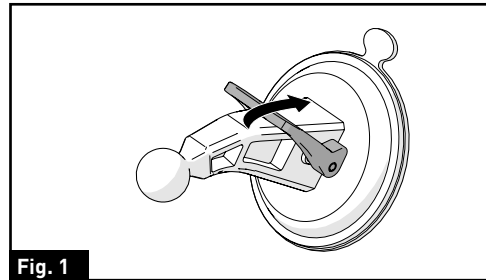


Fig. 1

4. Align the dot bullet of the suction cup with the opening on back of the monitor and push firmly until locked into place. (Fig. 2)

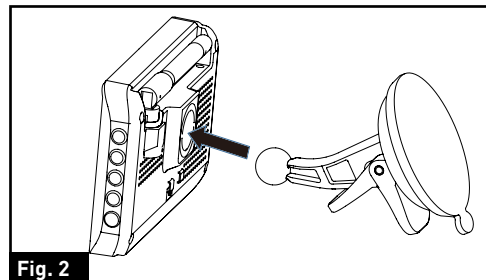


Fig. 2

5. Rotate the monitor to adjust the visual angle as needed.

Camera Installation

CAUTION: Ensure there are no electrical cables, gas lines, pipes or other important parts behind where the drill holes will be. To prevent the risk of electric shock or fire, during installation, remove the key from the ignition and isolate the 12V or 24V power source.

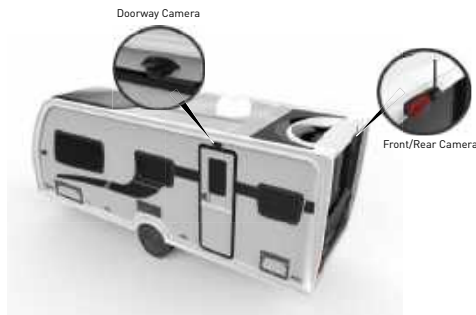
Suitable Installation Position

- For optimum performance, the camera should be mounted where there is minimal obstruction between the camera and monitor. Dense side-wall material and electrical appliances can reduce signal strength.
- Where practical install, as high as



Installation

- possible at the rear of the vehicle.
- Horizontal-center of the vehicle or as close as is optimal.
- Mount camera at least 2 inches above or below running lights. Close proximity to lights may cause image blooming, blurring and reduced night vision performance.
- The area should be flat with enough surface area to accommodate the bracket.
- The surface area should be clean and dry for a watertight installation.
- Ensure that power can be fed to the installation area from within the vehicle.

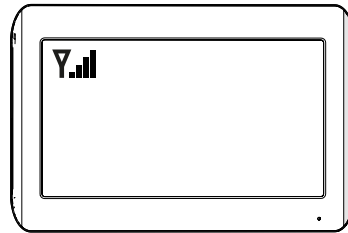


Camera Location

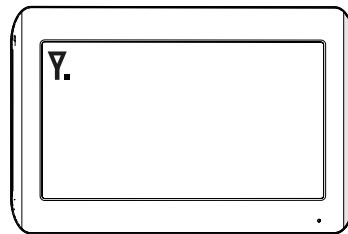
Testing

Prior to permanently mounting the camera, it is advisable to check if the intended mounting location will achieve adequate signal.

- Pair the camera and monitor (see **Pairing the Camera and Monitor** section).
- Temporary secure the camera in the intended location or as close as possible.
- Check signal icon **Y** on the monitor. Ideally there should be 3-4 bars.
- If the signal is 0-1 bars, reposition the camera and or monitor. The signal can also be improved by decreasing the amount of obstructions between the camera and monitor.



Good Signal



Poor Signal

English

Sharkfin Camera Installation (if purchased)

1. Select a suitable mounting position where you are going to install the doorway camera. Mark a basic outline using the provided bracket gasket. (Fig. 10)

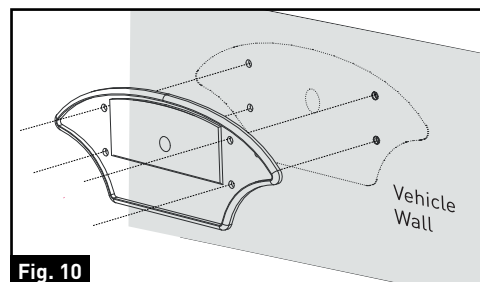


Fig. 10

2. Drill a 5/8" center hole on the vehicle wall using a 5/8" hole saw. (Fig. 11)



Installation

English

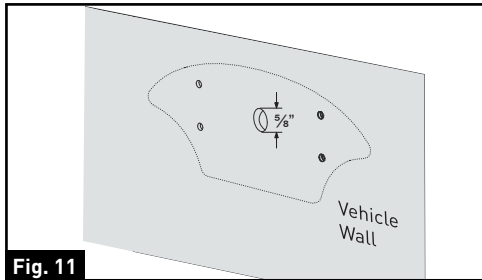


Fig. 11

3. Feed the supplied 6-foot camera power cable through the gasket. Ensure the bare end of the cable goes into the vehicle and the flat side faces inward. (Fig. 12)

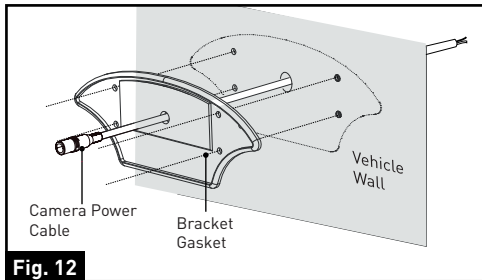


Fig. 12

4. Fix the gasket and bracket to the vehicle using four 3/4" flat self-tapping screws. Make sure the camera power cable is not wrapped or extruded. (Fig. 13)

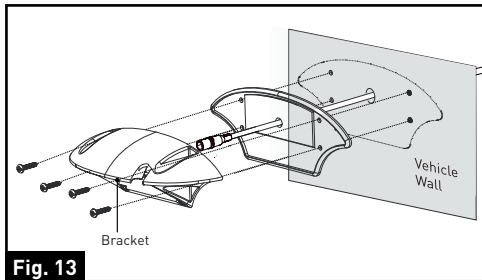


Fig. 13

5. Make sure the sealing lip around the edge of the gasket is seated over the edge of the bracket before fully tightening the screws.
6. If only installing the mounting bracket, secure the camera power cable inside the

mounting and attach the cover. (Fig. 14)

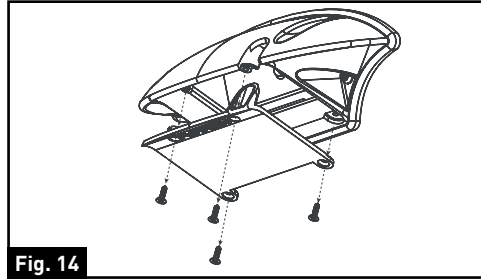


Fig. 14

7. If a doorway camera is to be installed, remove the Bracket Cover by unscrewing the four screws. (Fig. 15)

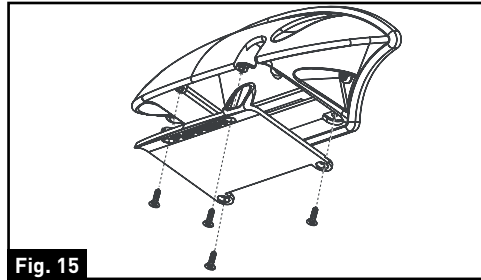


Fig. 15

8. Pull out the camera power cable, leaving approx 2 inches of slack. (Fig. 16)

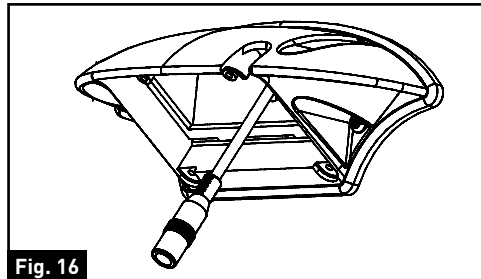


Fig. 16

9. Connect the camera power cable to the camera cable. (Fig. 17)



Installation

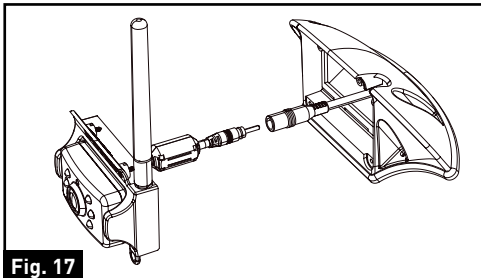


Fig. 17

10. Place the attached cables and connections into the bracket housing by first placing the cable to the right. (Fig. 18)

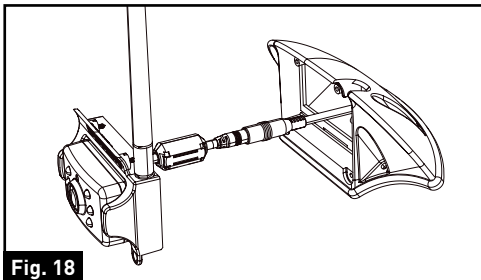


Fig. 18

11. Place the camera cable filter in the left of the bracket housing. (Fig. 19)

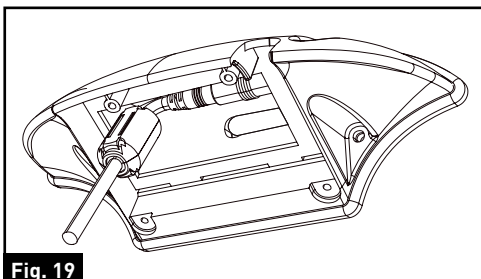


Fig. 19

12. Gently place the camera into the bracket and secure with 4 flat self-tapping screws. Make sure the connections and the camera antenna are secured tightly. (Fig. 20)

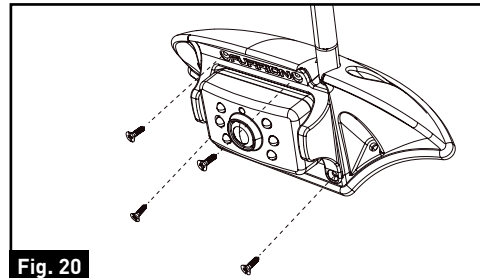


Fig. 20

English

Rear Camera Installation (if purchased)

A traffic light must be installed together with the camera. For best performance, we recommend a Furrion traffic light is selected.

1. Select a suitable position on the back of the vehicle wall where you would like to install the camera.
2. Remove the lens cover by scratching the slot on the side of the traffic light. (Fig. 22)

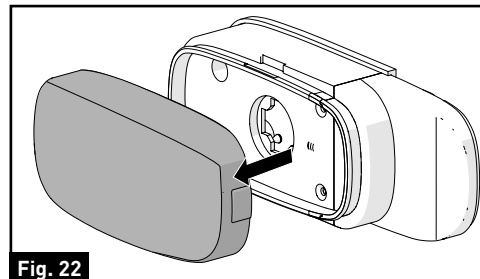


Fig. 22

3. Remove the two screws holding the decorative part using a Phillips-head screwdriver and set aside. (Fig. 23)



Installation

English

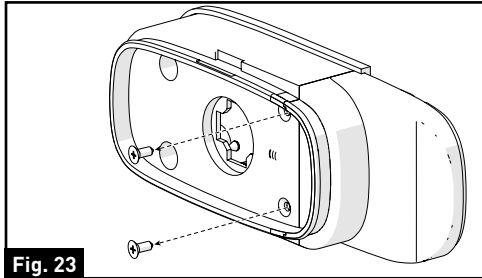


Fig. 23

4. Pull to remove the decorative part from traffic light and save in a safe place in case of future use. (Fig. 24)

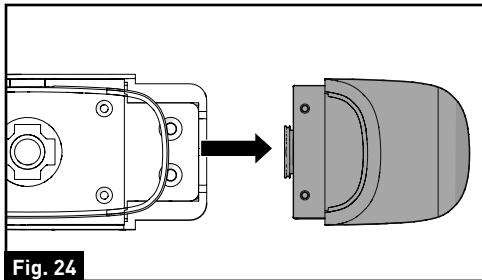


Fig. 24

5. Secure the traffic light base on the vehicle wall using the four flat self-tapping screws (quad drive flat head #6 x 3/4" self-drilling wood screw). (Fig. 25)

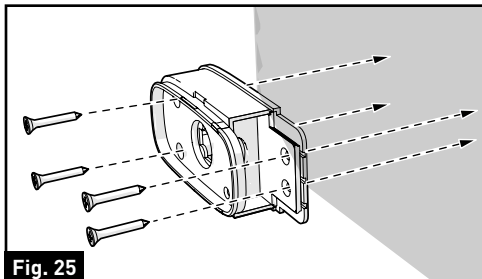


Fig. 25

6. Insert the front or rear camera into the traffic light base and secure with two flat self-tapping screws provided. (Fig. 26 and Fig. 27)

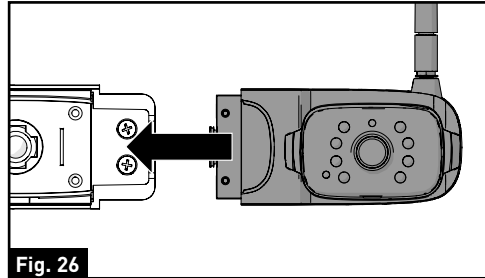


Fig. 26

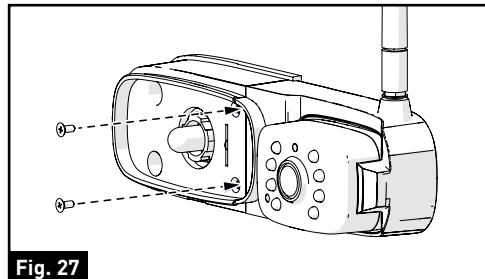


Fig. 27

7. Replace the lens cover over the traffic light base and press until a "click" is heard. The camera is now fully installed onto the vehicle. (Fig. 28 and Fig. 29)

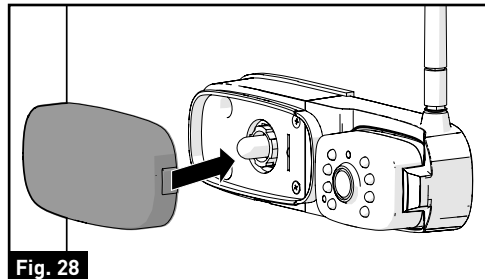


Fig. 28

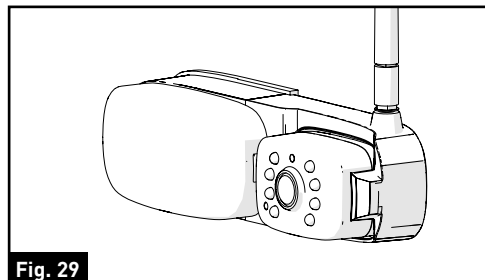


Fig. 29



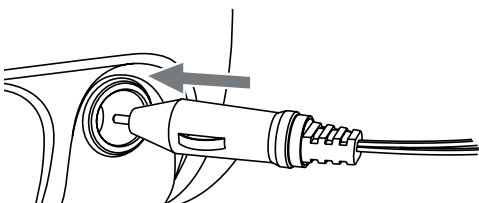
Installation

8. Repeat steps 1 to 7 to install the other camera.

Electrical Connections

Connecting the Monitor

- Route the power cable to the vehicle's cigarette lighter socket 12/24V power outlet. The cable must not interfere with the safe operation of the vehicle.
- Insert the small 12/24 Volt DC plug of the power cable into the right side of the monitor.
- Plug the 12/24 Volt cigarette lighter plug into the vehicle's cigarette lighter socket.



Connecting the Camera

⚠ WARNING

When connecting wires, ensure the circuit is isolated by disconnecting the negative terminal on the battery.

- Ensure correct polarity when wiring the cables. RED + BLACK -.
- Ensure correct polarity when wiring.
- Wire connections and terminals must be sealed and waterproof.

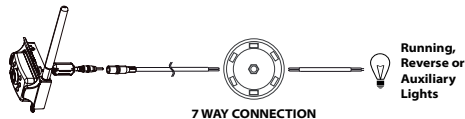
The Furrion Vision S Camera System can be connected to an electrical power source via a 7 Way Connector.

Wiring to running lights: the camera will activate when the running lights are switched on.

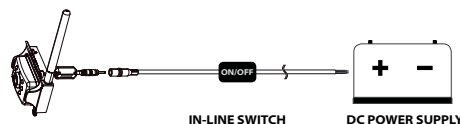
Wiring to reverse lights: the camera will activate when the vehicle engages reverse gear.



Consult the vehicle's service manual for specific wiring color code.

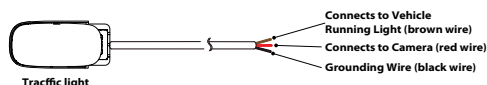


When wiring this camera directly to a 12V battery or converter in your RV, use an in-line switch on the power cable to power on or off your camera. This will enable this camera to be used when parked without a tow vehicle connected.



Connecting the Traffic Light

- Route the power cable to the vehicle's 12/24V running light. The cable must not interfere with the safe operation of the vehicle.



English



Change Settings

English

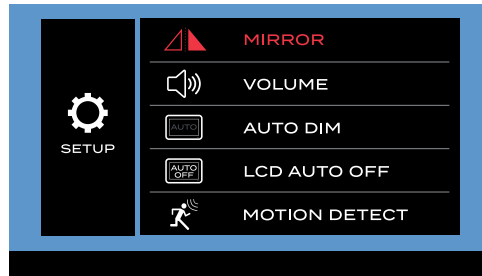
Camera Setting

Use ▲ or ▼ button to highlight **SETUP** menu, then press ⏻ to enter the next page or press ≡ button to return to the previous page.

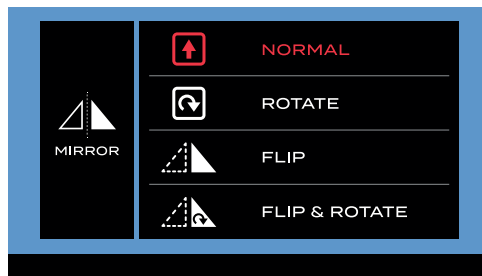


MIRROR SETTING

1. Use ▲ or ▼ button to highlight **MIRROR** menu, then press ⏻ to enter.

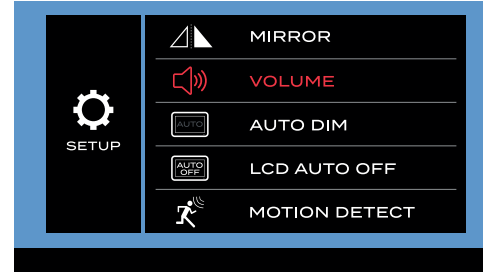


2. Press ▲ or ▼ button to set the camera image as **NORMAL** (0°), **ROTATE** (90°), **FLIP** (180°) or **FLIP & ROTATE** (270°). Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



VOLUME SETTING

1. Use ▲ or ▼ button to highlight **VOLUME** menu, then press ⏻ to enter.

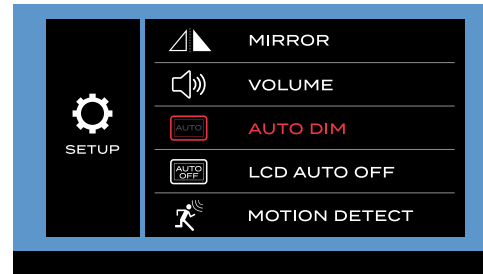


2. Press ▲ to increase the volume or press ▼ to decrease.



AUTO DIM SETTING

1. Use ▲ or ▼ button to highlight **AUTO DIM** menu, then press ⏻ to enter.

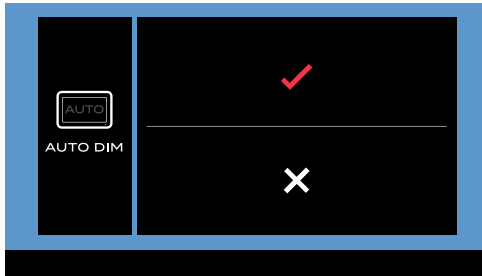


2. Use ▲ or ▼ button to select ✓ or ✗. Press ⏻ to confirm your selection or press ≡ button to return to the previous page. Press ✓ or ✗ to enable or disable



Change Settings

the light detective function.



LCD AUTO OFF SETTING

1. Use ▲ or ▼ button to highlight **LCD AUTO OFF** menu, then press ⏻ to enter.



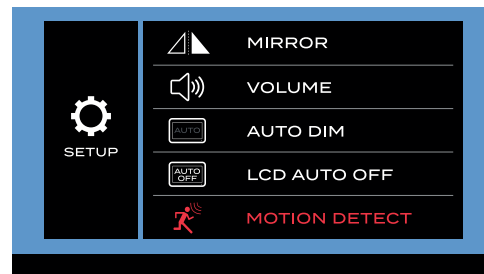
2. Press ▲ or ▼ button to set the LCD auto off time as **10 SEC, 20 SEC, 30 SEC** or **X** (off). Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



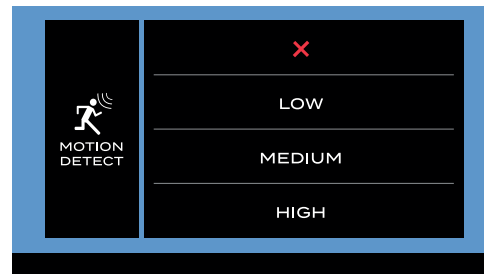
MOTION DETECT SETTING

The motion detect function is used to detect objects in motion and assist in safe driving while the vehicle is in reverse. When on, the monitor LCD will be illuminated automatically when motion is detected.

1. Use ▲ or ▼ button to highlight **MOTION DETECT** menu, then press ⏻ to enter.



2. Press ▲ or ▼ button to set the LCD auto off time as **LOW, MEDIUM, HIGH** or **X** (off). Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



English



Change Settings

English

Picture Setting

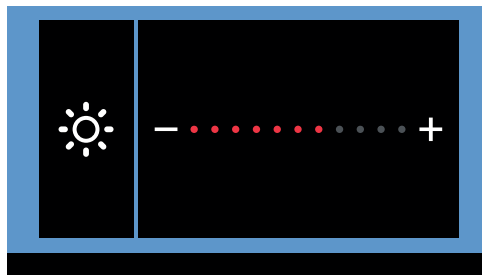
1. Use ▲ or ▼ button to highlight **LCD AUTO OFF** menu, then press ⏻ to enter.



2. Use ▲ or ▼ button to highlight **BRIGHTNESS, CONTRAST or COLOR** menu, then press ⏻ to enter.

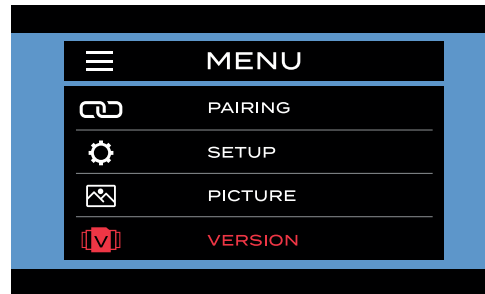


3. Press ▲ or ▼ to change the **BRIGHTNESS, CONTRAST or COLOR** setting. Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



Software Version

- Use ▲ or ▼ button to highlight **VERSION** menu, then press ⏻ to enter and view the current software version.



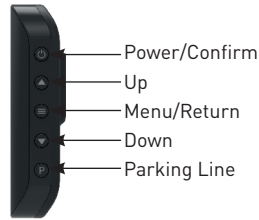


Operation

The Wireless Vehicle Rear Observation System operates when the vehicle is shifted into reverse. The Camera transmits a clear and wide image with Audio from the area behind the vehicle to the monitor inside the vehicle. During the vehicle in moving, the speaker is recommended to be mute. The monitor, when powered, remains in sleep mode until it receives a video signal on the 2.4GHz frequency. When the monitor receives a video signal, it automatically turns on and displays the image from the camera. The monitor automatically adjusts for color, brightness, and contrast, for either daytime viewing or nighttime viewing. At night the picture will appear Black and White. This is due to the low light level and is normal.

NOTE: Because this is a wireless system, the monitor is always watching for a video signal. It is possible to receive signals from other cameras. Systems such as security cameras, baby monitors, and even other back up camera systems can trigger the monitor to briefly turn on. This is normal for wireless products. If you find you have too much activation due to video signals in your area, use the included monitor power wire and run it to the rear of the vehicle. Attach it to the same power source as the camera, this will insure the monitor will only come on when you are in reverse and will eliminate any false signals.

Operating the System



English

Button	Function
	Use this button to turn the monitor On and Off and to confirm menu selections.
	Use this button to navigate menu selections and adjust settings.
	Use this button to switch between the viewing screen and the menu screen. Press to return to the previous menu.
	Use this button to navigate menu selections and adjust settings.
	Use this button to turn on the screen guidelines On and Off.



Care and Cleaning

English

Though your monitor requires little care, you will still need to maintain its condition and performance by following the guidelines below.

- Keep your system away from excessive moisture, extreme heat or cold.
- Keep liquids away from the display.
- Occasionally clean the surface of the monitor with a soft cloth moistened with water or glass cleaner.

Only clean the unit with a dry cloth. Do not clean the unit with strong chemical agents or abrasive cleaners. Never spill liquid of any kind on the product. Do not allow residue or liquids to enter any part of the appliance as this may cause risk of electrocution. Always disconnect from the mains before cleaning.

CAUTION: Never use solvents such as benzene, thinner or cleaners available commercially to clean the system.

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FURRION

Specifications

Specifications	
SUPPLY VOLTAGE	DC8 to 30V
WIRELESS FREQUENCY	2.4 GHz
WIRELESS RANGE	150m (open area)
TRANSMITTING SPEED	6 Mbps (single)
RECEIVING SENSITIVITY	18+/-2dBm
DECOMPRESSION FORM	H.264
DELAYING TIME	<250ms
CAMERA	
IMAGE DISTANCE	<5m
CMOS SIZE	1/3"
OPTICAL LENS	F2.0
IR CUT FILTER	850nm automatic
VIEW ANGLE	120°
CURRENT (IR ON)	<400mA@12V
CURRENT (IR OFF)	<200mA@12V
CAMERA PIXEL	720x480
DISPLAY	
LCD POWER OFF	<30mA@12V
LCD BACKLIGHT ON	<500mA@12V
LCD BACKLIGHT OFF	<300mA@12V
LCD SIZE	4.3"
LCD RESOLUTION AT 1 VIEW	480x272
LCD BRIGHTNESS	200cd/m ²
LCD CONTRAST	600:1
LCD VIEWING ANGLE	L/R75,U60,D70
LCD ASPECT RATIO	16:9

English

FURRION

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Troubleshooting

English	Problem	Solution
	Monitor won't turn on (no blue LED)	Check the power cable is connected.
Check the cigarette lighter has 12-24V DC Output.		
Check the fuse in the cigarette socket adapter.		
Camera & Monitor won't pair	Check if the camera is receiving power.	
	Make sure to hold the camera pairing button for 2 seconds.	
Intermittent / Weak signal icon appears	Check if the camera antenna is fitted and secured correctly - it should be vertical.	
	Distance between camera and monitor is too great. Reduce distance between Camera and Monitor.	
	Large dense objects could be obscuring the signal. If possible, move the objects.	
	Interference from electrical appliances may be affecting the wireless signal. Turn off the appliances when using the system.	
	Interference from overhead power lines may be affecting the signal.	
	Try unpairing and pairing.	
Night vision is poor or does not function	The light sensor on the camera may be dirty or obstructed.	
	Ensure the camera unit is installed at least 2 inches away from rear lights.	
Monitors Blue LED no light with no picture	The camera has no power connected.	
	Ensure the tow vehicle is running.	
	Ensure the 7 way connector is connected.	
	Ensure that the circuit the camera is connected to has power and is running.	



Warranty

Furrion warrants for a period of 1 year from date of retail purchase by the original end-use purchaser, that this product, when delivered to you in new condition, in original packaging, from a Furrion authorized reseller and used in normal conditions, is free from any defects in manufacturing, materials, and workmanship. In case of such defect, Furrion shall replace or repair the product at no charge to you. This warranty does not cover: products where the original serial numbers have been removed, altered or cannot readily be determined; damage or loss caused by accident, misuse, abuse, neglect, product modification, failure to follow instructions in instruction manual, commercial or industrial use; damage or loss caused to the decorative surface of product; to any data, software or information; and normal wear and tear. This warranty only protects the original end-user ("you") and is not transferable; any attempt to transfer this warranty shall make it immediately void. This warranty is only valid in the country of purchase.

THIS WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REMEDIES AND CONDITIONS, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. FURRION SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IF FURRION CANNOT LAWFULLY DISCLAIM IMPLIED WARRANTIES UNDER THIS LIMITED WARRANTY, ALL SUCH WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY.

No Furrion reseller, agent, or employee is authorized to make any modification, extension, or addition to this warranty.

English



Warranty

English

FURRION IS NOT RESPONSIBLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF WARRANTY OR CONDITION, OR UNDER ANY OTHER LEGAL THEORY, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DOWNTIME, GOODWILL, DAMAGE TO OR REPLACEMENT OF ANY EQUIPMENT OR PROPERTY, ANY COSTS OF RECOVERING, REPROGRAMMING, OR REPRODUCING ANY PROGRAM OR DATA STORED IN OR USED WITH FURRION PRODUCTS. FURRION'S TOTAL LIABILITY IS LIMITED TO THE REPAIR OR REPLACEMENT OF THIS PRODUCT PURSUANT TO THE TERMS OF THIS WARRANTY.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES OR EXCLUSIONS OR LIMITATIONS ON THE DURATION OF IMPLIED WARRANTIES OR CONDITIONS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS THAT VARY BY STATE OR (WHERE APPLICABLE IN THE COUNTRIES WHERE FURRION HAS NON-US/CANADIAN AUTHORIZED DEALERS) COUNTRY. NO ACTION OR CLAIM TO ENFORCE THIS WARRANTY SHALL BE COMMENCED AFTER THE EXPIRATION OF THE WARRANTY PERIOD.

Keep your receipt, delivery slip, or other appropriate payment record to establish the warranty period. Service under this warranty must be obtained by contacting Furrion at **warranty@furrion.com**

Product features or specifications as described or illustrated are subject to change without notice.

FURRION

Furrion Innovation Center & Institute of Technology

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- Email: support@furrion.com

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FURRION.COM

IM-FCM00002 V4.0



Fusion2GO™ 3.0 RV

All-Carrier RV Cellular Signal Booster Kit

User Guide



01.12.21

www.SureCall.com | 888.365.6283 | support@surecall.com



Table of Contents

Thank you for purchasing SureCall's Fusion2Go-RV cell phone signal booster kit. Fusion2Go-RV provides enhanced voice, text and data signal for any recreational vehicle.

If you have any questions during setup, please reach out to our US-based experienced support technicians:

- Call: 1-888-365-6283
- Email: support@surecall.com
- Or, chat: www.surecall.com, 7:00 AM – 5:00 PM PST, Monday – Friday

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How It Works

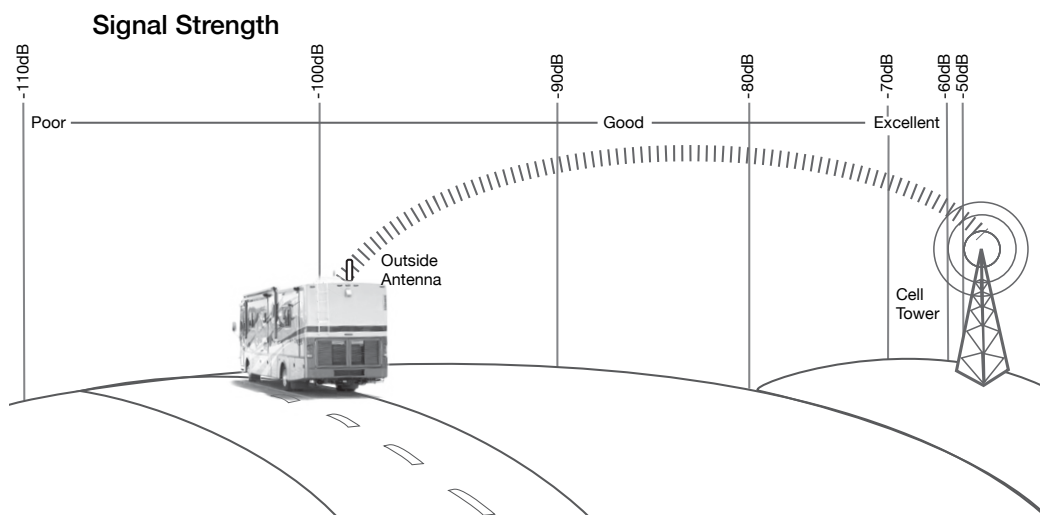
How It Works

The SureCall Fusion2Go-RV is a high-quality bidirectional booster that enhances cellular signals for motor homes, and other large vehicles.

The Fusion2Go-RV works with two antennas:

- An inside antenna that communicates with your cell phone.
- An outside antenna that communicates with the cell tower.

Signals sent from a cell tower are received by the outside antenna, amplified by the booster and then sent to your cell phone via the inside antenna. When your phone transmits, the signal is sent to the inside antenna, and then sent to the cell tower via the outside antenna. A minimum amount of cellular reception is required for the Fusion2Go-RV to work properly.





Package Contents

Package Contents

1. Unpack all package contents. For missing or damaged items, contact your reseller.
2. Turn over the signal booster and record the model and serial number for reference:

Serial #: _____

Purchase Date: _____

3. Keep the carton and packing material to store the product in case you need to return it.
4. Your Fusion2Go 3.0 RV signal booster package includes the following items:
 - » 1. One complete Fusion2Go 3.0 vehicle booster kit
 - » Plus RV adapting kit
 2. AC power adapter
 3. Inside whip antenna
 4. Outside omni antenna
 5. Coax cable, SC-240, 40ft



1. Fusion2Go 3.0
Amplifier kit



2. AC Power
adapter



3. Inside Whip
Antenna



4. Outside Omni
Antenna



5. SC-240
Cable

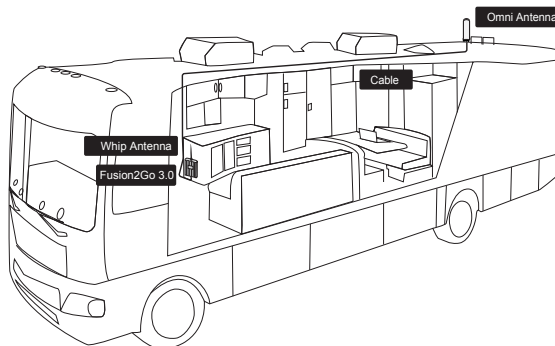


Step 1: Mount Outside Antenna

Before you begin, please note that your installation may require the use of a mast or RV mounting system on which to mount the outside antenna. One has not been provided and may be obtained by a 3rd party.

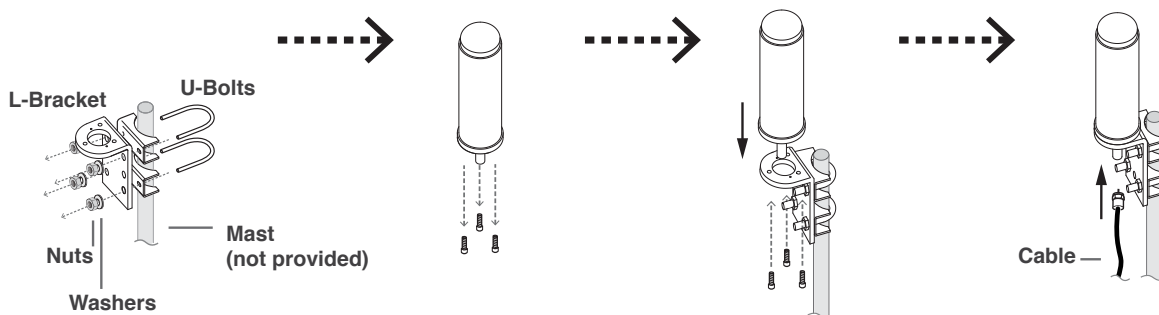
The provided antenna is omni-directional, which receives and sends signals in a 360° radius. Mount the antenna at the highest possible elevation and in an upright position.

Ensure that the mounting area has at least a 12-inch radius clear of obstructions and other radiating elements.



Installation:

1. Assemble the L-Bracket with U-bolts, brackets, nuts and washers and secure to mast, as shown in the illustration
2. Remove all three screws from antenna base
3. Secure antenna to the horizontal plate of L-Bracket using screws.
4. Connect one end of the provided coax cable to the antenna and tighten the connection.

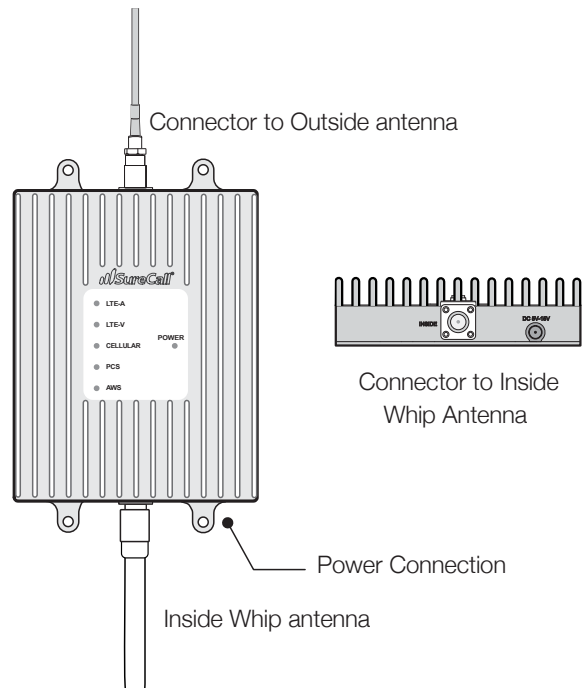




Installation

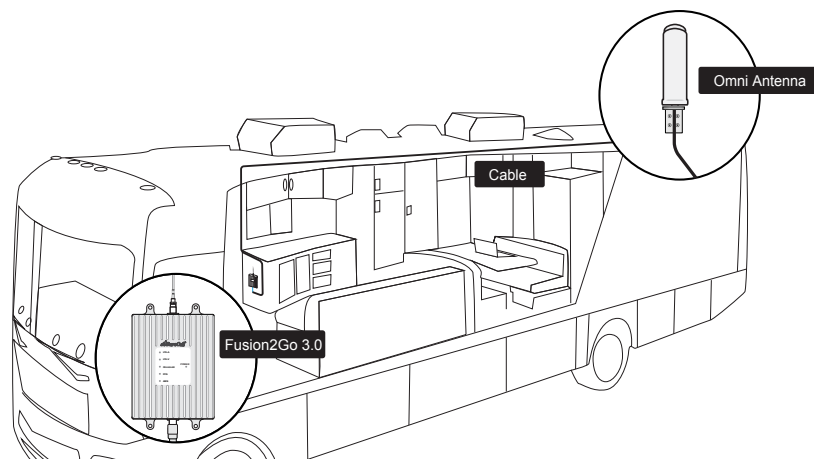
Step 2. Install the Signal Booster

1. Connect the inside whip antenna to the port on the side of the booster labeled "INSIDE".
2. Mount the booster within a cabinet or on a side panel close to a power source. Note that the Inside antenna and sends signal in a 360 degree radius. The antenna should be aimed vertically. The location you select should generally be in the center of where signal is needed and also avoid excessive heat, direct sunlight, or moisture, as well as, provide proper ventilation.
3. Route the cable from the outside antenna inside and connect to the port on the booster labeled "OUTSIDE".



Step 3. Connect Power

Connect the DC power adapter to the signal booster and plug into power outlet. The Power LED will light, indicating that the signal booster is ready for use.





LED Indicators

Place a call in a location you have previously experienced poor signal and confirm that your phone is receiving a boosted signal. Normal operation is indicated by Green LEDs (both flashing and solid). In the event Red LEDs appear, antenna adjustments may be needed.

Color	Condition	Indication
Green	Solid	Indicates normal operation.
Green	Flashing	Normal operation. Indicates that Automatic Gain Control (AGC) is self-adjusting due to over-signal or antenna proximity.
Red	Flashing	Indicates issues caused by overpowering or oscillation. Adjustment of your outside antenna placement is likely needed. Verify that it has sufficient separation from the inside antenna, as well as, any potentially interfering objects or antennas

Note that the booster case may become warm during operation. This is normal.

WARNING. The booster is rated for 5-15V input voltage. DO NOT use the booster with a higher voltage power supply. This can damage the booster and/or cause personal injury.

Troubleshooting

Problem	Resolution
Signal booster has no power	Verify that the Power LED is ON. Connect the power supply to an alternate power source. Verify that the power source is operational and the fuse is intact. If it remains OFF, contact tech support at: 1-888-365-6283 or support@surecall.com
After completing installation, signal has not improved	Verify that cable connections are tightly fitted to the booster. Try further separating the antennas. ⓘ Remember: Bars are not always a reliable measure of signal. The best way to confirm signal coverage is the ability to place and hold a call.



Specifications

Specifications:

Product:	Fusion2Go 3.0 RV US	Fusion2Go 3.0 RV Canada
Uplink Frequency Range (MHz):	698-716 / 776-787 / 824-849 / 1850-1915 / 1710-1755 (G Block Included)	
Downlink Frequency Range (MHz):	728-746 / 746-757 / 869-894 / 1930-1995 / 2110-2155 (G Block Included)	
Supported Standards:	CDMA, WCDMA, GSM, EDGE, HSPA+, EVDO, LTE and all cellular standards	
Input / Output Impedance:	50 Ω	
Maximum Gain:	50 dB	
Noise Figure:	≤ 5 dB	
VWSR:	≤ 2.0	
Gain Adjustment:	20 dB (Automatic)	
DC Power:	6-15V	
Maximum Output Power:	1 Watt EIRP	
Cable:	SC-240	
RF Connectors:	FME Male (both ends)	
Power Consumption:	≤ 10 W	
Operation Temperature:	-4° to +158° F	
Dimensions:	5.625 x 4 x 1.125 inches	
Weight:	1.43 lbs	
Certifications:	FCC ID: RSNF2GO3	IC: 7784A-F2GO3

FCC 15.105 Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help.

15.19 This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



Specifications

Antenna Kitting Information

Component	Prod No. Description	Gain				
		LTE-A	LTE-V	800 MHz	1900 MHz	1700 MHz / 2100 MHz
Vehicle						
Outdoor Antenna and Cable*	SC-202W and SC174-12.5 ft (12.5 ft)	-3.16 dB	-5.15 dB	-5.65 dB	-2.85 dB	-3.34 dB / NG
Outdoor Antenna and Cable*	SC200W and SC174-10 ft (10 ft)	-2.3 dB	-2.3 dB	-2.3 dB	-5.8 dB	-3.98 / -5.96 dB
Indoor Antenna and Cable*	SC110W and SC174-10 ft (10 ft)	-2.7 dB	-2.7 dB	-3.2 dB	-5.8 dB	-3.98 / -5.96 dB
Marine						
Outdoor Antenna and Cable*	SC288W or Galaxy 5412-P and SC240-40FN (40 ft)	-0.52 dB	-0.52 dB	-0.98 dB	-2.52 dB	-2.12 / -2.92 dB
Indoor Antenna and Cable*	SC248W Panel and SC240-20FN (20 ft)	4.94 dB	4.94 dB	4.71 dB	6.44 dB	6.64 / 6.24 dB
Indoor Antenna and Cable*	SC302W and SC240-20FN (20 ft)	0.44 dB	0.44 dB	0.71 dB	1.44 dB	0.64 / 1.24 dB
Desktop / RV						
Outdoor Antenna and Cable*	SC288W and SC240-40FN (40 ft)	-0.52 dB	-0.52 dB	-0.98 dB	-2.52 dB	-2.12 / -2.92 dB
Indoor Antenna*	SC120W whip	1.2 dB	1.2 dB	1.2 dB	3 dB	3 / 3 dB
Indoor Antenna and Cable*	SC302W and SC240-20FN (20 ft)	0.44 dB	0.44 dB	0.71 dB	1.44 dB	0.64 / 1.24 dB

*All equivalent antennas and cables are suitable for use with the Fusion2Go 3.0

Frequency (MHz)	PreAGC			PreAGC		
	Pulse GSM			4.1 MHz AWGN		
	Input (dBm)	Output (dBm)	Gain (dB)	Input (dBm)	Output (dBm)	Gain (dB)
Uplink: 1710-1755	-27.2	20.0	47.2	-25.3	20.7	46.0
Uplink: 1850-1915	-25.6	20.9	46.5	-25.9	19.6	45.5
Uplink: 824-849	-25.3	22.3	47.6	-21.7	25.6	47.3
Uplink: 698-716	-24.1	28.0	47.1	-20.1	26.6	46.7
Uplink: 777-787	-21.3	25.6	46.9	-20.5	25.9	46.4
Downlink: 2110-2155	-48.5	-3.7	44.8	-49.4	-4.5	44.9
Downlink: 1930-1995	-45.7	1.0	46.7	-46.7	0.2	46.9
Downlink: 869-894	-51.1	-5.5	45.6	-51.6	-5.8	45.8
Downlink: 728-746	-48.0	-0.3	47.7	-48.4	-1.8	46.6
Downlink: 746-757	-49.4	-2.8	46.6	-50.9	-4.3	40.6

Warning: Unauthorized antennas, cables, and/or coupling devices are prohibited by FCC new rules. Changes or modifications not expressly approved by SureCall could void the user's authority to operate the equipment.

FCC 27.50(d)(4) Statement: Fixed, mobile and portable (hand-held) stations operating in the 1720-1755 MHz band are limited 1 Watt EIRP. Fixed stations operating in this band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in this band must employ a means for limiting power to the minimum necessary for successful communications.



Consumer Guidelines

Consumer Guidelines

This is a CONSUMER device

BEFORE USE, you **MUST REGISTER THIS DEVICE** with your wireless provider and have your provider's consent. Most wireless providers consent to the use of signal boosters. Some providers may not consent to the use of this device on their network. If you are unsure, contact your provider.

In Canada, **BEFORE USE** you must meet all requirements set out in ISED [CPC-2-1-05](#)¹

You **MUST** operate this device with approved antennas and cables as specified by the manufacturer. Antennas **MUST** be installed at least 20 cm (8 inches) from (i.e. **MUST NOT** be installed within 20 cm of) any person.

You **MUST** cease operation of this device immediately if requested by the FCC (or ISED in Canada) or a licensed wireless service provider.

WARNING: E911 location information may not be provided or may be inaccurate for calls served by using this device.

Ce produit est un appareil de CONSOMMATION

AVANT DE L'UTILISER, vous **DEVEZ ENREGISTRER CE DISPOSITIF** auprès de votre fournisseur de services cellulaires et obtenir son consentement. La plupart des fournisseurs de services cellulaires autorisent l'utilisation d'amplificateurs de signal. Il se peut que certains fournisseurs n'autorisent pas l'utilisation de ce dispositif sur leur réseau. Si vous n'êtes pas sûr, contactez-le.

Au Canada, **AVANT DE L'UTILISER** vous devez répondre à toutes les exigences ISED [CPC-2-1-05](#)²

Vous **DEVEZ** utiliser ce dispositif avec les antennes et les câbles autorisés, tel que le spécifie le fabricant. Les antennes **DOIVENT** être installées à au moins 20 cm (8 po) (NE **DOIVENT PAS** être installées à moins de 20 cm) de toute personne avoisinante.

Vous **DEVEZ** arrêter cet appareil immédiatement à la demande de la FCC (ISED au Canada) ou de tout fournisseur de services cellulaires autorisé.

AVERTISSEMENT: Il se peut que les informations relatives à la localisation E911 ne soient pas disponibles ou soient inexactes pour les appels qui utilisent cet appareil.

Register your cellular booster with your wireless carrier at the following urls:

Verizon: <http://www.verizonwireless.com/wcms/consumer/register-signal-booster.html>

AT&T: <https://securec45.securewebsession.com/attsignalbooster.com/>

T-Mobile: <https://support.t-mobile.com/docs/DOC-9827>

Sprint: https://www.sprint.com/legal/fcc_boosters.html

U.S. Cellular: <http://www.uscellular.com/uscellular/support/fcc-booster-registration.jsp>

CAN ICES-3 (B)/NMB-3(B) (Canada) :

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des réglemets d'équipement.

L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

La puissance de sortie nominale indiquée par le fabricant pour cet appareil concerne son fonctionnement avec porteuse unique. Pour des appareils avec porteuses multiples, on doit réduire la valeur nominale de 3,5 dB, surtout si le signal de sortie est retransmis et qu'il peut causer du brouillage aux utilisateurs de bandes adjacentes. Une telle réduction doit porter sur la puissance d'entrée ou sur le gain, et ne doit pas se faire au moyen d'un atténuateur raccordé à la sortie du dispositif.

¹ For details on the requirements specified in ISED CPC-2-1-05, visit: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08942.html>

² Pour plus de détails sur les exigences ISED CPC-2-1-05, reportez-vous au site: <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08942.html>



Three-Year Product Warranty

Activate your manufacturer's 3-year warranty at www.SureCall.com/activate

SureCall warrants its products for three years from the date of purchase against defects in workmanship and/or materials. Specifications are subject to change. The three-year warranty only applies to products meeting the latest FCC Certification Guidelines stated on 2/20/2013 and going into effect April 30, 2014. A two-year warranty applies to any products manufactured before May 1, 2014.

Products returned by customers must be in their original, un-modified condition, shipped in the original or protective packaging with proof-of-purchase documentation enclosed, and a Return Merchandise Authorization (RMA) number printed clearly on the outside of the shipping container.

Buyers may obtain an RMA number for warranty returns by calling the SureCall Return Department toll-free at 1-888-365-6283. Any returns received by SureCall without an RMA number clearly printed on the outside of the shipping container will be returned to sender. In order to receive full credit for signal boosters, all accessories originally included in the signal booster box must be returned with the signal booster. (The Buyer does not need to include accessories sold in addition to the signal booster, such as antennas or cables.)

This warranty does not apply to any product determined by SureCall to have been subjected to misuse, abuse, neglect, or mishandling that alters or damages the product's physical or electronic properties.

SureCall warrants to the Buyer that each of its products, when shipped, will be free from defects in material and workmanship, and will perform in full accordance with applicable specifications. The limit of liability under this warranty is, at SureCall's option, to repair or replace any product or part thereof which was purchased up to THREE YEARS after May 1, 2014 or TWO YEARS for products purchased before May 1, 2014, as determined by examination by SureCall, prove defective in material and/or workmanship. Warranty returns must first be authorized in writing by SureCall. Disassembly of any SureCall product by anyone other than an authorized representative of SureCall voids this warranty in its entirety. SureCall reserves the right to make changes in any of its products without incurring any obligation to make the same changes on previously delivered products.

As a condition to the warranties provided for herein, the Buyer will prepay the shipping charges for all products returned to SureCall for repair, and SureCall will pay the return shipping with the exception of products returned from outside the United States, in which case the Buyer will pay the shipping charges.

The Buyer will pay the cost of inspecting and testing any goods returned under the warranty or otherwise, which are found to meet the applicable specifications or which are not defective or not covered by this warranty.

Products sold by SureCall shall not be considered defective or non-conforming to the Buyer's order if they satisfactorily fulfill the performance requirements that were published in the product specification literature, or in accordance with samples provided by SureCall. This warranty shall not apply to any products or parts thereof which have been subject to accident, negligence, alteration, abuse, or misuse. SureCall makes no warranty whatsoever in respect to accessories or parts not supplied by it.

Limitations of Warranty, Damages and Liability:

EXCEPT AS EXPRESSLY SET FORTH HEREIN, THERE ARE NO WARRANTIES, CONDITIONS, GUARANTEES, OR REPRESENTATIONS AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHER WARRANTIES, CONDITIONS, GUARANTEES, OR REPRESENTATIONS, WHETHER EXPRESSED OR IMPLIED, IN LAW OR IN FACT, ORAL OR IN WRITING.

SURECALL AGGREGATE LIABILITY IN DAMAGES OR OTHERWISE SHALL NOT EXCEED THE PAYMENT, IF ANY, RECEIVED BY CELLPHONE-MATE, INC. FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS THE SUBJECT OF CLAIM OR DISPUTE. IN NO EVENT SHALL SURECALL BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, HOWSOEVER CAUSED.

All matters regarding this warranty shall be interpreted in accordance with the laws of the State of California, and any controversy that cannot be settled directly shall be settled by arbitration in California in accordance with the rules then prevailing of the American Arbitration Association, and judgment upon the award rendered may be entered in any court having jurisdiction thereof. If one or more provisions provided herein are held to be invalid or unenforceable under applicable law, then such provision shall be ineffective and excluded to the extent of such invalidity or unenforceability without affecting in any way the remaining provisions hereof.

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WIFI RANGER

WIFIRANGER™

A WINEGARD® COMPANY

USER GUIDE

FIRMWARE 7.1.0b11

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WIFIRANGER.COM



WIFIRANGER USER GUIDE

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WIFIRANGER USER GUIDE

1

INTRODUCTION

Your WiFiRanger router is designed to be the communications hub for your RV, yacht, or over-the-road truck. The first sections of this guide are focused on getting you familiar with the basic features of the Ranger so you can be connected to the internet as quickly as possible. The later sections provide detailed discussions of the multitude of advanced features embedded in every Ranger.

Although WiFiRanger currently makes and markets nearly a dozen different types of routers, all of them use the same embedded software which we will refer to as the firmware. Regardless of the specific model of Ranger that you have, this guide will be applicable to it.

All WiFiRanger routers are controlled through an embedded Control Panel which is accessed through the browser of whatever web-enabled device you choose to use. Regardless of whether you have a laptop, an iPad, a smartphone, or a desktop computer, it will access your Ranger through the Ranger's control panel in the same manner.

Note: By default, all Rangers are delivered with certain advanced features hidden from users who may not need to access them. Hiding advanced features is controlled by a "switch" on the Setup tab of the Ranger's control panel. For simplicity this guide has been prepared with "Hide Advanced Features" being set to "off." If your control panel doesn't resemble the one pictured in this guide it may be because you have Hide Advanced Features set to "ON". There is no risk to setting Hide Advanced Features to "OFF"; displaying them doesn't result in any changes being made to your Ranger.

All WiFiRanger routers have the ability to connect to distant WiFi sources (up to several miles away depending on the Ranger model) and can rebroadcast signals from those WiFi sources inside your RV, boat or truck. That's a fundamental feature of all Ranger router, and enhanced WiFi connectivity has been a key design objective for WiFiRanger routers for more than 10 years. The first section of this guide provides instructions for using the WiFi capability of your Ranger to connect to WiFi sources and, through them, to the internet.

In addition, many WiFiRangers currently being sold also have integrated cellular modems which enable them to connect to available cellular networks. Your Ranger may have such a modem already installed. If not, for several Ranger models it is possible to "field install" a modem as an after-market accessory. WiFiRanger Customer Support can tell you if it is possible to add a modem to your Ranger if it doesn't already have one installed.

The second section of this guide provides instructions for connecting to a cellular network using a Ranger's integrated modem.

The remainder of the guide discusses the operation of each element of the WiFiRanger including advanced features, such as the use of MultiWAN connections. It is intended to serve as a reference guide to enable you to access the Ranger's advanced features as you feel comfortable doing so.

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2 BASIC GUIDE TO CONNECTING TO WIFI ACCESS POINTS

Your WiFi Ranger may consist of a single router either on the roof of your vehicle or inside it, or it may be comprised of two routers, one on the roof and one inside. Both configurations are treated separately in this section of the guide.

2a SINGLE ROUTER RANGER SYSTEMS

Using your WiFiRanger to connect to the internet is a 3-step process. Follow the steps below to get your WiFiRanger online:

STEP 1 Power up your WiFiRanger and connect your laptop, phone, or other device to its WiFi broadcast. The default WiFiRanger broadcast has the format “**Pvt.WFR_Model.ABCD**” where *Model* identifies the type of WiFiRanger router and ABCD are 4 unique numbers (which also happen to be the last 4 digits in the WiFiRanger’s ID number). The default password for this WiFi broadcast will be “**changemenowABCD**” where ABCD are the same 4 numbers. Connect to this broadcast the same way you would any other WiFi.

STEP 2 Open a browser window on your device and use the browser to access the address of the WiFiRanger’s Control Panel. The Control Panel will be found at <http://mywifiranger.com/>. Please note that this isn’t an internet address; it is a local address which your browser can access without being connected to the internet.

In order for your browser to be redirected to the control panel, it is essential that Control Panel Redirect (on the Setup page) be set to “ON”. It should be set automatically to this state but, if you encounter any difficulties, you should verify that the setting has not been changed.

In addition, if you are connecting to the Ranger by using an Android phone, you may encounter a log-in screen which will prompt you to confirm that you want to connect to the Ranger. Doing so will take you to the control panel.

If you are using a smart phone to connect to the control panel, it may be advisable to disable cellular data to force the phone to use WiFi. Otherwise it may switch to cellular without you knowing it.

If, for some reason, you cannot access the control panel using the above link, the control panel can also be accessed at <http://10.1AB.CD.1:8080/> where ABCD are the same 4 numbers referenced previously.

STEP 3 When you access the Control Panel, you will be presented with a list of all the WiFi networks that the WiFiRanger has identified arranged in decreasing order of signal strength. This is the Main page of the Ranger’s control panel. Later sections of this guide will acquaint you with other features of this page, but for now simply find the WiFi network you wish to connect to and click on the word CONNECT at the left side of its line.

WiFiRANGER USER GUIDE

Enter its password (network key) if you are prompted to do so. Each time you click on the SCAN button at the top of the WiFi section of the Main page the Ranger will update its list of available broadcasts. Note that if you have moved to a new location your Ranger may display the broadcasts from its prior location until you click on SCAN. Note that some networks will be marked as Open and will not require a password to connect.

After the WiFiRanger connects to the desired WiFi network, all of your computers and other devices that are connected to the WiFiRanger's WiFi will now have internet access (assuming, of course, that the WiFi network the WiFiRanger is connected to has internet available).

That's all there is to getting connected. Of course, your Ranger has a lot more features that you may wish to learn about, but, for now, you are connected to the internet through your Ranger.

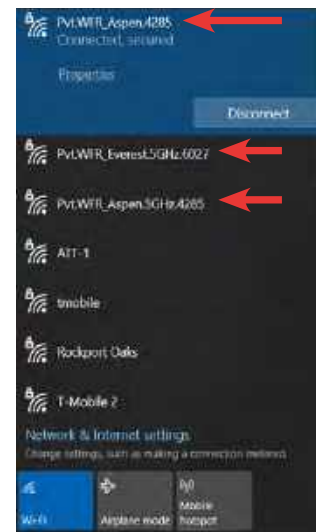
2b DUAL ROUTER RANGER SYSTEMS

Dual router Ranger systems utilize two routers operated through a single control panel to provide optimum WiFi performance. Having two separate routers allows the function of communicating with a WiFi access point to be separated from the function of communicating with your networked devices. This “decoupling” of functions allows the system's two radios to each be dedicated to a single function rather than acting in both roles. This provides a modest, but measurable, performance improvement.

[For the purposes of this Guide we're going to assume that your devices have been properly installed and are connected to each other via the power and Ethernet connectors of the Tetherpoint cable. If you have any questions about the installation of your routers, please refer to this guide: [Converge Owner's Guide](#)]

To connect to your dual router system, start by examining the list of available WiFi networks displayed on your computer, phone or other device. Depending on which indoor router you have you will see either one or two broadcasts (network SSIDs) from the inside Ranger probably labeled as 2GHz and 5GHz along with the model of the Ranger which could be Poplar, Spruce, Aspen or Core. There will also probably be another broadcast labeled with the model of the rooftop Ranger (Teton, Denali, Everest, or Sky). For purposes of this quick start guide we will focus on connecting to one of the broadcasts from the indoor router.

○ Figure 2b-1 shows three WiFi broadcasts from an Aspen/Everest WiFiRanger system; two broadcasts at 2.4 and 5 GHz from the Aspen and one 5GHz one from the rooftop Everest.



○ FIGURE 2b-1

Once you have selected the WiFi broadcast you wish to connect to, go to section 2a and follow the procedures for connecting to the WiFi and to the Ranger's control panel. When you have accessed the control panel return here.

WIFIRANGER USER GUIDE

You have now connected to the indoor router but to make full use of your two-router system you need to configure the rooftop router.

Go to the Control Panel and notice that there are tabs at the top of the control panel “box”. One of these tabs is labeled Setup. Click on that label and you will be taken to the Setup page. At the top of the page there are a series of lines, one of which is labeled “WFRControl [model type of your rooftop Ranger]”. That line might show in dark type, or it might be grayed out. Check to see if there is a “check” in the Active column of this line. If there isn’t one, then put one there now. Next, use the Save button at the bottom of the page to save what you have done.

- Next click on the “settings” gear on the right side of the WFRControl line. A new window will open; at the top of this window, you should see the words “Controlling ABCDEF via Ethernet” where ABCDEF is the ID number of your rooftop router. If you don’t see those words, click on the Repair button. If that doesn’t result in the proper text appearing, consult the detailed WFRControl section of this guide. Figure 2b-2 shows an Everest rooftop system being controlled by an Aspen.



○ FIGURE 2b-2

- If you have been successful in getting your two Ranger’s to “pair” you can now return to the Main page of the control panel. At the top left in the “WiFi box” you will now have a drop-down with the options being the Internal WiFi connections for your indoor router and for your rooftop router. The number of items displayed will depend on whether your Rangers are single band (2.4 GHz) or dual band (2.4 and 5 GHz) and whether you have activated all these options. Each time you change the dropdown selection and click on Scan, the Ranger will display the WiFi sources that the specified radio is seeing. Figure 2b-3 shows the dropdown box for the 2 and 5 GHz radios for an Aspen-Everest pair.



○ FIGURE 2b-3

2c USING THE CONTROL PANEL'S SETUP TAB TO SELECT INTERNET CONNECTIONS

The Setup tab is the functional heart of a Ranger's control panel; through it users decide what kinds of internet connections they wish to utilize. At the top of the Setup page is the list of internet connections that your specific model Ranger is capable of supporting. All Rangers are capable of supporting the same "set" of internet connections, but the specifics will vary depending on Ranger model. When you configure your system you will need to decide what set of internet connections you expect to use. You can change this set anytime you wish, but it is good practice not to activate connections that you have no intention of using.

Any internet connection in the list can be "enabled" by putting a check in the Enabled column of the corresponding line and then saving that action using the button at the bottom of the page. The title of the line will change from "grayed out" to bold when the line is activated.

In addition to simply enabling or disabling a connection, there are additional functions which can be accessed by clicking on the "gear" at the right side of each line. When the gear on an active line is clicked, a window will open. In that new window are controls for several additional functions related to that connection. The following are the functions that will be in that window:

STATIC IP Each connection can be set to a static IP. This allows for manually assigning the WiFiRanger with a static IP by Device. This feature is useful if connecting to an internet source that does not issue DHCP addresses. In these cases, assign a Static IP Address within the source's IP scheme and enter the corresponding Subnet Mask and Gateway IP. Once a Static IP is configured for the appropriate Device, connect to the non-DHCP internet source.

SPEED TEST Controls whether or not a speed test will automatically be performed when this source is connected to.

MINIMUM ACCEPTABLE SPEED Defines a download speed below which this connection shouldn't be used. Speedtests will be run at intervals determined by the "Minimum Speed" Test dropdown on the Setup page. If the speed of a connection is less than its defined "minimum acceptable speed" it will no longer be considered to be active. This feature is independent of MultiWAN setting or on whether or not Usage Tracking has been enabled. Using this feature requires that both Fallover and Speed Test (for that connection) be enabled. To set the minimum speed, move the slider to the speed you want and save.

INTERNAL WIFI All Rangers have at least one internal WiFi radio which can be used to connect to WiFi access points. Some Rangers have a single 2.4 GHz radio; some have both 2.4 and 5.8 GHz radios. To use a Ranger's internal radio it is necessary to have a check in the Enabled column of the Setup page in the line for that radio. If your Ranger has both 2.4 and 5.9 GHz radios and you want to use both, you will need to place checks in the Enabled column on both lines.

It is important to note that the Internal WiFi line(s) on the Setup page have nothing to do with the WiFi broadcast(s) that your Ranger creates for your networked device to connect to.



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You could, for example, not activate the Ranger's internal radio and yet still have the Ranger broadcast a WiFi signal for your devices to connect to. Think of the Setup page connections as being to the "outside world" whereas the Ranger's WiFi broadcast is for the use of your devices (your local world).

WFRCONTROL If you have a dual Ranger system, there will be a check in the Enabled column for WFR Control. As you verified in the Quick Start guide, clicking on the Settings gear on the right side of the WFRControl line will open a window in which you can verify that WFR control is in use. Ordinarily, you will not have occasion to make changes to settings that can be accessed through this line.

ETHERNET WAN All indoor Ranger routers have Ethernet ports which can be configured as WAN ports to be used for connecting to some cellular hotspots, cable or fiber modems, DSL modems, etc. To use an Ethernet port as a WAN port is necessary to put a check in the Enabled column on the Ethernet (or Ethernet 2) WAN line and save that change. In addition it is also necessary to click on the Settings gear on the right side of that same line. A window will open in which you can specify which of the Ranger's LAN ports will be used as a WAN port in your system. Even though one of the ports may be physically labeled as being for WAN, the designation on the Setting page will override that.

It is important to note that the WAN port is for connecting to an "external" internet connection; the remaining LAN ports are for connecting devices, such as laptops, if they have Ethernet ports.

A second Ethernet WAN port can be assigned if you desire to have two Ethernet WAN internet sources. Simply check Ethernet WAN 2 as Active, then expand its Settings to select which port to assign for the secondary Ethernet WAN.

CELLULAR The primary use of the cellular line on the Setup page is to activate and control the operation of embedded cellular modems that can be found in many WiFiRanger routers. Rooftop Ranger models Denali, Teton, Sky4 and SkyPro LTE can each support one modem and their Setup pages will show a single cellular line. Placing a check in the Enabled column of those lines, will enable and disable the modem.

However, indoor WiFiRanger routers (Poplar, Spruce, Aspen, Core and GoAC) will display multiple cellular lines on their Setup pages; the lines are labeled Cellular 1, Cellular 2 and Cellular 3. Those additional cellular lines are for USB-connected hotspots and/or smart phones which can be "tethered" to the Ranger using the router's USB port. A detailed discussion of tethering is found in Section 3.

WFRBOOST CPE This option is provided for advanced users who wish to connect their Rangers to "customer provided equipment". It is not recommended for use by most customers

Note: Regardless which specific internet connections you choose to enable, it is strongly suggested that you list them on the setup tab in the preferred order of their use. The list can easily be reordered by using the up/down arrows on the left side of each line or by manually changing the number at the left of each line. Any changes made should be saved using the button at the bottom of the tab.

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2d USING THE CONTROL PANEL'S MAIN PAGE TO SCAN FOR AND SELECT NETWORKS

The Main page of the control panel was introduced in the Quick Start section of this guide; in this section its use will be discussed in more detail. The Main page provides a lot more data than just a list of available WiFi networks. It contains lots of information which can help you select which network you wish to connect to. The WiFi broadcasts are displayed in decreasing order of their measured signal strength. The names shown in the list are those given to that broadcast by its “owner”. You may often hear people refer to those broadcast names as the “SSID” of that access point where SSID stands for Signal Set Identifier.

- The Signal column of the display provides a simple graphic depiction of the signal strength and “mousing over” this graphic will display a pop-up which shows the signal strength in decibels as shown in Figure 2d-1 In general, stronger signals are preferable to weaker ones, but don’t forget that signal strength is expressed in negative decibels, so a smaller number represents a stronger signal.



○ FIGURE 2d-1

To the immediate right of the signal strength graphic are letters which provide information as to the WiFi specification which that access point is using. In the previous figure all the signals are labeled “ac” because it was obtained using the Aspen’s 5.8GHz radio and most access points broadcasting in that band will operate in accordance with IEEE standard 802.11ac.

The column labeled “Type” tells us the type of encryption security the access point is using. If the word OPEN appears instead of an encryption type, that indicates that no encryption is being used and that access point will not have a password associated with it. The Ranger will automatically detect and connect to all common types of encrypted networks.

The next column to the right is labeled Channel and it displays the channel that the access point on that line is using. 2.4 GHz WiFi uses channels 1-11 and 5.8 GHz WiFi uses channels 36-165. It should be noted that the access point determines the channel, not the Ranger or other device being connected. Settings on the WiFi tab of the control panel will not affect the channel that is used for a particular connection.

The 5.8 GHz band has far more available channels than does the 2.4 GHz band which means that there is less chance that different WiFi sources will interfere with each other. Furthermore, the broadcast standard for the 5.8 GHz band provides for significantly more signal bandwidth than is available at 2.4 GHz. So, in general, if you are connecting to an access point that has both 2.4 and 5.8 GHz signals, you will get better performance from the 5.8 GHz one. However, 5.8 GHz signals don’t travel as well over long distances and are more readily attenuated by building walls, trees and other obstacles. That’s why it’s important to check the signal strength of the signals you are considering connecting to.

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2e SELECTING A NETWORK TO CONNECT TO

Quite often choosing a network to connect to is simple. For example, if you are connecting to your cellular hotspot it may have only a single SSID available. If it has both 2.4 GHz and 5.8 GHz SSIDs then the better choice will usually be the 5.8 GHz signal assuming that the signal strengths are comparable.

At RV parks and other similar locations, you may find that the Ranger displays several identical SSIDs at either 2.4 or 5.8 GHz, or both. This can happen if the park has several different access point sites throughout the park. Most likely your laptop or phone will show only a single SSID while your Ranger may display several with the same name. If you look closely, you will see that the column labeled MAC address shows a different value for each WiFi even though the SSIDs are the same. That's because the Ranger is "seeing" each access point separately. Depending on how the network is constructed, that may permit you to connect to a specific access point which may be faster or less congested than the one that might have the strongest signal. However, it's also possible that the network won't permit you to connect to the SSID of your choice and it will assign one regardless of which one you attempt to connect to. We'll discuss more about this in the "Ranging" section of the Advanced Topics chapter of this guide

When you decide on a network to connect to, simply click on the CONNECT button on the left side of the line you have selected. In the WiFi box at the top of the SSID list you will be able to observe the steps involved in connecting to the selected broadcast. If a Network Key (password) is required, you will be prompted to enter it. As with any computer password, be careful to enter it exactly as it has been provided to you. (If the SSID is listed as OPEN in the "Type" column, a password won't be requested, but the network may still be using a "splash page" as a simple form of security. The next section on Filtered Networks will discuss splash pages in more detail.)

After the connection has been completed the WiFi box should display CONNECTED and the Internet box to the right of it should show ONLINE. As shown in the figure, the selected SSID will now have a green highlight.

Once the SSID line has turned green, the CONNECT button will change to two buttons, RECONNECT and DISCONNECT as shown on the T-Mobile line in the previous figure. The purpose of the DISCONNECT button is obvious; the RECONNECT button should be used if there appear to be problems with the Ranger's connection to that WiFi broadcast. In particular, if you were to observe that the highlight on the line had changed from green to yellow, that would be an indication that data isn't flowing through that connection. It could be a problem at the access point or it could be an issue with the Ranger's connection to it. In either case, the first thing to do would be to click on the RECONNECT button to see you can re-establish a good connection. When you do that the Ranger will reconnect to the same SSID and often that will cause the line to return once again have a green highlight.

2f CONNECTING TO FILTERED NETWORKS (SPLASH SCREENS)

Sometimes the operator of a WiFi network chooses not to use encryption to control access but still wishes to exercise some degree of control over users. This is often found with the “free WiFi” provided by retail stores, hotels, RV parks, etc. In those cases the network manager will create a “splash page” that displays during the connection process. The splash page typically presents terms and conditions for usage of the WiFi and often requires the user to provide some identifying information such as name and site or room number. Until the splash screen conditions have been complied with, data will not flow through the internet connection.

Splash screens have traditionally been difficult for routers to deal with but version 7.1.0b11 (and later) of the WiFiRanger firmware “negotiates” with a WiFi access point so that the splash page is automatically presented to the user. Upon entry of the appropriate information onto the splash page, the user is then free to use the internet connection. The process can take ~30 seconds to complete, depending on the nature of the WiFi system you are connecting to.

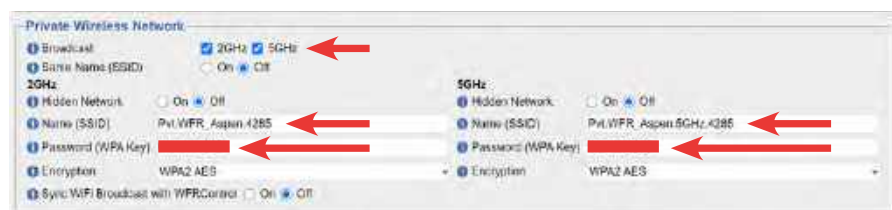
If the automatic process does not, itself, present the splash page to the user, the Ranger will indicate the presence of such a page by presenting the text “Filtered Network—Click to Connect” in the top center box of the control panel Main page. Clicking on that text will then take the user to the splash page.

(It should be noted that for the Filtered Networks process to function successfully, the Control Panel Redirect switch in the middle of the Setup page must be set to ON.)

2g CUSTOMIZING YOUR RANGER’S WIFI SETTINGS

All WiFiRanger routers are capable of supporting both a private network and a guest WiFi network. Settings for these networks are controlled on the WiFi tab of the Ranger’s control panel. By default, the guest network is disabled, and the private network is what is used in most cases. In some RV installations the guest network is used for data exchange between subsystems of the RV; in those cases no changes should be made to the guest network settings.

- The WiFi tab is where you can change the password and WiFi broadcast name (SSID) of your Ranger. Figure 2g-1 is a screenshot that shows the section of the WiFi tab that controls those functions. This screenshot was taken from an Aspen router that has both 2.4 GHz and 5 GHz broadcasts, so the figure shows SSIDs and passwords for both. Your Ranger may have only a 2.4 GHz broadcast so you may see only one set of controls.



○ FIGURE 2g-1

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You can rename your SSIDs and passwords as you wish but you are encouraged to use alphanumeric characters only. Some “special” characters may cause problems for devices attempting to connect. Enter your SSIDs and passwords and save by clicking on the button at the bottom of the page. Please note that changing these could result in the device you are connecting with being disconnected from the Ranger. If that occurs just reconnect to the renamed SSID using your new password.

The remainder of the WiFi tab contains less-frequently used controls which will be discussed in the later, advanced sections of this guide.

2h UPDATING THE RANGER’S FIRMWARE (EMBEDDED SOFTWARE)

It is very important to keep your Ranger's firmware updated so that it always has the latest available version. Doing so ensures that your device will operate as effectively as possible

In the upper right-hand corner of every page of the control panel is a link that normally reads Check for Updates. Clicking on that link until blue bars start to scroll forces a manual check for updates, but automatic checks for updates are made periodically whenever the Ranger is connected to the internet. When an available update is found, the link will and will read Update Firmware. Clicking on that link will begin the 10-15 minute update process. It is important that the Ranger be connected to a reliable internet source during an update, a cellular hotspot or your home WiFi would be excellent choices.

The update process is fully automatic. When it has completed, the Ranger will reboot using the new firmware. In the upper right corner of any control panel page the firmware version is displayed, and you will be able to verify that it has changed, reflecting the update.

Although often overlooked, registering your WiFiRanger is important to keeping it updated with the latest firmware (embedded software). Your Ranger cannot be updated unless you fill in the information on the Register tab of the control panel. At a minimum you must supply your name and email address. If you do not register you will not be permitted to download updates.

3 CONNECTING TO CELLULAR NETWORKS

3a USING EMBEDDED CELLULAR MODEMS

Embedded cellular modems can be located in either rooftop or indoor Ranger routers. The basic process for getting online with a modem is the same regardless of location. In either case the user must first decide which cellular carrier and which specific data plan is right for them. WiFiRanger routers all can be used with AT&T FreedomGo plans sold by Winegard but they are not locked to those plans; most AT&T and T-Mobile data-only plans (the kind used for hotspots) will work with embedded modems in WiFiRanger routers.

Once a data plan has been decided upon, the first step is to insert the SIM into the modem. Although this is simple, it is important to orient the SIM properly in the “slot”. All WiFiRanger routers use “full-size” SIMs which are rectangular with one diagonally cut corner. SIM slots have diagrams associated with them which depict the correct orientation of the SIM when it is inserted in the slot. The diagrams show the orientation of the “cut corner”. If your SIM is oriented as shown in the diagram it will make proper electrical contact. There is no requirement to power down the router when inserting or removing a SIM, but it is a recommended practice to do so.

Once the SIM has been inserted, the next step is to activate the modem in the Ranger. Regardless of whether the modem is in an indoor Ranger or in a rooftop one, the Setup page of the control panel will show which Cellular line is associated with it. Usually, the modem will display as the Cellular 1 connection, but that isn’t guaranteed.

- Figure 3a-1 shows the Setup page of an Aspen router with a modem that is displaying as Cellular 2. A check has been placed in the Enabled column which is the key activating step. The IMEI is shown; the SIM box is blank because a SIM has not yet been inserted.



FIGURE 3a-1



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- Figure 3a-2 shows the dropdown which enables users to choose between FreedomGo and other data plans. The dropdown defaults to My Data Plan as shown in the previous figure.

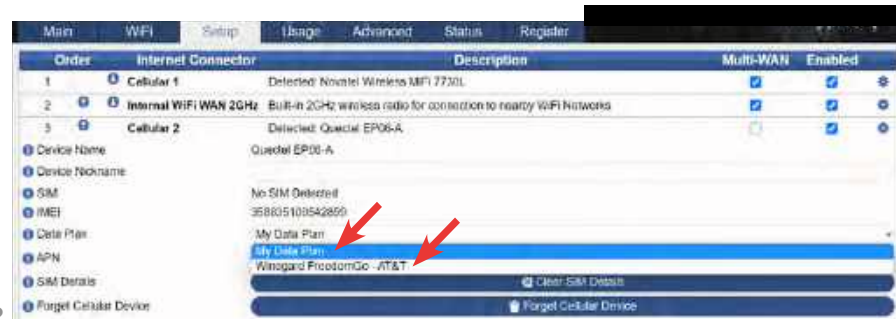


FIGURE 3a-2

Users who choose to use FreedomGo plans do not have to enter any further information. When the FreedomGo dropdown is selected in the previous figure, a link appears for purchasing data plans. That link takes the user to the Winegard site where the purchase can be made. No further action is required. If you purchase a FreedomGo data plan it will automatically become active in 12-36 hours.

Users who choose to use other cellular plans will need to enter the APN (Access Point Name) for the network they have chosen. Entering the appropriate APN will prepare the system for connecting via cellular. The APNs for the three major cellular carriers are:

- Verizon vzwinternet
- AT&T broadband
- T-Mobile fast.t-mobile.com

After entering the APN be sure to save the action by using the button at the bottom of the page. In order to obtain a cellular plan appropriate for your Ranger, you will probably be asked to provide the device's IMEI number which is a unique identifier which tells the cellular carrier what specific equipment is being connected to the cellular network.

After inserting your SIM also be sure to check that the SIM number appears in the window.

Note: Although there are other text boxes and dropdowns visible in the Cellular window, under most circumstances the only user entry that need be made will be for the APN. Making other changes or entering data in other boxes may have serious negative effects and may make it impossible to achieve a connection.

Once these steps have been taken (for FreedomGo SIMs and all others), all that is necessary is to click on the Connect button in the Cellular box on the main page of the control panel. You will be able to observe the text that appears in the Cellular box as the Ranger connects to the network.

Do not be confused if the text reads "Data Connection Available—Click for Internet". That is telling you that the modem has made a "background connection" to the network, but data isn't yet flowing. You still need to click the Connect button to complete the connection. When the modem has completed connecting the text should read "Data Connection—Using Cellular Data".

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3b MODEMS IN DUAL-RANGER SYSTEMS— POSSIBLE CONFIGURATIONS

In the previous section only single-Ranger systems were considered. Dual Ranger systems introduce a bit more complexity, but the basic operational functions are still the same. With a dual Ranger system, there are three different configurations to consider:

- 1 Modem embedded in indoor Ranger/rooftop Ranger has no modem**
 In this configuration the rooftop Ranger (for example, a Sky4 or an EliteAC) doesn't play a role in connecting to the cellular network. As a result, it can be ignored in the connection process and the instructions provided in Section 3a apply with no change and no further discussion is necessary.
- 2 Modem embedded in rooftop Ranger/indoor Ranger has no modem**
 In this configuration the modem is in a rooftop Ranger which is operated using WFRControl by the indoor Ranger. This configuration will be discussed in detail in the next section.
- 3 Modems are embedded in both rooftop Ranger and indoor Ranger**
 This case is a composite of the two other cases, and it can be treated using the techniques described for those cases.

3c MANAGING A DUAL RANGER SYSTEM WITH EMBEDDED MODEM IN ROOFTOP ROUTER

To access the modem in the rooftop Ranger you need to go to the **Setup page of the indoor Ranger's control panel**. On the Setup page, find the line labeled WFRControl and click on the gear on the right side of line. A window will open. Figure 3c-1 shows an example of what will be in that window. The window displays a miniature version of the control panel of the rooftop router. In this screenshot the rooftop router is an Everest, but the basic contents of the window will remain roughly the same regardless of which rooftop Ranger you have.

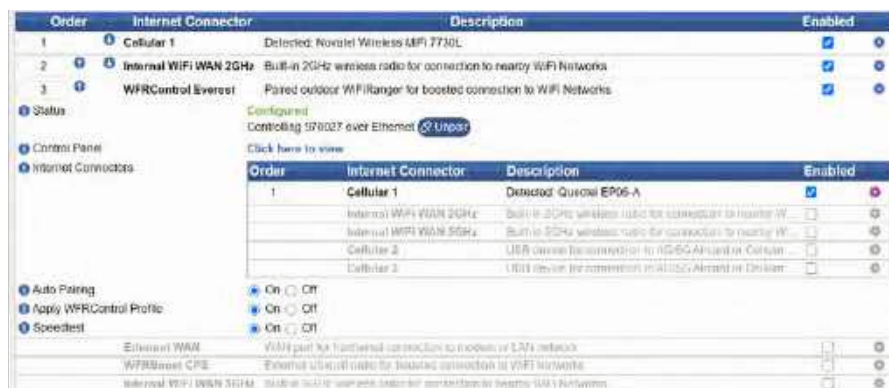


FIGURE 3c-1

This window allows you to control the modem in the rooftop Ranger as if you were directly dealing with that Ranger's control panel. You activate the Cellular connection in the rooftop router by putting a check into the Enabled column of the Cellular 1 line inside the window and save by clicking on the button at the bottom of the page.

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One important thing to note when working with this configuration is that the Cellular line on the Setup page of your **indoor** Ranger’s control panel has **nothing** to do with the operation of the modem in the rooftop Ranger. There is no reason to activate any of the Cellular lines on the indoor Ranger unless you plan on tethering a hotspot or phone to the device. If you don’t plan on tethering, leave the Cellular lines disabled.

Another important point to note is that since the rooftop Ranger is being controlled under WFRControl, it can only perform one task at a time. For example, if you have a Denali with a modem and its WiFi radio, it can only bring its data into the indoor Ranger to which it is connected using one of these connections of the other. To say it another way, if you want to use the modem in the Denali, you can’t, at the same time, use the Denali’s internal WiFi radio.

This also means that if you have an Everest with two modems and a WiFi radio, **you can only use one of these at a time** when the Everest is being operated under WFRControl.

At present, the only way around this limitation is to unpair the indoor and rooftop Rangers which allows you to operate a MultiWAN with the capabilities of the outdoor Ranger. This is discussed in detail in Section 5.

3d TETHERING OF CELLULAR DEVICES

Indoor WiFiRanger routers (Poplar, Spruce, Aspen, Core and GoAC) will display multiple cellular lines on their Setup pages; the lines are labeled Cellular 1, Cellular 2 and Cellular 3. Those additional cellular lines are for USB-connected hotspots and/or smart phones which can be “tethered” to the Ranger using the router’s USB port. A tethered cellular device will, in many respects, operate similarly to an embedded cellular modem.

To tether a device to a Ranger it is first necessary to place a check in the Enabled column for the appropriate line. If more than one device is to be tethered at one time, a powered USB hub will also be required. Once the appropriate cellular line has been enabled, additional drop-down CONNECT buttons will be created in the Cellular area on the upper right portion of the control panel Main page.

- Figure 3d-1 is a screenshot of the Setup page for an Aspen router which has a tethered Novatel 7730L hotspot displaying as Cellular 1 and an embedded Quectel modem displaying as Cellular 2.



○ FIGURE 3d-1

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- Figure 3d-2 shows how those multiple cellular connections result in multiple cellular drop-down choices in the Cellular box of this same Aspen.



○ FIGURE 3d-2

It should be noted that to tether a hotspot or phone to an indoor Ranger, it will be necessary to set up that device so that the USB tether is used for both power and data. The settings for that will be in that device's admin control software. Both Android and iOS devices can be tethered, the specific setup requirements will vary from device to device.

When the hotspot or phone has successfully been connected to the Ranger, the text in the Cellular box will read "**Data Connection—Using Cellular Data**" as shown in the previous figure.

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4 ADVANCED WIFIRANGER FEATURES

4a ADVANCED USE OF THE CONTROL PANEL MAIN TAB

- i. **Main Tab Overview** Although the Control Panel’s Main has previously been discussed, in this section of the Guide, we will examine its display and function in more detail.
 - o Figure 4a-1 is the Main tab for an Aspen router. Your Main tab will have some differences, but, overall, it will look very similar.

Notice the text box in the upper right corner of the page; this box appears on every screen of the control panel. It contains five elements:

1. Check for Updates Link—The presence of the blue “check for updates link” indicates that your Ranger has made a cloud-based connection to the WiFiRanger server. If the text Cloud Disconnected were to appear, clicking on the text a couple of times until blue bars start scrolling will restore the link. If the text reads Update Firmware you can initiate an update using the procedures discussed in section 2h of this guide.



FIGURE 4a-1

2. Firmware Version—Displays the firmware version being used by your Ranger.
3. Uptime—Displays the length of time the Ranger has been operating since it was last booted.
4. WiFiRanger ID—The complete 6-digit ID of the Ranger; each Ranger router has a unique ID which is essential if you were to request trouble-shooting assistance.
5. Mode (Simple or Advanced)—Ranger routers are, by default set to Simple mode in which some more advanced features are hidden from view. This guide has been written with the assumption that the mode has been set to Advanced. Setting the mode is discussed in Section 4ci-i.

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- ii. **SafeSurf™** Safesurf is a VPN (virtual private network) that is built into WiFiRanger firmware. Safesurf is available for use regardless of whether you are using WiFi, cellular or any other internet connection method. SafeSurf is enabled by clicking on the Enable SafeSurf button at the bottom of the control panel main tab. The VPN that is formed by enabling SafeSurf has your Ranger as one of its endpoints with the other being the WiFiRanger servers in Idaho.

For the purpose of this user guide, it is assumed that the reader understands the general purpose of using a VPN and has some general idea how VPN's work. For a simple explanation of what a VPN is more information can be obtained here: <https://wifiranger.com/how-is-a-vpn-like-a-phone-booth/>

When SafeSurf is enabled a lock symbol appears next to the "Online" text in the center top box on the control panel main page. There can be a brief delay in the appearance of this symbol from when the "Enable SafeSurf" button is clicked on. **The VPN is not functional until the symbol appears.** Also, due to the nature of VPNs, there is always a possibility that SafeSurf might become disabled while it is in use. If that happens the lock symbol will disappear.

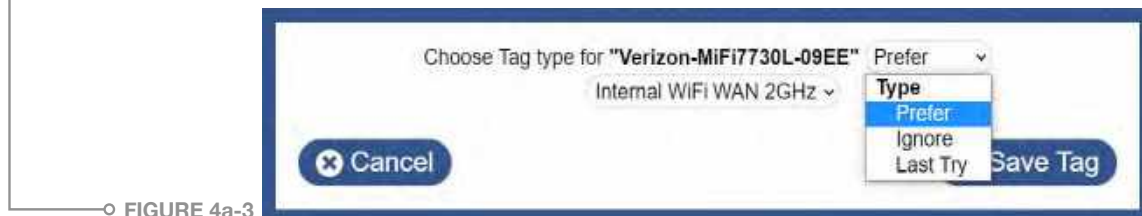
- Figure 4a-2 shows the SafeSurf lock symbol on the control panel Main tab.



○ FIGURE 4a-2

- iii. **Tagging Networks**—When the number of available WiFi networks is large or there are specific networks that you prefer the Ranger connect or not connect to, the tagging feature can be helpful. Place a check in the "Tag" column on the Main page of the Control Panel for any of the displayed SSIDs the Ranger will then prompt you to define the type of tag you wish to apply.

- As shown in Figure 4a-3 networks can be designated as Preferred, Ignored, or Last Try. The Ignore function can be particularly helpful when there are multiple "open" networks available, and you prefer that the Ranger not connect to them.



○ FIGURE 4a-3

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The Tagging dialog box can also specify if the tag is to be applied to all internet connections or just the one that you are using at the time the tag is applied. This can be helpful if you prefer that specific SSIDs connect using a specific connection method.

This is shown in Figure 4a-4.

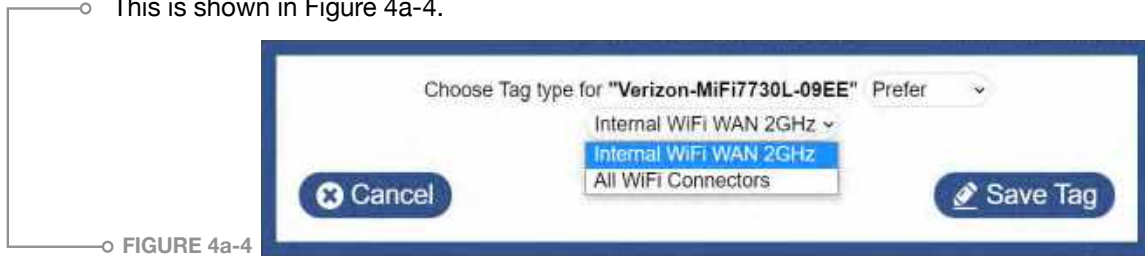


FIGURE 4a-4

Lastly, if there are SSIDs with similar multi-part names then you will be prompted to specify if you want the tag to apply to the entire name or a single portion of this. For example, if the SSID was “Jones RV park” you would be prompted to specify if the tag was to apply to “Jones”, “RV”, “park” or “Jones RV Park”

- iv. **Speed Testing** The Ranger has a built-in ability to perform a speed test of any internet connection it is using. This can be helpful if there are several internet connections available for use and you’re trying to determine which one to use. Only connections that you are actually connected to can be tested. If you are using a MultiWAN and have more than one connection in use all of them can be tested at the same time.

For any particular connection, the master control of whether a speed test will be run is determined by a selection made on the Setup page of the control panel. For any connection that has been enabled, click on the gear on the right side of the line; in the window that opens one of the switches determines whether the speed test function for that connection has been enabled.

Figure 4a-5 shows the speed test switch (the arrow shows the gear that has been clicked on to open the window). It should be noted that speed tests can consume non-trivial amounts of data to perform. Therefore, on connections with limited data allowances, speed tests should be performed only when necessary.

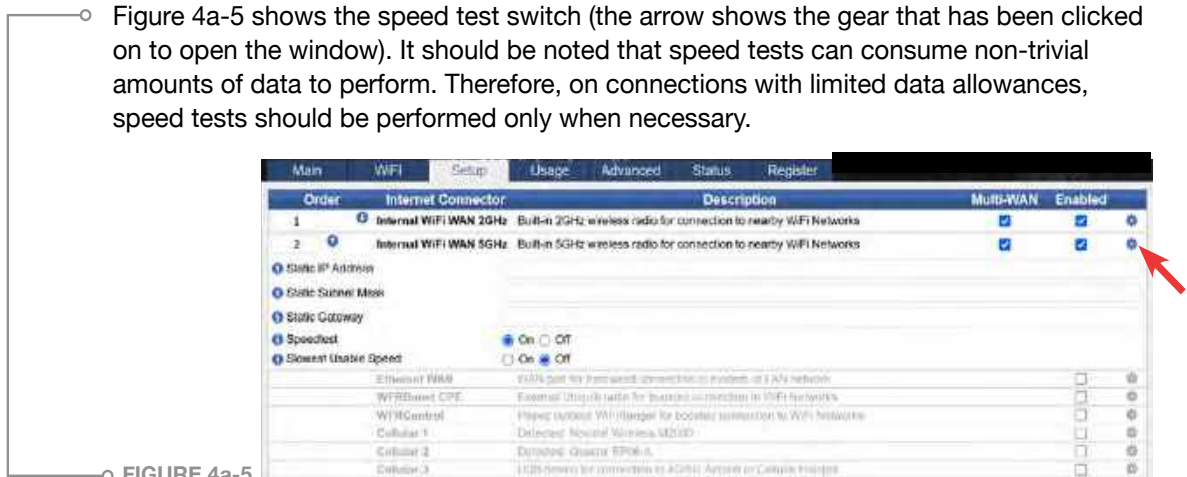
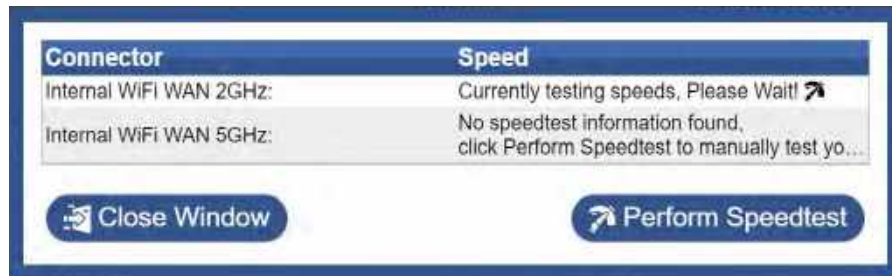


FIGURE 4a-5

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- Performing a speed test is controlled by the Speed Test button on the bottom of the Main tab. Clicking on the button brings up the window shown in Figure 4a-6.



○ FIGURE 4a-6

In this example, there are two internet connections being used in a MultiWAN setup. Clicking on the Perform Speed Test button will cause the test to begin with one of the active connections. The test can take up to several minutes, depending on the connection. The window can be closed during the test or it can be left open.

Clicking on the Speed Test button on the Main tab again will reopen the window and will display the latest speed test data. If the button is pressed too soon, before the test has been completed, that internet connection will be omitted from the display. Wait a moment for the test to complete and try again

- v. **Signal Strength** On the Main tab's list of SSIDs WiFi connections are listed in decreasing order of signal strength. In the signal column a graphic depiction of the relative signal strength of each connection is provided. If you "mouse over" the graphic display, the actual signal strength in decibels will appear as shown in Figure 4a-7. Knowing the precise signal strength can be very helpful if one is attempting to connect to a distant WiFi access point. Repositioning your receiving antenna could increase a marginal signal to the point where it becomes usable.



○ FIGURE 4a-7

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- vi. **Ranging** As one moves from one location to another, there will be situations where there exist multiple SSIDs that could be connected to but where the choice of which will provide the best connection can't be predicted in advance. This commonly occurs at RV parks and similar locations where there are multiple WiFi access points to connect to. Although it may seem logical to connect to the one with the strongest signal, that doesn't always guarantee that it will provide the fastest internet connection. That's where the Ranging function can provide helpful data. In Figure 4a-8, a situation is shown where our RV park Rockport Oaks has two access points in range. Although one has a somewhat stronger signal, we'd like to know which one provides the fastest connection and we'd like to be able to know that every time we connect.



FIGURE 4a-8

- The Ranging menu, which is a dropdown under the topmost connect button, provides a way to get that information. Figure 4a-9 displays the Ranging menu available in that dropdown. For our example, the figure also shows that we have tagged the two Rockport Oaks SSIDs so now we can select, from the drop down, the option for "fastest tagged" and the Ranger will automatically test the speeds of both tagged connections and will connect us to the fastest one.



FIGURE 4a-9

- vii. **Auto Connect** The Auto Connect button on the Main tab manually initiates the Failover feature. For a full discussion of Failover, see section 4ci-a.



4b EXPLORING THE CONTROL PANEL WiFi TAB

- i. **Stored Network Keys** The top section of the WiFi tab lists all stored network keys (passwords) for networks the Ranger has been connected to. The SSID, password and encryption type are provided for each network. Passwords for stored networks cannot be changed; if a network password has been changed delete the entire line using the delete icon on the right side of the line. When you re-connect to that network you will be prompted to enter the new password.
- ii. **WiFi Tags** The second section of the WiFi tab lists all tags that have been applied to WiFi networks. The SSID, type of tag and the connection it applies to are provided. Tags cannot be edited but can be deleted.
- iii. **Hidden WiFi Networks** If you connect to networks which are operating as “hidden”, their SSIDs can be entered in the third section of the WiFi tab so that they can be connected to with the Ranger.
- iv. **Range Options** If you use the Ranging options described in Section 4a-6 of this guide, the range options provided in the fourth section of the WiFi page allow you to tailor the ranging function so that specific restrictions are placed on all ranging attempts. This can be helpful if you wanted to, for example, restrict all ranging to just tagged connections.
- v. **Private WiFi Networks** This section of the WiFi tab was discussed previously in Section 3g of this guide. However, several advanced features were omitted from that discussion.

Same name (SSID)—WiFiRanger routers with dual band (2.4 GHz and 5.8 GHz) can be operated so that the same SSID is displayed for both bands. This allows connected devices to “roam” between bands, connecting to the best available connection.

Sync broadcast with WFR control—this allows for the use of a single SSID and password for the device operating under WFRControl and the router which is controlling it for the same purpose as noted above.

Hidden network (on/off)—Advanced users may choose to hide their network name (SSID) so it isn’t visible to others searching for WiFi signals. For Rangers with dual band capability this can be done for either 2.4 GHz and/or 5 GHz signals. However, users are cautioned that hiding a network can create serious problems unless they are familiar with how to connect to networks that have been hidden.

Private Network —The 2.4 GHz and/or 5 GHz private wireless networks can be disabled by removing the checks from the corresponding boxes. This might be something a user wanted to do if he planned to connect to an indoor Ranger entirely by Ethernet. However, turning off the WiFi network for a rooftop Ranger that doesn’t have an indoor “companion” can result in a device that cannot be connected to at all. In such cases, it may be necessary to perform a factory reset to be able to regain communication with that Ranger. Care should be taken before a decision is made to disable all WiFi broadcasts.

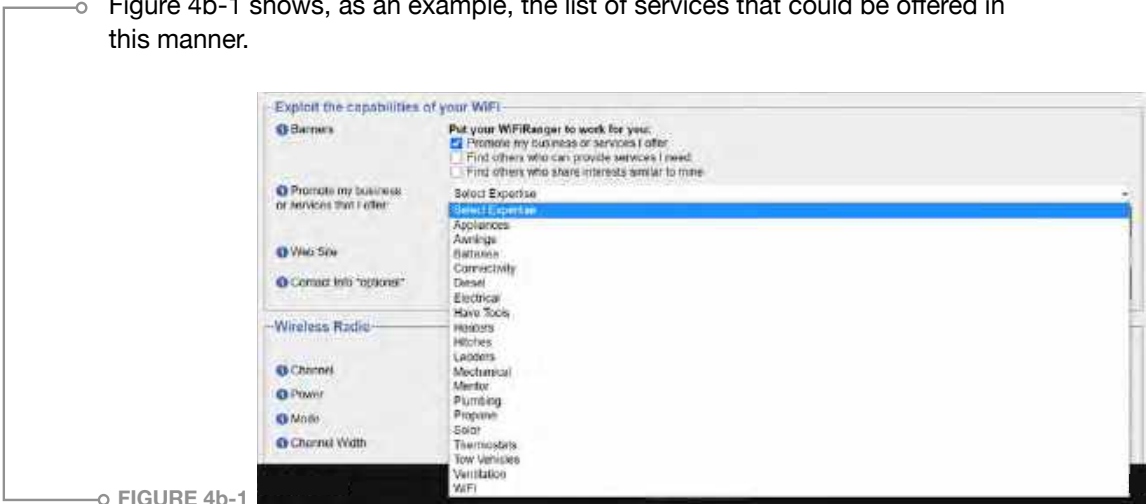
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OEM Management Networks—If your WiFiRanger was installed in a motorhome during manufacture, it is possible that there exists a hidden management WiFi network which is utilized by hardware in the coach to pass information between different subsystems. It is recommended that you not make any changes to this network without first consulting with the manufacturer of your coach.

- vi. **Guest Wireless Network** Your Ranger has the capability of supporting a completely separate WiFi network that you could use, for example, as a way of sharing your internet connection with other people at a campground. You can create a separate password for the guest network, and you can set the length of time and how often users can connect to it. You can even create a “professional” environment by setting up a “redirect” webpage that users are taken to while logging in. By default the guest network is off.

- vii. **Exploit the Capabilities of your WiFi/Social Networking** Your Ranger has the ability to add to its SSID information regarding services you might provide, services you are seeking or other general information about yourself and your interests. When you click on any of the “banners” in this section, such as “Services I offer” you are presented with a list of options from which you can select one or more. In addition, you can provide identifying information, such as your site number, phone number or email address, so others can contact you about your services. This information is then displayed when another WiFiRanger user sees your SSID and “mouses over it”.

Figure 4b-1 shows, as an example, the list of services that could be offered in this manner.



o FIGURE 4b-1

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If a WiFiRanger owner in your vicinity has activated this feature of his Ranger, you will see a “person” icon displayed next to his WiFi Network (SSID) on the Main tab of the Control Panel. Hover over the person icon to view his interests, skills or needs. You do not need to connect to his WiFi in order to see his info, as a simple WiFi scan will display the icon. Figure 4b-2 shows the Main page of a Ranger where several nearby SSIDs are exhibiting their information and one is being displayed in detail.



Connection	WiFi Networks	Signal	Type	Channel	Speed	Mac Address	Tag
General	BlueNetNetworks	Full	WPA	7	1.8 Mbps	DC:9F:0B:36:00:8A	
General	Pvt WiFi Ranger 100E	Full	WPA	8		02:5E:0C:31:12:59	
General	Pvt WiFi Ranger Sky 1885	Full	WPA	8		02:27:22:83:73:A5	
Network	all	Full	WPA	8		04:27:22:83:73:A5	
General	Pvt WiFi Ranger 100E	Full	WPA	7		02:16:40:4C:AC:1E	
General	Public 100E	Full	WPA	7		04:16:40:4C:AC:1E	
General	ZyXEL 100E	Full	WPA	2		FC:8F:C4:09:C9:58	
General	00S	Full	WPA	1		8C:8C:0E:2B:83:0E	
General	Boyle Network	Full	WPA	11		00:08:88:18:68:18	
General	Pvt WiFi Ranger 5.1767	Full	WPA	7		02:27:22:83:73:A5	
General	Pvt WiFi Ranger	Full	WPA	7		02:27:22:83:73:A5	
General	RR Guest Network	Full	WPA	7		08:28:68:18:68:18	
General	3RHE0T-4U-420FV	Full	WPA	7		00:8B:9E:48:85:F9	
General	PulseNet747	Full	WPA	7		04:27:22:83:73:A5	
General	NetisSys	Full	WPA	11		00:27:22:73:36:8F	

Social Info
 Interests: Fine dining, live music, hiking things, living seasonally, playing music
 Website: http://wifiranger.com/
 About Me: post the SSID, over the radio, around Tamara, and just before Alton.

FIGURE 4b-2

- vii. **Wireless Radio** This last section of the WiFi tab controls the configuration of the Ranger’s WiFi radios. The default settings for WiFi channel is Automatic for both 2.4 GHz and 5.8 GHz radios but those can be changed if there a reason for doing so. The 2.4 GHz band is often overcrowded at campgrounds and other public locations and, if you notice that, it may be beneficial to change to a less crowded channel. This is less likely to happen on the 5.8 GHz band because of the large number of channels.

The default power setting for both bands is also Automatic. In most cases, the Automatic setting will provide the best results. Indiscriminate use of high power WiFi can create unwanted interference, both for you and others.

Most users will be best served by leaving the Mode switch in its default channel width setting of 20 MHz which should be satisfactory for most purposes. 5 GHz broadcasts can utilize bandwidths as large as 80MHz and advanced users may choose to change the setting to Automatic which will permit use of increased bandwidth.

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4c ADVANCED SETUP TAB CONTROLS

- i. **System Preferences** The Setup tab contains several important configuration settings
 - a. Failover—Automatically attempts to connect the Ranger to the activated connections in the order in which they are listed on the Setup tab. This is why the proper ordering of connections is important. WiFiRangers are shipped with Failover disabled to avoid creating a re-connect loop if no initial internet connection is available when the device is first connected. However, once the user has become familiar with the Ranger, most users will find it helpful to have Failover enabled all the time. When Failover is enabled, the reconnection attempt will occur after the selected interval has expired. The AutoConnect button on the Main tab will manually cause the Failover process to initiate regardless of the interval selected.
 - b. “Minimum Speed” Tests—This dropdown is the master switch which enables the Minimum Acceptable Speed slider on any internet connection where the user chooses to use it. The interval set by the dropdown specifies how often speed tests will be run for any connections for which it has been enabled. For the Minimum Acceptable Speed feature to be operational, Failover has to be enabled as well as speed testing for the selected connection.
 - c. MultiWAN mode—MultiWAN is discussed in detail in Section 5. This switch selects the MultiWAN mode.
 - d. Control Panel Redirect—when the Ranger is not yet connected to the internet, this switch forces the browser to display the Ranger’s control panel. For ease of access to the control panel, it is important that this switch remain “ON”.
 - e. Initial Auto Connect—Enabling this switch causes the Ranger to attempt to connect to the first enabled connection as part of the boot process. For example, if you turn off your Ranger overnight, this switch will enable it to reconnect to your desired connection when it boots up in the morning.
 - f. Attempt Auto Login—Automatically attempts to bypass login/agreement page at Filtered WiFi Networks. Public networks that require a username and password cannot be bypassed, but Filtered networks that simply have a one-click access button may be automatically bypassed with this feature on..
 - g. Sync data—Enabling this switch allows the Ranger to provide signal quality data to WiFiRanger servers
 - h. Hide Advanced Features—Enabling this switch hides several control panel settings that are intended for use by advanced users. Operating the system in Advanced Mode (Hide Advanced Features set to “off”) provides the user with a number of additional features which users they may choose to enable. However, if the Ranger were to be subsequently reverted to Simple Mode all changes made while in Advanced Mode would also be undone. Therefore, it is not generally recommended that systems be reverted once they are set to Advanced Mode. However, it should be noted that performing a Factory Reset using the button on the bottom of the Setup tab will always revert the Ranger to Simple Mode.

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- ii. **Profiles** For those who change their Ranger’s configurations often, Profiles provide an easy way to set a number of parameters at the same time. Several profiles are provided as examples; others are easily added. Profiles can include settings such as “which connections are activated”, “the order of the active connections”, etc.
Use of profiles is entirely optional. Figure 4c-1 shows an example of a profile in which a tethered MiFi hotspot is used as the primary connection with WiFi being available as an optional backup. In this case Failover has been set to “off” to prevent the connection from changing unless the user directs the action take place.



FIGURE 4c-1

Additional profiles can be created and saved. Choose a name for the new profile and create a brief description. Then set the Ranger’s configuration settings as you desire them to be and save. When you subsequently load that profile, your settings will be restored

Bottom of the Tab Buttons:

At the bottom of the Setup tab, in addition to the Save button, there are three additional buttons:

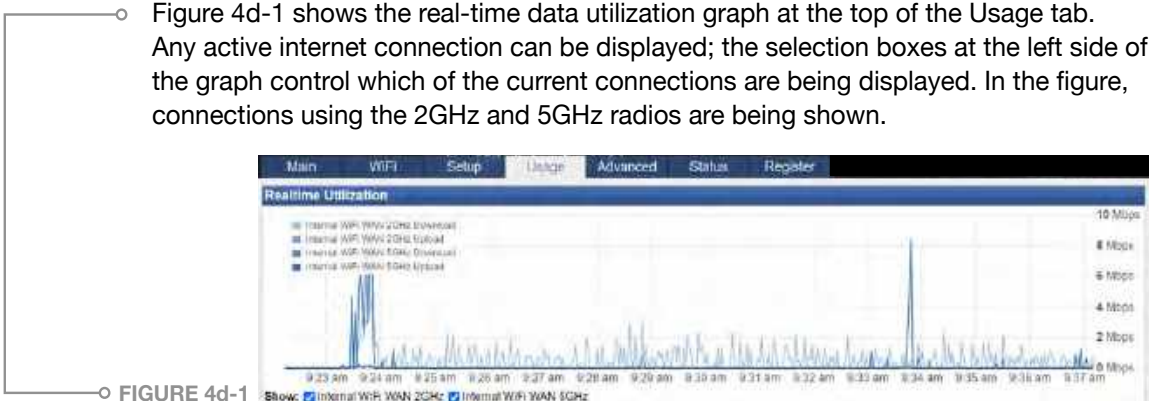
- Logfile** You could be asked by WiFiRanger technical support to download a logfile from your Ranger for diagnostic purposes. This button will download a logfile.
- Reboot** This button will initiate a reboot by your Ranger. Passwords and other stored data will not be reset by this action.
- Reset** This button will initiate a factory reset of your Ranger. Stored passwords and other data will be erased. The Ranger’s SSID and password will be returned to their default settings.

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4d USAGE TAB

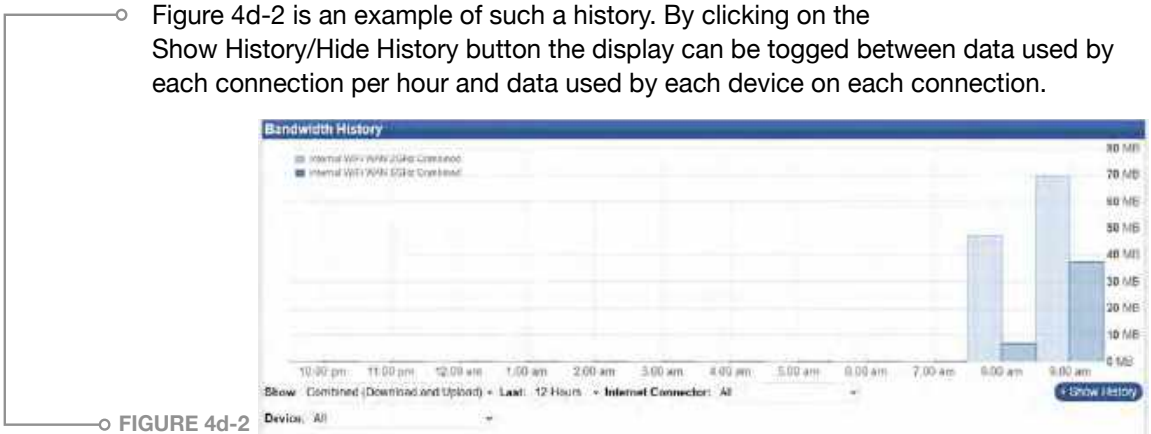
By default the Ranger’s usage tab is set to OFF. Enabling usage tracking creates an additional load on the processor and some performance degradation may occur. Unless device restrictions are being implemented, it is probably best to use the Usage tab for diagnostic purposes rather than for extended use. To enable the Ranger’s usage tracking features set the Usage switch to “ON” and save.

- a. Usage tracking—This is a powerful diagnostic tool for understanding the use of data by the Ranger and the devices connected to it. It is particularly helpful when multiple connections are being used in a MultiWAN configuration.



A caution about interpreting the data on the real-time graph is that the lines for multiple connections can overlap each other and can create misleading impressions when viewed in the aggregate. For example, in the graph shown, the dark blue line will always display in preference to the light blue line when they overlap. Without examining both graph traces separately it is impossible to know the actual usage of each.

- b. Bandwidth History—The central portion of the Usage tab displays data used by hour, by device and by internet connection.
- Figure 4d-2 is an example of such a history. By clicking on the Show History/Hide History button the display can be toggled between data used by each connection per hour and data used by each device on each connection.



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- c. **Bandwidth Groups**—This section of the Usage Tab allows for creation of custom groups of internet sources to combine the total data usage into one viewable and trackable statistic. This can help with keeping track of overall usage of a shared 4G plan that may include a MiFi and multiple smart phones. Instead of only having visibility for each individual device on the shared 4G plan, you can lump the sum of their usage together to accurately avoid overages.

Configuring a Bandwidth Group

1. Enter new Group Name under Bandwidth Groups section
2. Select desired color from palate (used for group title and graph bars)
3. Click Add
4. Follow on-screen options to combine desired internet sources into Group
5. Click Add to Group to put another device in the Group
6. Click Save Changes

- d. **Device Restrictions**—Make rules to manage internet speeds or access for specific devices and/or internet connections. This can give you control over bandwidth usage for optimizing performance, limiting usage by particular individuals, and/or avoiding overages on data plans. Device Restrictions could, for example, be used to schedule when children have internet access, to cutoff 4G service when approaching monthly limits, or limiting internet speeds or downloads on particular devices.

Configuring a Device Restriction

1. Select all or a particular Internet Connector or network interface
2. Select all Devices or a particular one
(check Exclude if effect should apply to all other Devices)
3. Select desired Effect when restriction engages
4. Set Schedule for when restriction applies
5. Set Threshold for amount of bandwidth consumed that triggers the effect
6. Set Reset Interval for timetable that the bandwidth Threshold will be reset on
7. Click Add

A “limit speed” restriction will be highlighted in yellow when active and a “disable internet access” restriction will be highlighted in orange when active. A message will also display on the Control Panel that indicates that the restrictions is in effect. Any restrictions that are not highlighted in yellow or orange are not currently being applied. Figure 4d-3 provides examples of several device restrictions.



Device Restriction	Effect	Schedule	Limit Type	Activation	Usage	Reset Interval	Status
Emergency WAN	Stop Internet	10:00am to 8:00pm	None	Always Active	0 KB	Hourly	Mon-Fri 10:00 AM - 8:00 PM
All Internet Connector	Limit Speed	All Day	None	Always Active	0 KB	Hourly	Mon-Fri 10:00 AM - 8:00 PM
All Internet Connector	Limit Speed	All Day	Compressed	Always Active	0 GB	Hourly	Mon-Fri 10:00 AM - 8:00 PM
Emergency WAN	Stop Internet	All Day	None	Always Active	22.00 KB	Hourly	Mon-Fri 10:00 AM - 8:00 PM

Add Restriction
 CHOOSE RULE TO THROTTLE SPEEDS OR STOP INTERNET CONNECTIVITY TO OPTIMIZE USAGE.

Select Internet Connector
 CHOOSE ALL OR A PARTICULAR INTERNET CONNECTOR THAT THE RESTRICTION WILL APPLY UNDER

Select Internet Connector: All Internet Connectors

Next

FIGURE 4d-3



4e ADVANCED TAB

The Advanced tab is only visible when Hide Advanced Features on the Setup tab is set to “OFF”. The top section of the Advanced tab allows the user to enable port forwarding for a specified ranger of ports--the user specifies the IP Address of the destination device/ computer, the starting/ending ports, and the protocol in use.

UPnP Services Allows automatic network discovery and function of devices and services

DMZ IP Address On the Advanced tab, set a DMZ IP Address of a server behind the WiFiRanger. DMZ stands for Demilitarized Zone, which in computer security terms means that this server is exposed through the router’s firewall so that access is granted to the DMZ server from the internet. Hosting a DMZ server behind a WiFiRanger does not compromise other devices or computers on the LAN. Only the specified server will be exposed to the internet.

IP Alias Create Private LAN IP Aliases that bridge up to two IP subnets with the WiFiRanger’s unique DHCP subnet. This feature allows for easily placing a WiFiRanger into an existing network that was on a different subnet with statically assigned devices. By creating a Private LAN IP Alias, devices issued a DHCP address will also see anything statically assigned in the IP Alias range. To create an IP alias, enter the desired Gateway IP and Subnet separated by a comma (no spaces).

DNS Usually Domain Name Servers will be automatically obtained through your internet connection(s); however, you can specify a static set of DNS servers. For most purposes the automatic setting should be sufficient. However, occasionally a specific internet connection may fail to provide accurate DNS information. When that happens specifying a set of static DNS servers usually will remedy the issues. The most commonly used static DNS servers are those operated by Google which have the following IP addresses: 8.8.8.8 and 8.8.4.4

Hardware

Router Lights: If you have a reason to disable the LED lights on your Ranger, you can do so with this switch.

USB Power Only: By default, the USB port on an indoor Ranger can be used both to provide power and data tethering. However, if you wish to prohibit use of the port for data, this switch will disable that function.

Admin Access By default, Admin Access is set to “OFF.”

Under some circumstances you may have users of you network who you wish to restrict from having access to the Ranger’s control panel. For example, you might have specified device restrictions to control internet usage by children and you wish to prevent them from undoing those restrictions. In such cases you can enable Admin Access by changing the “Login Required” switch to “ON” and specifying a username and password.

When Admin Access is enabled attempts to access the control panel will be redirected to the Admin Access login screen.

Caution: It should be noted that enabling Admin Access is **not** cleared by a factory Reset; therefore, if you enable Admin Access credentials, be sure not to lose that information. Otherwise, you could lose all access to your Ranger.

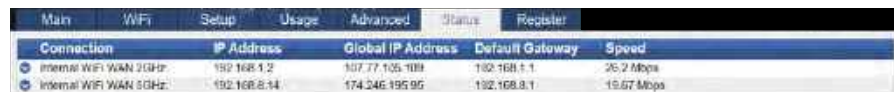
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4f STATUS TAB

The top section of the Status tab lists the internet connections currently in use by the Ranger and provides specific internal and external address information about them. If you are using only one internet connection at a time, this section will have only a single line.

However, if you operate your Ranger in a MultiWAN configuration as explained in Section :??, the number of lines in the top section of the Status page will correspond to the number of internet connections currently in use. **If the display in the top section of the Status tab were to have yellow highlighting on two or more of the listed connections, this would indicate the presence of an IP address conflict between two or more of your connections which, essentially, would make them unusable until the conflict was corrected.** The topic of how such conflicts come about and how they can be corrected is outside the scope of this guide.

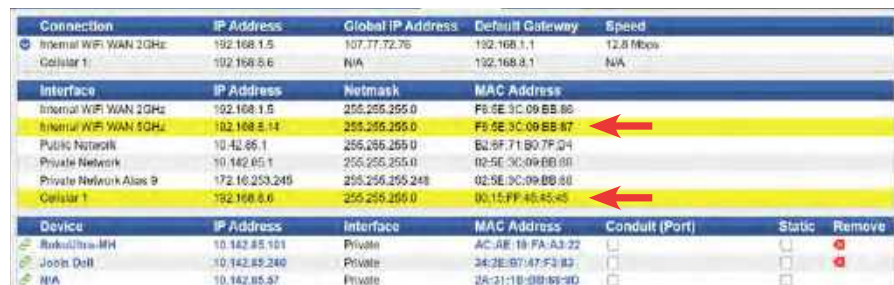
- Figure 4f-1 shows the upper section of the Status tab for a Ranger which is operating in a MultiWAN mode with two internet connections. The Default Gateways for the two connections are not the same and, as a result, no IP address conflict exists. Therefore, no yellow highlight is present.



Connection	IP Address	Global IP Address	Default Gateway	Speed
Internal WiFi WAN 2GHz	192.168.1.2	107.77.105.108	192.168.1.1	25.2 Mbps
Internal WiFi WAN 5GHz	192.168.8.14	174.246.195.95	192.168.8.1	19.67 Mbps

FIGURE 4f-1

- However, figure 4f-2 shows the Status tab when two connections have conflicting IP addresses. Notice the yellow highlight on the 5.8GHz and Cellular 1 lines which indicates they are in conflict. When this occurs only one of the conflicting connections will have access to the internet.



Connection	IP Address	Global IP Address	Default Gateway	Speed
Internal WiFi WAN 2GHz	192.168.1.5	107.77.72.75	192.168.1.1	12.8 Mbps
Cellular 1	192.168.8.6	N/A	192.168.8.1	N/A

Interface	IP Address	Netmask	MAC Address
Internal WiFi WAN 2GHz	192.168.1.5	255.255.255.0	F8:6E:3C:09:BB:85
Internal WiFi WAN 5GHz	192.168.8.14	255.255.255.0	F9:5E:3C:09:BB:87
Public Network	10.42.85.1	255.255.255.0	B2:5F:71:80:7F:04
Private Network	10.142.85.1	255.255.255.0	02:5E:3C:09:BB:80
Private Network Alias 8	172.16.253.245	255.255.255.248	02:5E:3C:09:BB:80
Cellular 1	192.168.8.6	255.255.255.0	00:15:FF:45:45:45

Device	IP Address	Interface	MAC Address	Conduit (Port)	Static	Remove
Redull/Row-WH	10.142.85.101	Private	AC:AE:09:FA:A3:22		<input type="checkbox"/>	<input type="checkbox"/>
Johns Dell	10.142.85.240	Private	34:2E:07:A7:F3:83		<input type="checkbox"/>	<input type="checkbox"/>
N/A	10.142.85.57	Private	2A:21:1B:8B:69:9D		<input type="checkbox"/>	<input type="checkbox"/>

FIGURE 4f-2

The Device section of the Status tab lists all the devices that are currently connected to your private network and those that have recently been connected. The name of each device can be edited by clicking on it and once edited, the device will retain that name for future connections.



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The IP and MAC addresses of all devices are shown. The IP address of any device can be converted to “static” by putting a check in the Static box on the appropriate line.

The Device section of the Status tab can also be used to create “conduits” (port forwarding) for devices on your private network by putting a check in the Conduit box and specifying the port to be opened.

Static IP addresses may be required by IP cameras and other smart devices and port forwarding may be needed for gaming and other purposes. Implementing these features is straightforward; explaining how they are used is outside the scope of this guide.

4g REGISTER TAB

Registration of your Ranger by using the Register tab is a requirement for downloading future firmware updates. If you fail to register you will see notification of available updates but will be unable to download them. The minimum amount of information required on the Register page is your name and email address.

Note: At present there is no interconnection between information entered on the Register tab and customer account you may have created at WiFiRanger.com.

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5

MULTIWAN OPERATION

Traditionally, a router connects a single internet source to devices on a network. Multiple connections may be available but only a single connection is active at any given time. WiFiRanger’s MultiWAN mode enables the user to utilize multiple connections either simultaneously or as backups to each other.

There are two modes for employing MultiWAN. The switch for selecting the MultiWAN mode is found in the System Preferences section of the Setup tab. Until that switch is set the MultiWAN boxes will not appear on the connection lines of the Setup tab.

The specific internet connections to be included in a MultiWAN setup are selected by placing a check in the MultiWAN column of the appropriate line in the upper section of the Setup tab as shown in Figure 5-1. That figure illustrates an Aspen router in which the 2 GHz and radio and Cellular 1 connection are designated as being part of a MultiWAN connection. Also, important to note is that other internet connections are designated as Active but are not involved in the MultiWAN. There is nothing that requires the MultiWAN to use all available connections.



Order	Internet Connector	Description	Multi-WAN	Enabled
1	Cellular 1	Detected: Novatel Wireless MFI 7730L	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	Internal WiFi WAN 2GHz	Built-in 2GHz wireless radio for connection to nearby WiFi Networks	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	WiFiControl Everest	Paired outdoor WiFi Ranger for boosted connection to WiFi Networks	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	Cellular 2	Detected: Quectel EP06-A	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Ethernet WAN	WAN port for fast wired connection to modem or LAN network	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	WiFi Backup CPE	External (USB) wireless for backup connection to WiFi networks	<input type="checkbox"/>	<input type="checkbox"/>
	Internal WiFi WAN 5GHz	Built-in 5GHz wireless radio for connection to nearby WiFi Networks	<input type="checkbox"/>	<input type="checkbox"/>
	Cellular 3	USB device for connection to 4G LTE or Cellular Network	<input type="checkbox"/>	<input type="checkbox"/>

FIGURE 5-1

To decide which available internet connections should be used in a MultiWAN it is necessary to first specify which MultiWAN mode is being used. We will discuss both modes in the following sections.

5a LOAD BALANCE MODE

When Load Balance is selected as the MultiWAN mode, all designated internet connections will share the data flow in what is often referred to as a “round robin” configuration. Data flowing (both downloads and uploads) will shift, in sequence, from one internet connection to another among the sources designated as being in the MultiWAN. Because the data flow is shared between multiple connections, the net effect is that the data load for each connection is reduced. This may be helpful if some of the connections involved in the MultiWAN have fixed data budgets.

The download and upload speeds for each source remain the same as they would if the connections were used individually, but the use of multiple connections results in more total data being able to flow in parallel across all connections. This can provide significant advantages when streaming video using connections as is explained in this article:

<https://wifiranger.com/how-load-balancing-makes-netflix-and-chill-better/>

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It should be noted that Load Balancing works best if all the connections used in the MultiWAN have roughly equivalent speed and response (ping) characteristics. A factor of two difference in connection speeds probably won't cause a noticeable effect, but a factor of 10 might.

All connections participating in a Load Balanced connection are pinged every 10 seconds. If the ping fails, the connection is then disconnected from the MultiWAN until a future ping to the same connection is successful. It should be noted that pinging does not verify speed of a connection, only its "existence".

It should be noted that Load Balancing may not work well with certain secure websites which may react poorly to what is perceived as a changing IP address for the user. If that is the case, simply disable the MultiWAN for those websites.

- To create a Load Balanced MultiWAN connection, simply designate on the Setup tab which connections are to be included and save your selections. Then return to the Main tab and connect each of the designated connections. In the Internet box at the top center of the page, you will first see the text Configuring MultiWAN which will be followed by ONLINE with a list of the connections that are being used. Figure 5a-1 depicts a MultiWAN with two connections one of which uses the 2 GHz WiFi while the other is a cellular connection.



FIGURE 5a-1

WIFIRANGER USER GUIDE

5b HOT STANDBY MODE

In Hot Standby mode the Ranger will make “standby” connections to multiple internet sources but only one at a time will be in use. If the Ranger “senses” that its current connection has stalled, the data flow will automatically be shifted to the next connection in the MultiWAN. The “health” of a connection in a Hot Standby configuration is determined by pinging it every 10 seconds. As noted in the previous section, pinging doesn’t verify connection speed just that the connection is responding in a normal manner to a ping attempt.

In Hot Standby mode, connections will be accessed in the order in which they are listed in the top section of the Setup tab. The first listed connection in a Hot Standby MultiWAN is connected to using the Main tab of the control panel as usual. The second listed connection becomes the Standby connection, and the Ranger will so designate it with an orange “flame” icon next to it on the Main page of the control panel. Subsequent connections beyond the second will also become standbys.

All connections in a Hot Standby configuration will continue to be pinged every 10 sections, even if “data traffic” has been shifted to a secondary connection. This allows the system to transfer data flow back to a primary connection after the problems affecting it have been resolved.

- Figure 5b-1 shows an example of a hot standby configuration where the WiFi connection is the primary with the standby being the cellular modem. Note that the cellular box displays “Data Connection” indicating that an active connection exists, but the “flame” icon on the right of the text shows that the connection is actually in standby mode.



○ FIGURE 5b-1

**6****GLOSSARY COMMON WIFI & CELLULAR TERMS**

5G Fifth-generation wireless (5G) is the latest iteration of cellular technology, engineered to increase the speed and responsiveness of wireless networks.

ACCESS POINT (Also called a Wireless Access Point or WAP) In computer networking an access point is a networking hardware device that allows other Wi-Fi devices to connect to a wired network.

ETHERNET A standard communication protocol used to create local area networks. It transmits and receives data through cables.

FIRMWARE Permanent software programmed into a read-only memory in a device such as a router.

IP ADDRESS A unique string of characters that identifies each computer using the Internet Protocol to communicate over a network.

LAN A computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

LTE “Long Term Evolution”; the fourth generation cellular network standard.

MODEM A modem modulates and demodulates electrical signals sent through phone lines, coaxial cables, or other types of wiring; in other words, it transforms digital information from your computer into analog signals that can transmit over wires, and it can translate incoming analog signals back into digital data that your computer can understand.

NETWORK KEY Security key used to connect to a network; often called a password.

ROUTER A device which allows multiple devices to connect to and share an internet connection.

SPLASH SCREEN (FILTERED NETWORK) An initial screen displayed during a connection to a network; often found in commercial settings such as hotels, RV parks, restaurants, etc.

SSID A unique ID that consists of no more than 32 characters and is used for naming wireless networks (Stands for “Service Set Identifier”).

WAN Wide-area network as a computer network that connects smaller networks. Since WANs are not tied to a specific location, they allow localized networks to communicate with one another across great distances.

WIFI A family of wireless network protocols, based on the IEEE 802.11 family of standards, which are commonly used for local area networking of devices and Internet access, allowing nearby digital devices to exchange data by radio waves.

WPA, WPA2, WEP Encryption standards for WiFi communications.

WIFIRANGER USER GUIDE

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MAGNADYNE OMNI-DIRECTIONAL ANTENNA

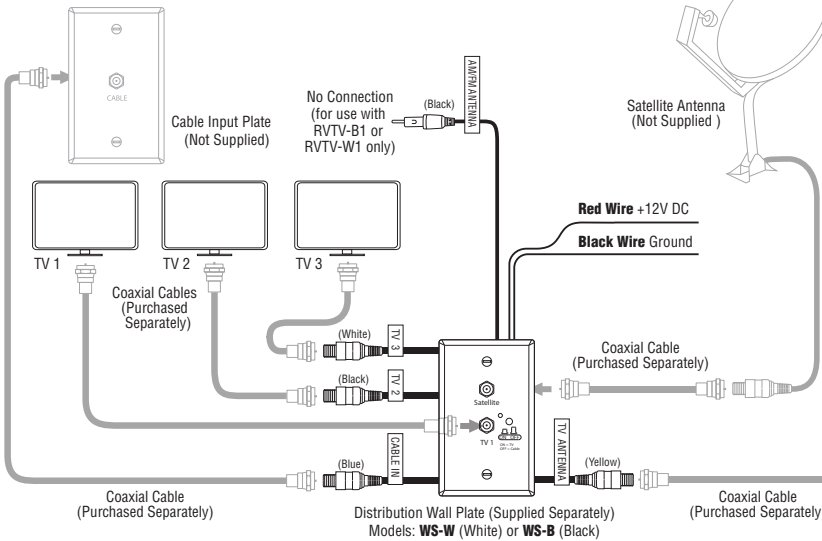
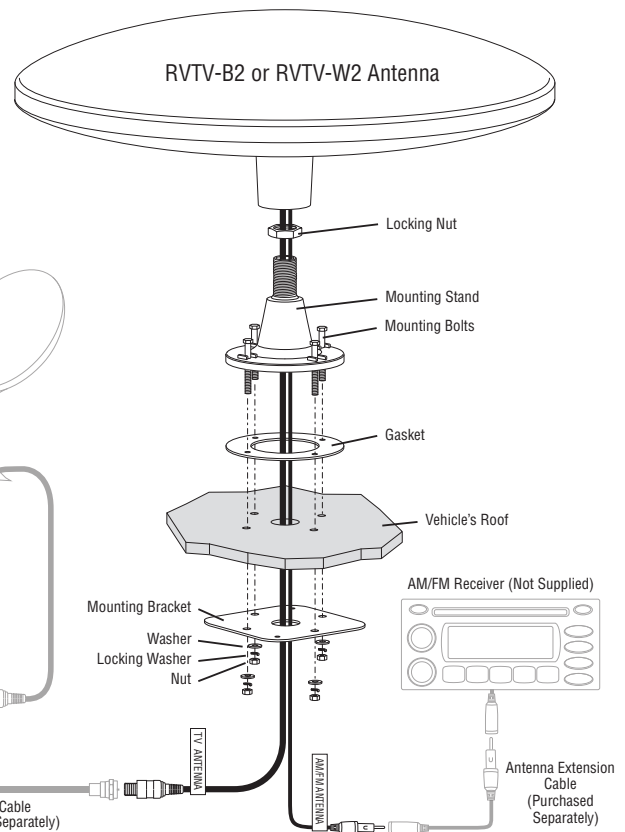
Models: RVTV-B2 (Black)
RVTV-W2 (White)

Installation Instructions

Installation

- Step 1: Choosing a Location:** Make sure the mounting location has a sufficient flat area so the antenna's mounting stand can be mounted flat.
- Step 2: Drilling Holes:** Use the mounting bracket as a template to determine where to drill the holes.
- Step 3: Assembling the Antenna:** Rotate the antenna's locking nut all the way down on the base. Gently pull the antenna's cables thru the mounting stand. Screw the antenna onto the mounting stand then rotate up the locking nut to lock the antenna into place.
- Step 4: Attaching the Antenna:** Feed the cables thru the gasket then thru the hole in the roof. Put the mounting bolts thru the holes in the mounting stand. On the interior, place the mounting bracket then use the washers and nuts to secure the antenna.
- Caution:** Do not overtighten the mounting bolts, damage to the mounting stand or roof may occur.
- Step 5: Wiring:** Connect the cables from the antenna to distribution wall plate and to the radio. Connect the power cables from the distribution wall plate according to the diagram below.

Technical Specifications
 Frequency range: VHF: 47-230MHz
 UHF: 470-862MHz
 Receiving range: FM/VHF/UHF
 Gain: 30dB
 Noise: 3dB
 Maximum output level: 110dBµV
 Impedance: 75Ω
 Power supply: DC 12V



MAGNADYNE® 1111 West Victoria Street
Compton, CA 90220

www.magnadyne.com

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For Technical Assistance, please call (800) 638-3600

RVTV-X2-IMUM Rev. A 1-7-13



Models: RVTV-B2 (Black)
RVTV-W2 (White)

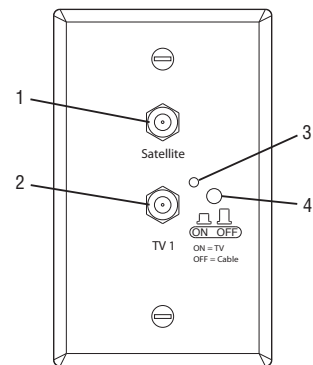
Operating Instructions

Distribution Wall Plate Features

Features:

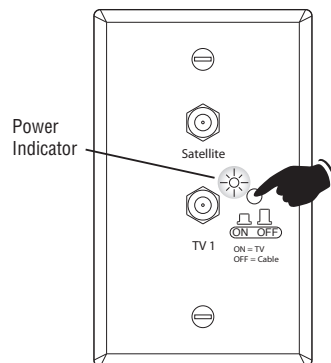
- Compatible with HDTV.
- Built-in high gain and low noise amplifier, shielded for minimum interference.
- Omnidirectional antenna receives VHF, UHF and AM/FM signal from every point regardless of the direction you are traveling.
- Amplifier with SMD technology and micro-electronics ensures excellent antenna performance.
- Waterproof antenna made of UV resistant ASA material.

- 1. Satellite Antenna Output Connector:** Use a cable to connect to a TV to receive a satellite signal.
Note: A satellite antenna must be connected to the vehicle.
- 2. TV 1 or Cable Output Connector.** Use a cable to connect to a TV to receive either TV antenna or cable reception.
- 3. TV Antenna Power Indicator.** When lit indicates TV reception. When off indicates cable reception.
- 4. TV Reception or Cable Selector Switch.** Press this button to choose from TV or cable reception.
Note: Every TV (TV 1, TV 2 and TV 3) connected to the wall distribution plate will be switch when a selection is made, either TV or cable.



Selecting TV Antenna Reception

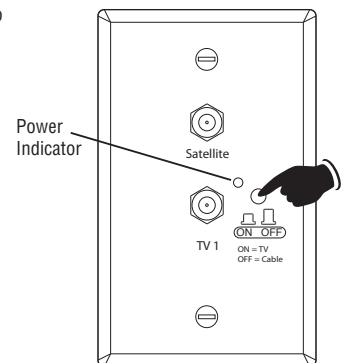
To receive TV antenna reception press the On/Off switch so the power indicator is lit.

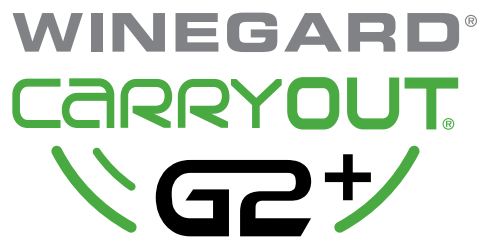


Selecting Cable TV

To receive cable TV press the On/Off switch so the power indicator is off.

Note: The vehicle must be connected to an external cable source.





Instruction Manual



DO NOT RETURN ANTENNA TO PLACE OF PURCHASE



POWER INSERTER

See page 2 for setup instructions



Specifications

Compatible with DIRECTV®, DISH®, & Bell TV™ programming
 Supports up to two receivers
 For stationary use only
 Includes 25' coaxial cable, 3' coaxial cable, and power inserter
 Unit weight: 10 lbs
 Unit height (no feet): 13.5"



Diameter: 14.3"
 Elevation range: 18–65°
 Azimuth: 0–416°
 UV-protected plastic dome

NOTE Operating temperature specifications: -25° to 70° C (-13° to 158°F)

Compatible Receivers

Receiver models change frequently.

DIRECTV Receiver Compatibility

The Carryout G2+ antenna is not compatible with DIRECTV SWM-only receivers (e.g. H25 or HR34). If you have a SWM-only technology receiver, Winegard Model SWM-840 kit is available. This SWM kit will allow for proper SWM technology operation with Winegard mobile satellite TV antennas.

DISH Receiver Compatibility

Operation may require an HD receiver. The antenna is not compatible with DISH Hopper™ or Joey™ receivers. Dual tuner receivers will require two coax connections from the antenna. In order to simultaneously watch or record two different programs, each program must be broadcast from the same satellite.

Compatible Satellites

DIRECTV: 101° or 119° (will not receive HD on 110° or any KA-band HD on 99° and 103°)

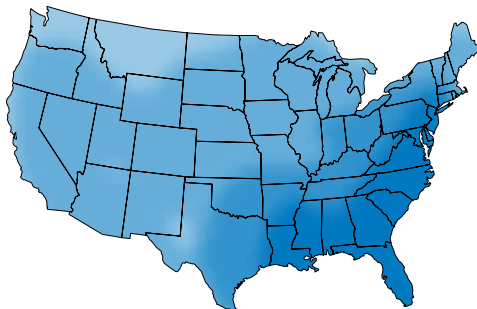
DISH (Western Arc): 110°, 119°, 129°

Bell TV: 91° or 82°

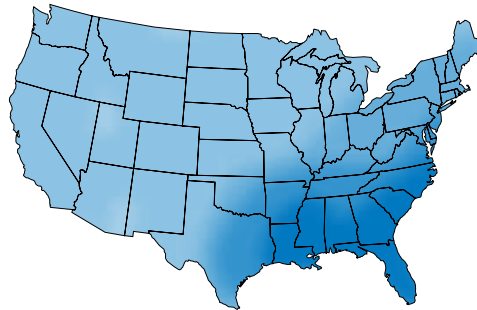
Refer to maps* to determine coverage in areas of the U.S.

Good **Signal Strength** Best

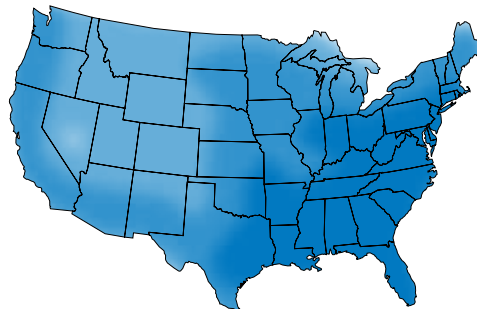
DIRECTV Sat. 101°



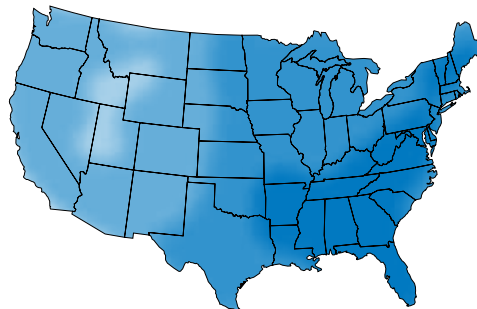
DIRECTV Sat. 119°



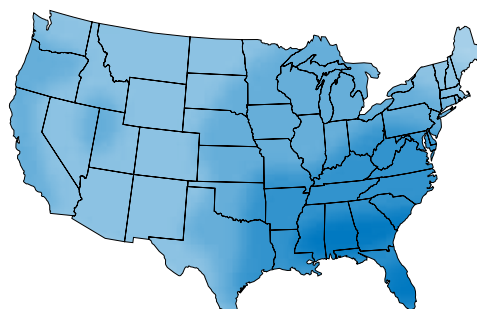
DISH Sat. 110°



DISH Sat. 119°



DISH Sat. 129°





WINEGARD CARRYOUT G2+ SATELLITE ANTENNA

Warnings

- ⚠ Do not place the unit in water greater than one inch deep, or water may damage the electronics.
- ⚠ Do not install or operate the antenna in winds of 35 mph or greater. The antenna will roll in winds ≥ 35 mph.
- ⚠ Care should be taken when transporting and setting up the antenna. Do not toss or drop the antenna.
- ⚠ Do not paint the antenna. Painting the antenna may cause signal degradation and will void your warranty.

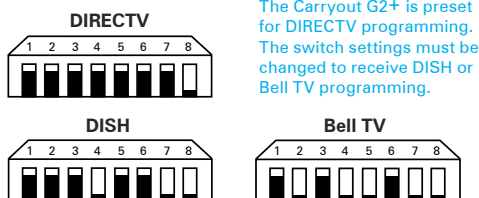
1. Switch Settings

The Carryout G2+ antenna switch settings are located on the Winegard Power Inserter and are preset for DIRECTV programming.



To set the antenna for any other programming provider, locate the switches on the Power Inserter and set according to the diagram below:

Switch Settings—Up () or Down ()



2. Installing the Handle

1. Locate the two screws for the handle in the base. Remove the screws from the base with a Phillips screwdriver.



NOTE The two holes for the handle are located between the cable connections and eyelet.

2. Locate the handle in the box. With "WINEGARD" on the handle facing upwards, align the two holes in the handle with the two holes in the base.
3. Thread two screws through the two aligned holes in the bottom of the handle.
4. Tighten the two screws using a Phillips screwdriver. Do not overtighten.

Carryout G2+ Antenna

3. Choosing a Location

1. Choose a location with a clear, unobstructed view of the southern sky. Avoid obstructions such as trees, hills, vehicles, or buildings—these can block the signal from the satellite.

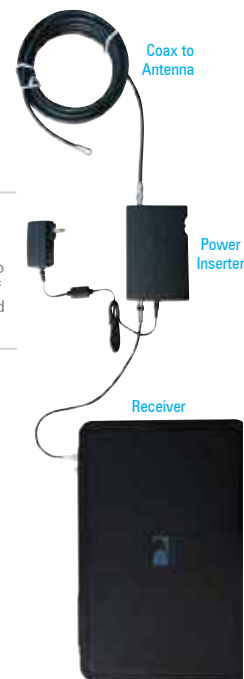
NOTE Satellite signal will not pass through solid objects. For this reason, it is vital to select a location with a clear, unobstructed view of the southern sky.

2. Make sure the antenna is not placed in the path of people or vehicles; otherwise, the antenna may be knocked off of the signal if run into, or cables may be disconnected from the unit.
3. Select a location that will enable the Carryout G2+ antenna to sit within three degrees of level. The antenna may take longer to lock onto signal if the antenna is not level.

4. Wiring the Antenna

TIP Run the coaxial cable directly from the satellite receiver to the Carryout G2+ antenna when searching for signal.

1. Ensure the power button on the Winegard Power Inserter is in the OFF position (not pressed in).
2. Connect the included 25' coaxial cable between the primary port of the Carryout G2+ and the ANTENNA port on the Power Inserter. Tighten coax connections until finger tight, and tighten a quarter turn more with a wrench. Do not overtighten.



NOTE A 25' coaxial cable is included with the antenna. To ensure proper operation, use only the included coaxial cable. Failure to use the included coax cable or use of the interior/exterior pre-wiring could hinder proper operation.

3. Connect the included 3' coaxial cable between the "SAT IN" port of your satellite receiver and the RECEIVER port of the Winegard Power Inserter. Tighten coax connections until finger tight, and tighten a quarter turn more with a wrench. Do not overtighten.
4. Plug power adapter into 110/120VAC outlet and connect to power port on Power Inserter (located next to RECEIVER coax port).
5. Once system is fully connected, press the power button on the Power Inserter.
6. Give the Carryout G2+ antenna approximately 3-5 minutes to complete the search sequence. Once the Carryout G2+ antenna has gone completely quiet, proceed to configure receiver for desired operation. For DIRECTV, see page 3. For DISH, see page 4.



5. Receiver Setup

Connect the receiver to a power source, and complete receiver setup. Receiver setup for the primary receiver follows; if your receiver differs from the options shown, you may need to consult your receiver manual. The wording and display used in your receiver may differ slightly.

DIRECTV Receiver Setup



1. Press **Menu** on your remote. Select **Parental, Fav's & Setup**.



2. Select **System Setup**.



3. In your receiver menu, you will need to identify the Satellite menu. Once there, find the option for **Satellite Setup**.



4. You may be required to press the **DASH (-)** before proceeding (underneath #7 on the remote).

3 Receiver setup instructions are accurate at time of printing and may change without notice.

5. Select **3-LNB (18"x 20")** or **3 Satellites**. If given the option of **SWM** or **Multiswitch**, select **Multiswitch**.



6. Power on the antenna, and allow the antenna a few minutes to acquire signal. Once the antenna has finished acquiring signal, the antenna will be silent.

7. After the antenna has acquired signal, press **Continue**; the receiver will automatically verify the setup.



8. Errors may be displayed on the screen. It is normal to see one or two boxes with an **X** instead of a **✓**. Select **Continue**.



9. Select **Continue** again. The program guide will download.
10. When the status bar reaches 100%, press **Continue**.
11. The receiver will run Data Feed and Guide Feed Tests for a few moments.
12. When prompted to set up the remote, select **Setup Remote Later** to do this at a later time.
13. Select **Watch DIRECTV**. Receiver setup is now complete.

Carryout G2+ Antenna



WINEGARD CARRYOUT G2+ SATELLITE ANTENNA

DISH Receiver Setup



If using two DISH receivers with the Carryout G2+ antenna, both receivers must be configured off of the primary port by following the steps below.

1. Disconnect coax cable from the Satellite In port on the back of the receiver.

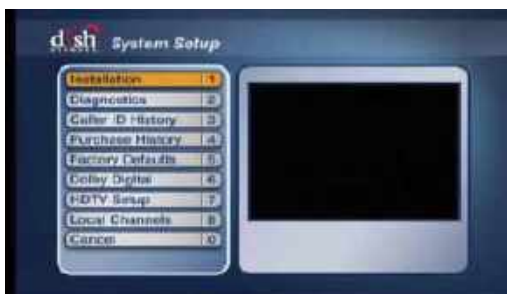


Back of 211z receiver shown

2. Press **Menu** on your remote. Select option 6, **System Setup**.



3. Select option 1, **Installation**.



4. Select option 1, **Point Dish**.



5. Select **Check Switch**.



6. Select **Test**. It will go through a number of steps, then return to the screen shown here with previous information cleared. If at any point it asks you to save, select **Save** or **Yes**.



7. Reconnect coax cable to "Sat In" port on back of receiver. Power on the antenna. Allow the antenna 3-4 minutes to acquire satellites.

8. Check that there are no check marks by SuperDISH or Alternate. If setting up a DISH 311, 301, or 500 series receiver, in some cases you may need to check the boxes next to SuperDish and Alternate before running the Check Switch test.

9. Next, select **Test** again to install the SW64 switch. This SW64 switch is a DISH receiver setting, not a physical part.



10. When you see the SW64 as the installed switch, the antenna is ready for use.



Troubleshooting

Issue	Possible Cause	Solution
Vin indicator unlit on power inserter	<ul style="list-style-type: none"> No DC power into power inserter 	<ul style="list-style-type: none"> Ensure power adapter is plugged into outlet and that outlet is providing AC power Ensure power adapter is connected to power inserter
Receiver indicator unlit on power inserter	<ul style="list-style-type: none"> No communication between receiver and power inserter 	<ul style="list-style-type: none"> Ensure 3' coaxial cable between receiver and power inserter's RECEIVER port is properly connected For DIRECTV users, ensure receiver is compatible and configured correctly. See page 3 for configuration instructions If cable is connected and receiver is properly configured, try different piece of RG6 coaxial cable
Receiver indicator faintly lit or flickering on power inserter	<ul style="list-style-type: none"> Intermittent communication between receiver and power inserter 	<ul style="list-style-type: none"> Replace 3' coaxial cable piece with a different piece RG6 coaxial cable
Antenna indicator unlit on power inserter	<ul style="list-style-type: none"> No communication between power inserter and Carryout G2+ antenna 	<ul style="list-style-type: none"> Ensure included 25' coaxial cable is being used and is properly connected between power inserter's ANTENNA port and Carryout G2+ PRIMARY port Ensure power button on power inserter pushed in ON position Replace 25' coaxial cable with different RG6 coaxial cable
Antenna indicator faintly lit or flickering on power inserter	<ul style="list-style-type: none"> Intermittent communication between power inserter and Carryout G2+ 	<ul style="list-style-type: none"> Ensure included 25' cable is being used and is properly connected between power inserter ANTENNA port and Carryout G2+ PRIMARY port Replace 25' coaxial cable with a different RG6 coaxial cable
The antenna continuously searches and eventually stops without ever acquiring any satellites.	<ul style="list-style-type: none"> Possible obstructions are blocking signal from the satellite 	<ul style="list-style-type: none"> Check to see if the southern sky is clear. Trees, buildings, large signs, or an overpass can block the signal Rain, snow, or excessive dew on the dome can interrupt the signal. Brush any snow or dew off of the dome. If heavy rain or snowfall is blocking the signal, it may be necessary to wait until the weather clears.
The antenna appears to lock onto signal, but my receiver does not show a picture or signal reading	<ul style="list-style-type: none"> Receiver improperly configured for the Carryout G2+ antenna 	<ul style="list-style-type: none"> Verify the switch settings are set correctly for the desired provider. See switch settings on page 2 Reconfigure the receiver according to steps on page 3 or 4
I have switched satellite service providers, and the antenna is no longer working properly	<ul style="list-style-type: none"> Switches are not set for the correct provider 	<ul style="list-style-type: none"> Set the switches to the correct programming provider. See switch settings on page 2

FCC Guidelines

Changes or modifications not expressly approved by Winegard could void your authority to operate the equipment.

NOTE This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.



Using Outside Receptacle

If your outside TV receptacle is wired for satellite, you'll need to locate where that receptacle leads and connect that directly to your satellite receiver.

If the outside TV receptacle is wired for cable, the wiring will have to be modified for use with satellite. The coaxial cable cannot run through any other devices or switches before the satellite receiver.

Typically, if wired for cable, the wiring will either run through a Winegard power supply or video switch. The easiest way to fix this is to disconnect the cable from that device, use a barrel connector, and connect a new cable that runs directly to the receiver, bypassing the power supply or video switch.



Transporting & Maintenance

Before transporting the antenna, disconnect all coaxial cabling from antenna and power inserter. Unplug power adapter from outlet.

The Carryout G2+ antenna is designed to be maintenance free. However, it is a good idea to periodically clean the dome with a soft cloth, water, and dish soap.

Optional Accessories

MT-4000 Ladder Mount

Permanent or temporary mount for RV with quick disconnect. Creates all the benefits of an ultra low profile roof mounted antenna plus quick and easy portability.



RK-2000 Roof Mount Kit

Permanently mount the Carryout G2+ antenna to your vehicle roof. No need to buy another antenna to replace your portable.



TR-1518 Tripod Mount

The tripod mount has adjustable height and leveling settings of 14.5"– 22" and quickly disassembles for compact storage.



MT-SM30 Window Mount

Temporary mount with maximum flexibility. Easy one time assembly. Includes 2 brackets for temporary side mount opt.



For more information or to purchase accessories contact your local RV dealer or winegard.com



Carryout G2+ Antenna



WINEGARD MOBILE PRODUCTS LIMITED WARRANTY (2 YEARS PARTS; 1 YEAR LABOR)

Winegard Company warrants this product against defects in materials or workmanship for a period of two (2) years from the date of original purchase. During year one (1) of such warranty, Winegard Company will also pay authorized labor costs to an authorized Winegard dealer to repair or replace defective products. No warranty claim will be honored unless at the time the claim is made, Customer presents proof of purchase to an authorized Winegard dealer (to locate the nearest authorized Winegard dealer).

Customer must provide proof of purchase with a dated sales receipt for the Winegard product to verify the product is under warranty. If the date of purchase cannot be verified, the warranty period shall be considered to begin thirty (30) days after the date of manufacture.

If a defect in material or workmanship is discovered, Customer may take the product to an authorized Winegard dealer for service. Customer must provide proof of purchase to verify the product is under warranty. If the product is brought to an authorized Winegard dealer for service prior to expiration of year one (1) of the warranty period and a defect in material or workmanship is verified by Winegard Technical Services, Winegard Company will cover the Winegard dealer's labor charges for warranty service. The Winegard dealer must contact Winegard Technical Services in advance for pre-approval of the service. Approval of the service is at the sole discretion of Winegard Company.

Alternatively, Customer may ship the product prepaid to Winegard Technical Services.

Customer must return the product along with a brief description of the problem and provide Winegard Technical Services with Customer's name, address, and phone number. Customer must also provide proof of purchase to verify the product is under warranty. If the product is returned before the expiration of the warranty period, Winegard Company will (at its option) either repair or replace the product.

This Limited Warranty does not apply if the product has been damaged, deteriorates, malfunctions or fails from: improper installation, misuse, abuse, neglect, accident, tampering, modification of the product as originally manufactured by Winegard in any manner whatsoever, removing or defacing any serial number, usage not in accordance with product instructions or acts of nature such as damage caused by wind, lightning, ice or corrosive environments such as salt spray and acid rain. This Limited Warranty also does not apply if the product becomes unable to perform its intended function in any way as a result of the television signal provider making any changes in technology or service.

RETURN AUTHORIZATION POLICY

A Return Material Authorization (RMA) is required prior to returning any product to Winegard Company or Winegard Warranty Services under this warranty policy. Please call our Technical Services Department

to obtain the RMA number. Please furnish the date of purchase when requesting an RMA number.

Enclose the product in a prepaid package and write the RMA number in large, clear letters on the outside of the package. To avoid confusion or misunderstanding, a shipment(s) without an RMA number(s) or an unauthorized return(s) will be refused and returned to Customer freight collect.

WINEGARD COMPANY DOES NOT ASSUME ANY LIABILITIES FOR ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, MADE BY ANY OTHER PERSON.

ALL OTHER WARRANTIES WHETHER EXPRESS, IMPLIED OR STATUTORY INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY ARE LIMITED TO THE TWO YEAR PERIOD OF THIS WARRANTY.

In states that do not allow limitations on implied warranties, or the exclusion of limitation of incidental or consequential damages, the above limitations or exclusions do not apply.

Some states do not allow limitations on how long an implied warranty lasts, or the exclusion of limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives Customer specific legal rights. Customer may also have other rights that may vary from state to state.

SATELLITE RECEIVER WARRANTY

See manufacturer's limited warranty policy.

WS-MOBWARREV3

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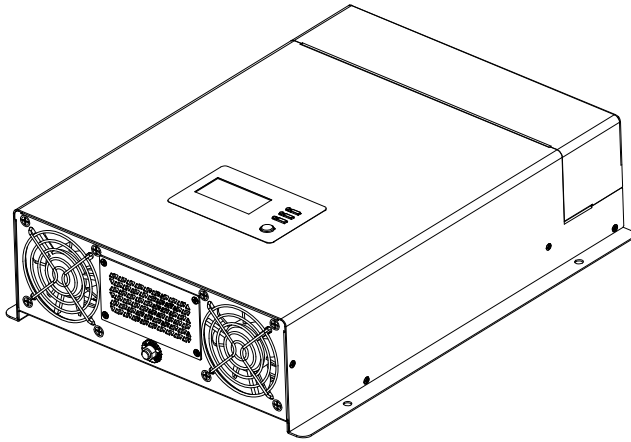
DISH is a registered trademark of DISH Network L.L.C. DIRECTV is a registered trademark of DIRECTV, LLC. Bell TV is a registered trademark of Bell Canada, Inc.

Disclaimer: Although every effort has been made to ensure that the information in this manual is correct and complete, no company shall be held liable for any errors or omissions in this manual. Information provided in this manual was accurate at time of printing. If the antenna does not function as expected



Smart choice for power™

xantrex™



Owner's Guide

Freedom XC Series Inverter Charger

Product Part Numbers
817-1050
817-2080



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 (C) REMINDS YOU THAT IF THIS MANUAL IS IN ANY LANGUAGE OTHER THAN ENGLISH, ALTHOUGH STEPS HAVE BEEN TAKEN TO MAINTAIN THE ACCURACY OF THE TRANSLATION, THE ACCURACY CANNOT BE GUARANTEED. APPROVED CONTENT IS CONTAINED WITH THE ENGLISH LANGUAGE VERSION WHICH IS POSTED AT [HTTP://WWW.XANTREX.COM](http://www.xantrex.com).

Document Part Number

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Date and Revision

June 2017 Rev A

Product Part Number

817-1050 (Freedom XC 1000 120VAC)
 817-2080 (Freedom XC 2000 120VAC)

Contact Information

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 +1 408 987 6030
 Email: customerservice@xantrex.com
 Web: <http://www.xantrex.com>

Information About Your System

As soon as you open your product, record the following information and be sure to keep your proof of purchase.

Serial Number _____
 Product Number _____
 Purchased From _____
 Purchase Date _____

To view, download, or print the latest revision, visit the website shown under Contact Information.

975-0784-01-01

About This Guide

Purpose

The purpose of this Owner's Guide is to provide explanations and procedures for operating, maintaining, and troubleshooting a Freedom XC Series Inverter Charger for Recreational, Fleet Vehicle, or Marine installations.

Scope

The Guide provides safety and operating guidelines as well as information on installing and configuring the Inverter. It also provides information about troubleshooting the unit. It does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

Audience

The Guide is intended for users and operators as well as installers of the Freedom XC Series Inverter Charger.

Abbreviation or Acronym

A	Amps
AC	Alternating Current
DC	Direct Current
in-lbf	inch-pounds or pound-force (a unit of torque)
kW	Kilowatts (1000 watts)
LBCO	Low Battery Cutout (or Cutoff)
LED	Light Emitting Diode

N-m	Newton-meters (a unit of torque)
PV	Photovoltaic (Solar)
V	Volts
VAC	Volts AC
VDC	Volts DC
W	Watts

Related Information

You can find more information about Xantrex products and services at <http://www.xantrex.com>.

NOTE: The Installation section starting on page 9 is intended for qualified personnel. Qualified personnel have training, knowledge, and experience in:

- Installing electrical equipment (up to 1000 volts).
- Applying all applicable installation codes.
- Analyzing and reducing the hazards involved in performing electrical work.
- Selecting and using Personal Protective Equipment (PPE).



Important Safety Instructions

IMPORTANT: READ AND SAVE THIS OWNER'S GUIDE FOR FUTURE REFERENCE.

This guide contains important safety instructions for the Freedom XC Series Inverter Charger that must be followed during operation and troubleshooting. **Read and keep this Owner's Guide for future reference.**

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, can result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, can result in moderate or minor injury.

NOTICE

NOTICE indicates a potentially hazardous situation, which, if not avoided, can result in equipment damage.

Important: These notes describe things which are important for you to know, however, they are not as serious as a caution or warning.

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Safety Information

1. **Before using the Inverter, read all instructions and cautionary markings on the unit, the batteries, and all appropriate sections of this manual.**
2. Use of accessories not recommended or sold by the manufacturer may result in a risk of fire, electric shock, or injury to persons.
3. The inverter is designed to be connected to your AC and DC electrical systems. The manufacturer recommends that all wiring be done by a certified technician or electrician to ensure adherence to the local and national electrical codes applicable in your jurisdiction.
4. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the inverter with damaged or substandard wiring.
5. Do not operate the inverter if it has been damaged in any way.
6. This unit does not have any user-serviceable parts. Do not disassemble the inverter except where noted for connecting wiring and cabling. See your warranty for instructions on obtaining service. Attempting to service the unit yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
7. To reduce the risk of electrical shock, disconnect both AC and DC power from the inverter before attempting any maintenance or cleaning or working on any components connected to the inverter. Turning off the Inverter using the Power button on the front panel will not reduce an electrical shock hazard.
8. The inverter must be provided with an equipment-grounding conductor connected to the AC input ground.
9. Do not expose this unit to rain, snow, or liquids of any type. This product is designed for indoor use only. Damp environments will significantly shorten the life of this product and corrosion caused by dampness will not be covered by the product warranty.
10. To reduce the chance of short-circuits, always use insulated tools when installing or working with this equipment.
11. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with electrical equipment.

DANGER

ELECTRICAL SHOCK AND FIRE HAZARD

Installation must be done by qualified personnel to ensure compliance with all applicable installation and electrical codes and regulations. Instructions for installing the Freedom XC Series Inverter Charger are provided here for use by qualified personnel only.

Failure to follow these instructions will result in death or serious injury.

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⚠️ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠️ WARNING

FIRE AND EXPLOSION HAZARD

- Unit's components may produce arcs or sparks.
- Do not install near batteries, in machinery space, or in an area in which ignition-protected equipment is required.

Failure to follow these instructions can result in death or serious injury.

Areas include any space containing gasoline-powered machinery, fuel tanks, as well as joints, fittings, or other connections between components of the fuel system.

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⚠️ CAUTION

ELECTRICAL SHOCK AND FIRE HAZARD

- Do not open. No serviceable parts inside. Provided with integral protection against overloads. Bonding between conduit connections is not automatic and must be provided as part of the installation.
- Read manual before installing or using.
- Do not cover or obstruct ventilation openings.
- Do not mount in zero-clearance compartment – overheating may result.
- Do not expose to rain or spray. This inverter is designed for marine applications only when additional drip protection is installed in certain orientations. See “Approved Mounting Orientations” on the Installation Guide for more information.
- Install GFCIs only as specified in this manual. Other types may fail to operate.
- Do not connect AC OUT to any other source of power. Damage to unit may occur.
- For AC IN and AC OUT, use wires suitable for at least 75°C.

Failure to follow these instructions can result in minor or moderate injury.

NOTES:

1. Follow these instructions and those published by the battery manufacturer and the manufacturer of any equipment you intend to use in the vicinity of the battery. Review cautionary markings on these products and on the engine.

2. Freedom XC inverter products are designed for deep cycle lead-acid batteries. See warning below when connecting to lithium ion batteries.
3. Do not use transformerless battery chargers in conjunction with the inverter due to overheating.

⚠️ WARNING

LITHIUM_ION BATTERY TYPE HAZARD

Make sure to use a lithium ion battery pack that includes a Battery Management System (BMS) with built-in safety protocols. Follow the instructions published by the battery manufacturer.

Failure to follow these instructions can result in property damage, death or serious injury.

⚠️ CAUTION

PHYSICAL INJURY HAZARD

This Freedom XC Series Inverter Charger is not intended for use by persons (including children) with reduced physical, sensory, or mental capabilities or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

Failure to follow these instructions can result in minor or moderate injury.



Precautions When Working With Batteries

Important: Battery work and maintenance must be done by qualified personnel knowledgeable about batteries to ensure compliance with battery handling and maintenance safety precautions.

⚠ WARNING
BURN FROM HIGH SHORT-CIRCUIT CURRENT, FIRE AND EXPLOSION FROM VENTED GASES HAZARDS
<ul style="list-style-type: none"> • Always wear proper, non-absorbent gloves, complete eye protection, and clothing protection. Avoid touching your eyes and wiping your forehead while working near batteries. See note #4. • Remove all personal metal items, like rings, bracelets, and watches when working with batteries. See notes #5 and #6 below. • Never smoke or allow a spark or flame near the engine or batteries. <p>Failure to follow these instructions can result in death or serious injury.</p>

NOTES:

1. Mount and place the Freedom XC Series Inverter Charger unit away from batteries in a well ventilated compartment.
2. Always have someone within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
3. Always have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with running cold water for at least twenty minutes and have someone within range of your voice or close enough to get medical attention immediately.

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Precautions When Placing the Inverter

⚠ WARNING
FIRE HAZARD
Do not install the inverter or any part of its supplied wiring in engine compartments.
Failure to follow these instructions can result in death or serious injury.

⚠ CAUTION
BURN HAZARD
Avoid touching the external surfaces - heatsink may be hot.
Failure to follow these instructions can result in minor or moderate injury.

NOTICE
RISK OF DAMAGE TO THE INVERTER
<ul style="list-style-type: none"> • Never allow battery acid to drip on the inverter when reading gravity, or filling battery. • Never place the Freedom XC Series Inverter Charger unit directly above batteries; gases from a battery will corrode and damage the inverter. • Do not place a battery on top of the inverter. <p>Failure to follow these instructions can damage the unit and/or equipment.</p>

5. Use extra caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion. Use tools with insulated handles only.
6. Batteries can produce a short circuit current high enough to weld a ring or metal bracelet or the like to the battery terminal, causing a severe burn.
7. When removing a battery, always remove the negative terminal from the battery first for systems with grounded negative. If it is grounded positive, remove the positive terminal first. Make sure all loads connected to the battery and all accessories are off so you don't cause an arc.

Regulatory

The Freedom XC Series Inverter Charger is certified to appropriate US and Canadian standards. For more information see "Regulatory Approvals" on page 73.

The Freedom XC Series Inverter Charger is intended to be used for mobile or commercial applications. This Inverter is designed for marine applications only when additional drip protection is installed in certain orientations. See the section on Specifications for information.



FCC Information to the User

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

⚠ CAUTION
Unauthorized changes or modifications to the equipment could void the user's authority to operate the equipment.



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Introduction

The Freedom XC Series Inverter Charger (Freedom XC) is designed with integrated inverting functions and power management features suitable for marine, recreational, and commercial vehicle installations.

Please read this chapter to familiarize yourself with the main performance and protection features of the Freedom XC.

Materials List

The Freedom XC base package includes the following items:

- one Freedom XC unit
- one Owner’s Guide and extra safety labels
- one pre-installed ground lug(not shown)
- one set of plastic bushings for large DC cables^a (not shown)

NOTE: If any of the items are missing, contact Xantrex or any authorized Xantrex dealer for replacement. See “Contact Information” on page i.

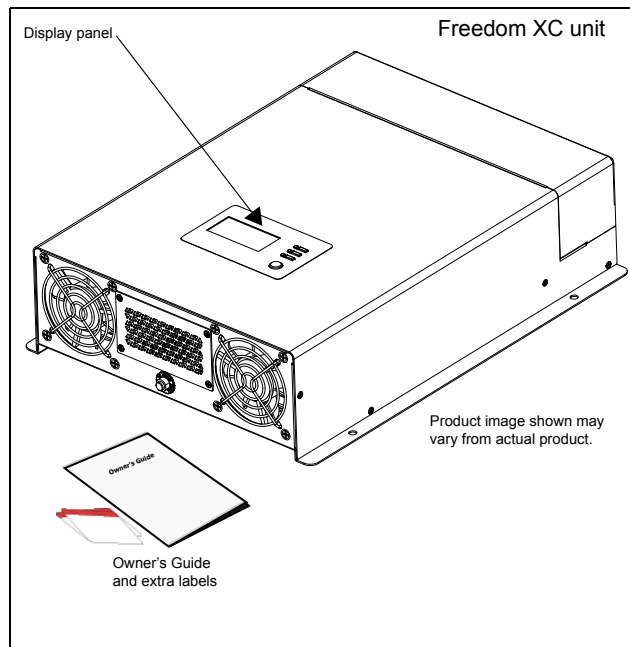


Figure 1 What's In The Box

^a.Available only to XC 2000 model.

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Introduction

Key Features

Power for Most Appliances The Freedom XC inverter/charger provides up to 1000 watts (Freedom XC 1000) or 2000 watts (Freedom XC 2000) of continuous utility grade, sine wave power derived from a battery bank. It is designed to handle loads such as microwave ovens, TVs, DVD/Blu-ray players, and power tools. In addition, the Freedom XC’s high-surge capability lets you handle many hard-to-start loads, including full size residential refrigerators.

The built-in transfer switch automatically transfers between inverter power and shore power from recreational facilities such as boat docks or campsites to ensure power is always available.

Back-up Capability If incoming shore power is interrupted by external events like brownouts, the Freedom XC automatically becomes an independent power source^a that supplies utility grade AC power to your loads.

Comprehensive Protection The Freedom XC’s built-in protection features safeguard your batteries (from unnecessary drain) such as the low battery voltage alarm and shutdown and protect equipment such as a configurable AC transfer speed.

- **Selectable Low Battery Shutdown:** The low battery shutdown for the inverter/charger can be manually selected by the user from 10.5 to 12.8 VDC.

- **Low Voltage Shutdown Delay Timer:** Configurable from 1 to 300 seconds to reduce an unnecessary shutdown of inverter operation such as during cranking or other brief but heavy discharge of battery.
- **Inverter Power Save:** The Freedom XC can be programmed to automatically turn off after 1 to 25 hours of continued operation of loads that are under 50 watts. It is designed, with LBCO (low battery cut off), to prevent the battery from deep discharge.

Configurable AC Transfer Speed The Freedom XC allows two speed settings for the AC transfer from Grid Mode to Battery Mode and vice versa which avoids nuisance resetting of appliances. The normal transfer rate is for common appliances and the faster transfer rate is designed for more sensitive digital equipment like a desktop computer.

Overload Alarm and Shutdown During Battery Mode (also called Inverter Mode), the Freedom XC automatically alerts you if the loads that are connected and drawing power from the unit are close to approaching the maximum operating limit. If so, the Freedom XC automatically shuts down when the maximum operating limit is exceeded. See page 66 for precautions.

^a.Assuming the inverter/charger is connected to a battery source with an adequate charge at the time of the power interruption.

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Freedom XC Owner's Guide



Over temperature Alarm and Shutdown During Battery Mode, the Freedom XC automatically alerts you if it is overheating and approaching the over-temperature shutdown limit. The Freedom XC automatically shuts down when the limit is exceeded. See page 66 for precautions.

Built-in Charge Formulas For the inverter to perform at the highest level, the batteries must be charged correctly. The Freedom XC has optimized algorithms for flooded, gel, and AGM batteries.

Manual Equalization Over a period of time, the cells in a flooded battery can develop uneven chemical states. This can result in a weak (undercharged) cell which, in turn, can reduce the overall capacity of the battery. To improve the life and performance of a non-sealed, flooded battery, the Freedom XC multi-stage charging cycle includes a manual equalize mode that can be used, if recommended by the battery manufacturer.

Dead Battery Charging Another feature of the Freedom XC is dead battery charging. This is the ability to recharge batteries, even if the battery voltage has reached zero volts.

Ignition Control The Freedom XC provides two user-selectable options for ignition control:

- **Ignition Auto-on:** The Freedom XC can automatically turn the inverter on and off in tandem with the vehicle's ignition circuit or a manually operated remote switch.

- **Ignition Lockout:** The Freedom XC features the ability to inhibit the inverter from operating in the absence of a voltage signal from a vehicle's ignition circuit. This is particularly useful if the inverter is required to operate only when a vehicle's engine is running.

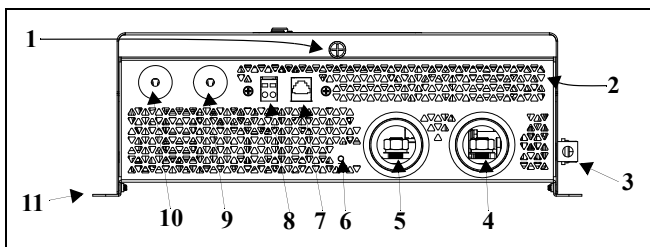
Configurable AC Output Frequency and Voltage The Freedom XC is factory set to 60 Hz AC output frequency. It can be configured to 50 Hz for use in regions outside the USA and Canada. The AC voltage setting can also be configured to either of three settings: 108, 110, or 120 volts.

Load Management The Freedom XC has a built-in 30A transfer relay that connects the inverter output or AC input from the AC generator to the loads. Because the usual AC power sources such as small generators often have limited current availability, having the capability to manage your AC loads is extremely valuable. The Freedom XC provides a number of features to facilitate 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 has a power share feature which prioritizes your AC loads by reducing the charge current and maintaining the total input current to less than the breaker setting.

Features

AC and DC Panel

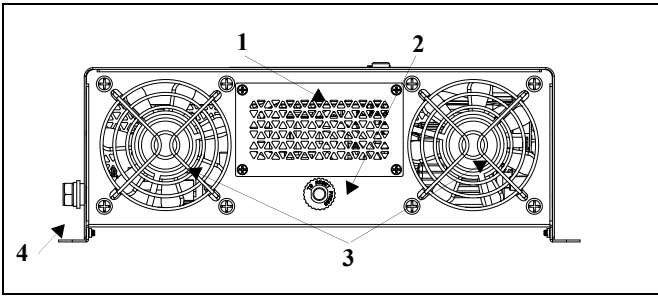


Feature	Description
1	Captive nut panel screw holds the AC compartment cover in place.
2	Ventilation grille (openings) must not be obstructed.
3	Grounding stud with attached nut provides a ground path for the Freedom XC chassis to the DC system ground.
4	DC output opening for routing (-) negative DC cable.
5	DC output opening for routing (+) positive DC cable.
6	LED indicator for reverse DC polarity.

Feature	Description
7	Remote port allows you to connect an accessory remote control device.
8	ACC input terminal for connecting ignition control wiring. Ignition Control Switch (ACC) for connecting [ON (I)] and disconnecting [OFF (O)] the ignition signal.
9	AC output knockout can be removed for routing AC output wiring.
10	AC input knockout can be removed for routing AC input wiring.
11	Mounting flanges on both sides allow you to mount the inverter/charger permanently on deck or on a wall.



GFCI Panel



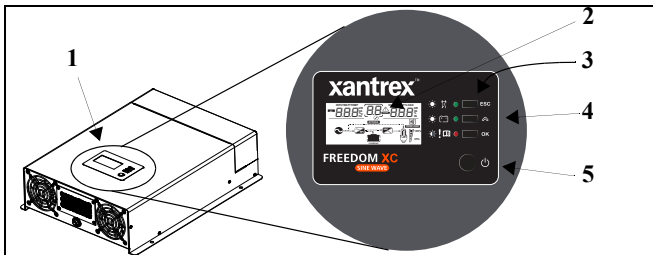
Feature	Description
1	GFCI cover is removed when installing a GFCI outlet. Location of GFCI receptacles.
2	20 A supplementary protector with reset button provides overload protection for the Freedom XC GFCI kit (PN: 808-9817). Press to recover from an overload condition. In a hard wired installation, the supplementary protector does not protect output wiring.
3	Ventilation grille (openings) must not be obstructed for the proper operation of the cooling fan and inverter/charger. When the inverter/charger is mounted, the ventilation grille must not point up or down. Cooling fans turn on when the internal temperature reaches a set point temperature.
4	Grounding lug provides a ground path for the Freedom XC chassis to the DC system ground.

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Features

Display Panel

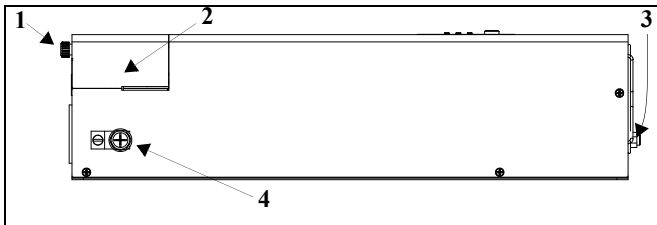


Feature	Description
1	Display panel displays status information on the screen. It is comprised of a display screen, LEDs, select and power buttons.
2	Multi-function LCD screen shows status information and error codes.
3	Status LEDs indicate the mode of operation.
4	Three function buttons change status information displayed on the screen. Also, changes inverter/charger settings.
5	Power button is pressed for turning on the unit. The inverter turns on for the loads and when applicable, the charger turns on automatically.
IMPORTANT: See “Freedom XC Display Panel” on page 39 for detailed information on the panel’s buttons.	

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Side Panel



Feature	Description
1	Captive nut panel screw holds the wiring compartment cover in place.
2	Wiring compartment cover protects the wiring compartment from debris and keeps the cables secure. Using the captive nut panel screw, the cover can be opened and lifted out during wiring.
3	20 A supplementary protector provides overload protection for the GFCI receptacles. In a hard wired installation, the supplementary protector does not protect output wiring.
4	Grounding lug provides a ground path for the Freedom XC chassis to the DC system ground.




Safety Instructions

Before You Begin the Installation

Before beginning your installation:

- Read this entire Installation section so you can plan the installation from beginning to end.
- Assemble all the tools and materials you require for the installation.
- Review the Important Safety Instructions on page iii.
- Be aware of all safety and electrical codes which must be met.

 WARNING
ELECTRICAL SHOCK AND FIRE HAZARD
<ul style="list-style-type: none"> • All wiring should be done by qualified personnel to ensure compliance with all applicable installation codes and regulations. • Disconnect all AC and DC power sources. • Disable and secure all AC and DC disconnect devices and automatic generator starting devices.
Failure to follow these instructions can result in death or serious injury.

Installation Codes

Governing installation codes vary depending on the specific location and application of the installation. Some examples include the following:

- The U.S. National Electrical Code (NEC)
- The Canadian Electrical Code (CEC)
- The U.S. Code of Federal Regulations (CFRs)
- Canadian Standards Association (CSA) and the RV Industry Association (RVIA) for installations in RVs
- The American Boat and Yacht Council (ABYC) for Marine installations in the U.S.

It is the installer's responsibility to ensure that all applicable installation requirements are met.

This section for use by qualified personnel only.

Installation Tools and Materials

You will need the following to install the Freedom XC:

- Wire stripper
- Mounting (#2) screws or bolts
- #2 Phillips screwdriver
- 3mm slot long neck screwdriver for spring clamp AC terminals
- Wrench for DC terminals (1/2" or 13mm socket wrench)
- AC cable (that is, two-conductor-plus-ground cable), sized appropriately for load and application
- 1/2" Strain relief clamps (for the AC knockouts)
- Wire nuts or crimp connectors for AC wire and appropriate tools
- DC cable, sized appropriately for load and application
- Lugs for DC cables to fit 5/16" DC stud terminals as well as appropriate tools (like a crimping tool)
- AC and DC disconnects and over-current protective devices

Basic Installation Procedures

This section provides sample installation information as a guide for your installation. For your convenience, the overall procedure is divided into these main steps:

- ❑ Step 1: Designing the Installation on page 12
- ❑ Step 2: Choosing a Location for the Unit on page 17
- ❑ Step 3: Mounting the Unit on page 18
- ❑ Step 4: Connecting the AC Input Wires on page 20
- ❑ Step 5: Connecting AC Output to an Existing AC Circuit on page 24
- ❑ Step 6: Connecting the DC Cables on page 26
- ❑ Step 7: Connecting to a Remote Panel on page 32
- ❑ Step 8: Testing Your Installation on page 33

This section for use by qualified personnel only.

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Basic Installation Procedures

Step 1: Designing the Installation

Most Freedom XC installations share common components, and some of these are briefly described in Figure 1.

Figure 1 shows some components and their relationship to each other in a typical recreational vehicle or fleet vehicle installation. Also, see “Marine Installation” on page 35.

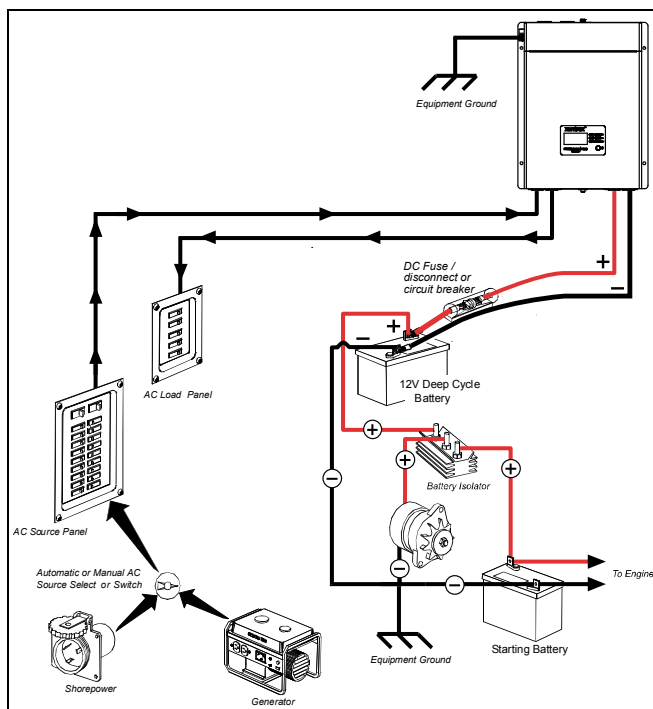


Figure 1 Typical Recreational Vehicle and Fleet Vehicle Installation

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Freedom XC Owner's Guide



AC Shore Power

A source of 120 volts AC 60Hz sine wave alternating current provides energy to pass power through to AC loads. This source is usually the utility grid (power company) or an AC generator. An automatic or manual AC source selector switch can be used to switch between the multiple sources of shore power to the Freedom XC system.

The AC source feeding the Freedom XC must have the neutral conductor bonded to ground. When the inverter passes shore power through, it will lift its internal bonding relay on the output and will rely on the input being bonded in order to ensure that the power delivered to a sub panel is properly bonded. See “AC Output Neutral Bonding” on page 15 for more information on bonding relay operation.

Important: Throughout this manual, the term “shore power” refers to AC input power from a utility grid, generator, or other AC source.

AC Disconnect and Over-Current Protection Device

Most safety requirements and electrical codes require the Freedom XC’s AC and DC inputs and outputs to be provided with over-current protection (such as circuit breakers or fuses) and disconnect devices.

AC Input: The circuit breaker or fuse (connected through hard wiring) that is used to supply the Freedom XC must be rated at no more than 30A and must be approved for use on 120 volts AC branch circuits. The wire used between the breaker and the Freedom

XC input must be sized adequately to carry current up to the rating of the input breaker and in accordance with the electrical codes or regulations applicable to your installation.

AC Output: The circuit breaker or fuse must be rated at no more than the rating of the input breaker in the installation and must be approved for use on 120 volts AC branch circuits. The wire used between the Freedom XC and the AC output breaker must be of adequate size to match the AC input circuit breaker’s rating. The wiring from each AC output breaker to each of the loads must be adequately sized to carry the current rating of the individual AC output breaker.

Disconnect Devices: Each system requires a method of disconnecting the AC circuits. If the over-current protection devices are circuit breakers, they will also serve as the disconnects. If fuses are used, separate AC disconnect switches will be needed ahead of the fuses. These will have to be a branch circuit rated for 120 volts AC and have an appropriate current rating.

This section for use by qualified personnel only.

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Basic Installation Procedures

AC Distribution Panels

Most systems incorporate distribution centers both ahead of the Freedom XC (the AC source panel) and between the Freedom XC and the loads (the AC load panel). An AC source panel includes a main circuit breaker, which serves as over-current protection and as a disconnect for the AC shore power supply line. Additional circuit breakers serve individual circuits, one of which serves the Freedom XC. The AC load panel can incorporate an AC output circuit breaker and breakers for individual load circuits.

NOTICE

RISK OF DAMAGE TO THE INVERTER

Do not connect the Freedom XC to a 120/240V, 3-pole, 4-wire circuit.
Failure to follow these instructions can damage the unit and/or equipment.

AC Cabling

AC cabling includes all the wires and connectors between the AC source and the Freedom XC, as well as all cabling between the Freedom XC and the AC output panels, circuit breakers, and loads. The type and size of the wiring varies with the installation and load. For example, in high vibration environments, such as marine or RV applications, wire nuts may not be acceptable, so crimp splices would be required. In other applications, flexible multiple-strand wire may be required. Installation codes usually specify solid or stranded, overall size of the conductors, and type and temperature rating of the insulation around the wire.

AC breakers and fuses must be sized to adequately protect the wiring that is installed on the input and output AC circuits of the Freedom XC. All breakers and wiring must be sized and connected in accordance with the electrical codes or regulations applicable to your installation. Table 1 gives some examples of wiring sizes based on the U.S. National Electrical Code and the Canadian Electrical Code. These examples are based on using a two-conductor-plus-ground cable rated at 75 °C, and assuming an ambient temperature of up to 30 °C. Ensure that your breakers and fuses have suitable temperature ratings for your wiring. Other codes and regulations may also be applicable to your installation.

Table 1 Required AC Wire Size vs Breaker Rating

Breaker Size (amps)	10A	15A	20A	30A
Minimum Wire Size	14AWG	14AWG	12AWG	10AWG



This section for use by qualified personnel only.

AC Output Neutral Bonding

The neutral conductor of the Freedom XC's AC output circuit (that is, AC Output Neutral) is automatically connected to the safety ground during inverter operation. When AC utility power is present this connection is not present, so that the utility neutral (that is, AC Input Neutral) is only connected to utility ground at your source. This conforms to the National Electrical Code (NEC), which 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 in only one place. Check the regulations for your specific application to ensure that the installation will comply with the necessary requirements. In other words, the AC Input Neutral and Output Neutral must be isolated from each other.

AC Grounding

As per UL458 SA29.5, for all permanently connected marine inverters: The Freedom XC should be connected to a grounded, metal, permanent wiring system. Also, make sure that an AC ground wire is connected to the AC ground terminal on the unit. Do not just connect the line and neutral wires.

All connections to the unit should comply with all local codes and ordinances.

DC Cabling

This includes all the cables and connectors between the batteries, the DC disconnect and over-current protection device, and the Freedom XC. Most mobile installations require multi-strand insulated cables for flexibility and durability in high vibration environments and require disconnects and over-current devices. Electrical wiring sizes in North America are indicated by AWG notation. In other parts of the world, the metric system is used. Under the AWG standard, a larger gauge number indicates a smaller wire diameter. Wire size is usually marked on the larger sized cables. Table 2 specifies the minimum recommended DC cable size and maximum fuse size for the Freedom XC. **The DC cables must be copper and must be rated 75 °C minimum.** The cables should be terminated with lugs that fit the DC stud terminals snugly (⁵/₁₆" hole size).

Table 2 Recommended Cable and Fuse Sizes

Inverter	Cable Length: Battery to Inverter (one way)	Minimum Cable Size	Maximum battery Fuse Size
Freedom XC 1000 120VAC	Less than 5 feet (1.5 meters)	No. 2 AWG	150 A DC
Freedom XC 2000 120VAC	Less than 5 feet (1.5 meters)	No. 2/0 AWG	250 A DC

NOTE: It is not recommended using a cable longer than 5 feet (1.5 meters) in each direction. North American cable sizes above are based on the US National Electrical Code Table 310.17 - 75 °C cables, assuming an ambient temperature of 30 °C cables.

Basic Installation Procedures

Important: Using the correct cable size is critical to achieving the rated performance of the Freedom XC unit. When starting a heavy load the Freedom XC can draw current surges from the battery of up to 400A. If the DC wiring is too small the voltage drop from this surge will result in a voltage at the Freedom XC terminals that is too low for the Freedom XC to operate correctly. The Freedom XC may appear to operate correctly with smaller cables until a heavy load such as a microwave or refrigerator attempts to start - then the unit may work correctly sometimes and not work correctly other times.

DC Disconnects and Over-Current Devices

The DC circuit from the battery to the Freedom XC must be equipped with a disconnect and over-current device. This usually consists of a circuit breaker, a "fused-disconnect", or a separate fuse and DC disconnect. Do not confuse AC circuit breakers with DC circuit breakers. They are not interchangeable. The rating of the fuse or breaker must be matched to the size of cables used in accordance with the applicable installation codes. The breaker or disconnect and fuse should be located as close as possible to the battery, in the positive cable. Applicable codes may limit how far the protection can be from the battery.

Batteries

The Freedom XC uses 12-volt battery banks. Every Freedom XC system is recommended to have a deep-cycle battery or group of batteries with a total capacity of 100 Ah or more which provides the DC current that the Freedom XC converts to AC.

Ground Fault Circuit Interrupters (GFCIs)

A GFCI is a device that de-energizes a circuit when a current to ground exceeds a specified value that is less than that required to blow the circuit breaker. GFCIs are intended to protect people from electric shocks and are usually required in wet or damp locations.

Installations in marine and recreational vehicles require GFCI protection of branch circuits connected to the AC output of the Freedom XC.

The following GFCI will work correctly with the Freedom XC whether installed on the AC panel or in the inverter's AC output distribution wiring system.

Make	Model
Eaton/Cooper	SGF20W



Step 2: Choosing a Location for the Unit

⚠ WARNING

FIRE AND EXPLOSION HAZARDS

- Do not install the Freedom XC in compartments containing batteries or flammable materials, or in locations that require ignition-protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connections between components of the fuel system. This equipment contains components that tend to produce arcs or sparks.
- Do not cover or obstruct the ventilation openings. Do not install the Freedom XC in a zero-clearance compartment. Overheating may result.

Failure to follow these instructions can result in death or serious injury.

The Freedom XC should only be installed in locations that meet the following requirements:

- ❑ **Dry.** Do not allow water or other fluids to drip or splash on the Freedom XC. **Do not mount the Freedom XC in an area subject to splashing water or bilge water.**
- ❑ **Cool.** Normal air temperature should be between -4 °F and 104 °F (-20 °C and 40 °C)—the cooler the better.
- ❑ **Ventilated.** Allow at least 5 inches of clearance at the DC end of the Freedom XC for air flow, 1 inch on each side, and 2

inches at the AC end. The more clearance for ventilation around the unit, the better the performance. Do not allow the ventilation openings on the ends of the unit to become obstructed.

- ❑ **Safe.** Do not install the Freedom XC in the same compartment as batteries or in any compartment capable of storing flammable liquids like gasoline.
- ❑ **Close to the battery compartment and the AC source and load panels.** Avoid excessive cable lengths (which reduce input and output power due to wire resistance). Use the recommended cable lengths and sizes, especially between the battery banks and the Freedom XC.
- ❑ **Protected from battery acid and gases.** Never allow battery acid to drip on the Freedom XC or its wiring when reading specific gravity or filling the battery. Also do not mount the unit where it will be exposed to gases produced by the batteries. These gases are very corrosive, and prolonged exposure will damage the Freedom XC.

This section for use by qualified personnel only.

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Basic Installation Procedures

Step 3: Mounting the Unit

To mount the Freedom XC:

1. Remove the Freedom XC from its shipping container, verify that all components are present, and record relevant product information on “Information About Your System” in the Owner’s Guide.
2. Select an appropriate mounting location and orientation. (See Figure 2 below.) To meet regulatory requirements, for use in on-land applications, the Freedom XC must be mounted in one of the following orientations:
 - Under a horizontal surface (see A)
 - In a horizontal position on a vertical surface (see B)

NOTE: For marine installations, only this orientation is allowed, due to the probability of moisture finding access into the enclosure.

- On a horizontal surface (see C)

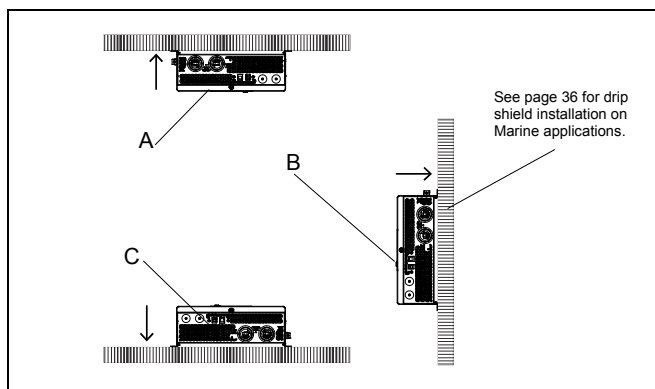


Figure 2 Approved Mounting Orientations

3. Mark the desired number of mounting holes on the wall by placing the unit on the wall.
4. Pilot-drill the mounting holes.
5. Fasten the Freedom XC to the mounting surface. If you are mounting the unit on a wall or bulkhead, use #12 or #14 pan-head wood or sheet metal screws to secure it to the framing behind the wall or bulkhead. Alternatively, use nut inserts and ¼"-20 machine screws.

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Freedom XC Owner's Guide



Connecting the Equipment Ground

⚠ WARNING

FIRE HAZARD

Never operate the Freedom XC without properly connecting the equipment ground. A fire hazard could result from improper grounding. **Failure to follow these instructions can result in death or serious injury.**

The Freedom XC has a ground lug on the side of the unit as shown in Figure 3. Follow the guidelines in “Grounding Locations” to connect the inverter’s chassis to the ground.

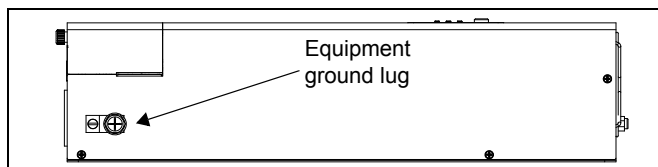


Figure 3 DC Panel Connections

Grounding Locations

You must connect the equipment ground lug to a grounding point—usually the vehicle’s chassis or DC negative bus ground—using recommended copper wire (if insulated then green insulation with or without one or more yellow stripes) or larger.

For recommended equipment ground cable size, see below.

Table 3 Recommended Equipment Ground Cable size

Application	Minimum equipment ground cable size (Stranded cable is recommended)
Recreational Vehicle ^a	No. 8 AWG
Marine ^b	No. 3 AWG (Freedom XC 1000) No. 1/0 AWG (Freedom XC 2000)

NOTE: There are no restrictions on length for the equipment ground cable.

- a. Based on US National Electrical Code NFPA70, Article 551, par. 551-20c.
- b. Based on ABYC E-11 11.18.

In general, the equipment ground cable size must not be smaller than one AWG size than the supply cable.

This section for use by qualified personnel only.

Step 4: Connecting the AC Input Wires

⚠ WARNING

FIRE, SHOCK, AND ENERGY HAZARDS

Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes. Do not connect the output terminals of the Freedom XC to any incoming AC source. **Failure to follow these instructions can result in death or serious injury.**

General AC Wiring Considerations

AC Wiring Connectors Where applicable, connect AC wires with crimp-on splice connectors. The amount of insulation you strip off individual wires will be specified by the connector manufacturer and is different for different types of connectors.

AC and DC Wiring Separation Do not mix AC and DC wiring in the same conduit or panel. Where DC and AC wires must cross, make sure they do so at 90° to one another. Consult applicable codes for details about DC and AC wiring in close proximity to each other.

AC wiring includes all the wires and connectors between the AC source and the Freedom XC and all wiring between the inverter, the AC panels, and circuit breakers. The type and size of the wiring varies with the installation and load. For some RV applications, flexible multiple-strand wire is required.

AC wiring must be sized appropriately to carry full load current on the input and output AC circuits in accordance with the electrical codes or regulations applicable to your installation. Table 4 is based on the U.S. National Electrical Code and the Canadian Electrical Code, assuming two-conductor-plus-ground cable, using 75 °C wiring, at an ambient temperature of 30 °C. Other codes and regulations may be applicable to your installation.



This section for use by qualified personnel only.

Table 4 Required AC wire size vs. required breaker rating

	Required Breaker Size (amps)	Required Wire Size
Freedom XC (both models)	30 A maximum 20 A maximum through a GFCI	10 AWG

The AC input terminal is located inside the unit through the front panel's knockout hole and is labeled properly as **AC IN** or **AC INPUT**. The unit comes with spring clamp-type terminals where individual wires can be attached securely.

NOTICE

EQUIPMENT DAMAGE

Make sure the wires are connected properly. The AC wiring terminal blocks are split into input and output sections.

Failure to follow these instructions can damage the unit and/or equipment.

When making the AC input and AC output connections, observe the correct color code for the appropriate AC wire, as described below in Table 5.

Table 5 Color codes for typical AC wiring

Color	AC Wire
Black/Red	Line
White/blue	Neutral

Table 5 Color codes for typical AC wiring

Color	AC Wire
Green/yellow or bare copper	Ground (Earth)

NOTICE

REVERSE POLARITY DAMAGE

Make sure the wires are connected properly. Improper connections (connecting a line conductor to a neutral conductor, for example) will cause the Freedom XC to malfunction and may permanently damage the inverter. Damage caused by a reverse polarity connection is not covered by your warranty.

Failure to follow these instructions can damage the unit and/or equipment.

Wiring Knockouts When installing wires to AC terminals, always remove the appropriate wiring knockouts (there are two on the AC panel) and install the proper strain-relief clamps or bushings.

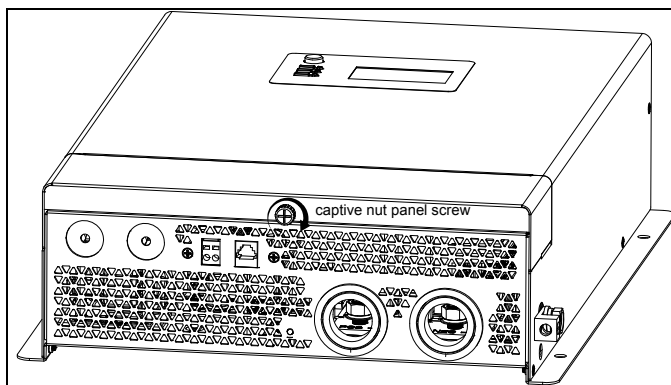
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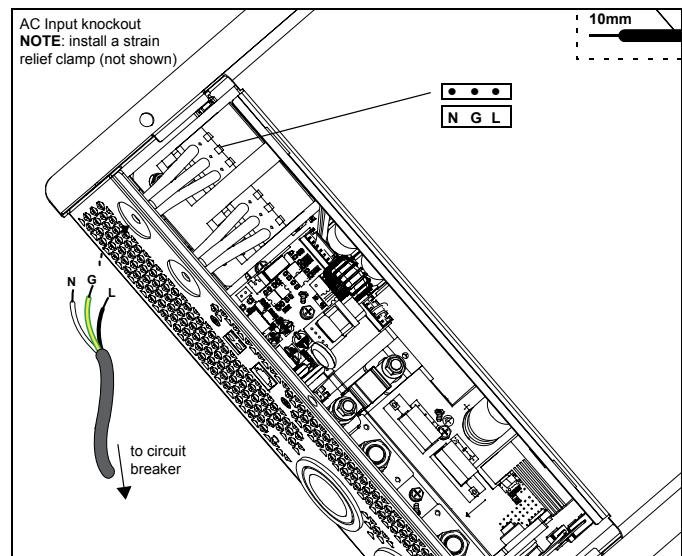
Basic Installation Procedures

AC Input Connections

1. Ensure AC and DC power sources are turned off.
2. Install the required circuit breaker in the AC distribution panel supplying AC power to the unit.
3. Remove the AC compartment cover by loosening the captive nut panel screw and lifting the cover up and out.



4. Strip a single AC input wire, as appropriate.
5. Remove the knockout and install a 1/2" strain relief clamp.
6. Route the wires through the strain relief clamp (not shown in the figure).



7. Locate the Neutral, Ground and Line terminals on the AC input terminal labeled as **N**, **G**, and **L** respectively.

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This section for use by qualified personnel only.

8. Using a 3mm slot long neck screwdriver, open the spring clamp by inserting the tool in the clamp slot and gently pulling the screwdriver handle forward, for Line terminal.
9. Insert Line AC wire into Line (L) terminal slot on the unit.
10. Release the spring clamp to secure the wire.
11. Repeat previous steps 8 through 10 for Ground (G) and Neutral (N) connections.
12. Tighten the strain relief clamp to secure the wires.
13. Replace the AC compartment cover onto the unit, if you are not connecting other wires such as for the AC Output. Otherwise, keep the AC compartment open and proceed to the next step.
14. Connect the other end of the wires to the circuit breaker in the AC distribution panel supplying AC power to the unit.

Basic Installation Procedures

Step 5: Connecting AC Output to an Existing AC Circuit

⚠ WARNING

FIRE, SHOCK, AND ENERGY HAZARDS

Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes.

Failure to follow these instructions can result in death or serious injury.

A manufacturer-tested and approved GFCI must be connected to the Freedom XC AC output, and GFCI protection must be provided on every receptacle connected to the AC hard wired installation. Other types may fail to operate properly when connected to the Freedom XC. See “Ground Fault Circuit Interrupters (GFCIs)” on page 16.

NOTICE

EQUIPMENT DAMAGE

Do not connect any AC source (such as a generator or utility power) to the AC output wiring of the Freedom XC.

The Freedom XC will not operate if its output is connected to AC voltage from another source, and potentially hazardous or damaging conditions may occur. These conditions can occur even if the inverter is off.

Failure to follow these instructions can damage the unit and/or equipment.

Do not connect the Freedom XC to an AC branch circuit that has high-power consumption loads.

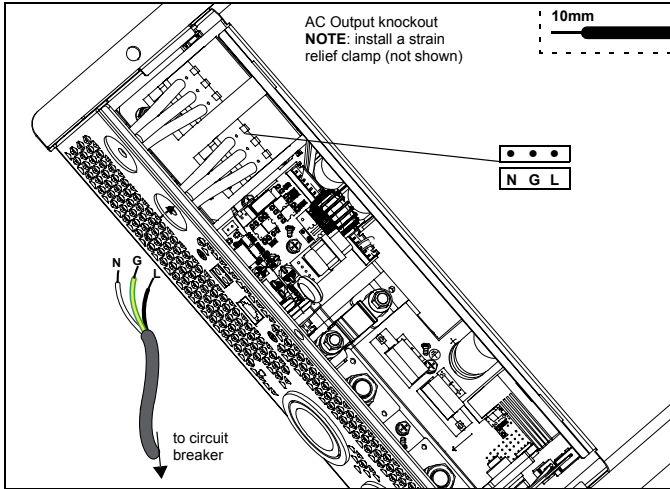
The Freedom XC will not operate electric heaters, air conditioners, stoves, and other electrical appliances that consume more than its rated watts.



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AC Output Connections

To make a permanent connection to existing AC wiring:



1. Ensure AC and DC power sources are turned off, if not already done from “Step 4: Connecting the AC Input Wires” on page 20.
2. Install the required circuit breaker in the inverter distribution panel receiving AC power from the inverter.
3. Remove the AC compartment cover, if not already done from “Step 4: Connecting the AC Input Wires” on page 20.
4. Strip a single AC output wire, as appropriate.
5. Remove the knockout and install a ½" strain relief clamp.
6. Route the wires through the strain relief clamp (not shown in the figure).
7. Locate the Neutral, Ground and Line terminals on the AC OUT terminal labeled as **N**, **G**, and **L** respectively.
8. Using a 3mm slot long neck screwdriver, open the spring clamp by inserting the tool in the clamp slot and gently pulling the screwdriver handle upward.
9. Insert Line AC wire into Line (**L**) terminal slot on the unit.
10. Release the spring clamp to secure the wire.
11. Repeat Step 8 through Step 10 for Ground (**G**) and Neutral (**N**) connections.
12. Tighten the strain relief clamp to secure the wires.
13. Replace the AC compartment cover, if you are finished with connecting all the AC wires in the unit.
14. Connect the other end of the wires to a circuit breaker in the inverter distribution panel.

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Basic Installation Procedures

Step 6: Connecting the DC Cables

NOTICE

REVERSE POLARITY DAMAGE

Check cable polarity at both the battery and the Freedom XC before making the final DC connection. Positive must be connected to positive; negative must be connected to negative.

Reversing the positive and negative battery cables will damage the Freedom XC and void your warranty.

Failure to follow these instructions can damage the unit and/or equipment.

WARNING

FIRE HAZARD

Use only copper wire rated 75 °C minimum. Make sure all DC connections are tight to a torque of 71–80 in-lbf (8–9Nm). Loose connections will overheat.

Failure to follow these instructions can result in death or serious injury.

If at all possible, minimize routing your DC cables through an electrical distribution panel, battery isolator, or other device that will cause additional voltage drops which can degrade the inverter’s ability to operate the loads.

Figure 4 shows the DC end for your reference.

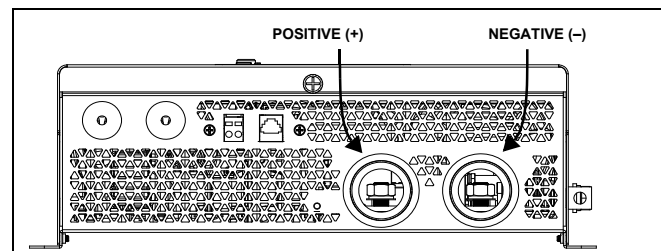


Figure 4 DC End

Follow the procedure given below to connect the battery leads to the terminals on the DC end. The cables should be as short as possible and large enough to handle the required current, in accordance with the electrical codes or regulations applicable to your installation. Table 2 on page 15 specifies the minimum DC cable size and maximum fuse size for the Freedom XC.

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Freedom XC Owner's Guide



This section for use by qualified personnel only.

To make the DC connections

Refer to Figure 5.

1. Make sure the inverter is off and no AC or DC is connected to the unit.
2. Remove the DC compartment cover by loosening the captive nut panel screw.
3. Loosen the DC terminal nuts from the terminal bolts and set them aside for later.
4. Strip ½" (13 mm) to ¾" (19 mm) insulation from one end of each cable. The amount stripped off will depend on the terminals chosen.
5. Attach the connectors that will secure the cables to the battery, to the disconnect/battery selector switch, and the fuse block. The connectors you use must create a permanent, low-resistance connection. It is recommended to use approved and certified cable lugs. Use the tool recommended by the terminal manufacturer. Make sure no stray wires protrude from the lug or terminal.
NOTE: You may find it more convenient to have the cable lugs attached by the company that sells you the cable and/or connectors.
6. Strip ½" (13 mm) to ¾" (19 mm) of insulation from each cable end that will be connected to the inverter cable. The amount stripped off will depend on the terminals chosen.

7. Attach the cable lug that will join the cable to the inverter DC terminal. Cover the lug stem with heat shrink insulation (see Figure 5) to ensure that the lug does not touch the enclosure.
8. Install a fuse and fuse holder in the cable that will be used for the positive side of the DC circuit. The fuse must:
 - be as close to the battery positive terminal as possible
 - be rated for DC circuits
 - have an Ampere Interrupting Capacity (AIC) that exceeds the short-circuit current available from the battery (that is, Class T fuse)
9. To prevent sparking when making the connection, ensure the disconnect/battery selector switch is off.
10. Route the positive cable through the left side strain relief clamp and attach the cable lug on the positive cable to the positive DC terminal on the inverter.
11. Fasten the DC terminal nut (set aside earlier) to the terminal bolt. Tighten the nut to a torque of 71–80 in-lbf (8–9 N-m). Do not overtighten. Make the connection snug enough so the cable lug does not move around on the DC terminal. Center it through the DC knockout hole and do not let it touch the edge. See Figure 5, "DC Cable Connections" on page 28.

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Basic Installation Procedures

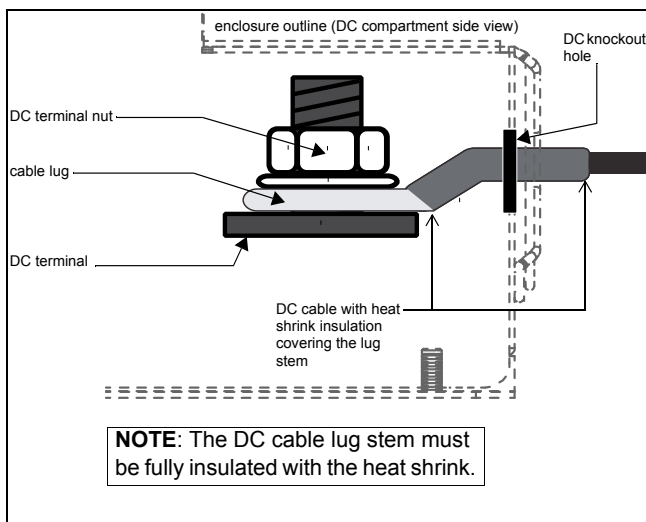


Figure 5 DC Cable Connections

NOTICE

EQUIPMENT DAMAGE

Tighten the nuts on terminals properly. Loose connections cause excessive voltage drop and may cause overheated wires and melted insulation. Do not over-tighten the nut on the DC input terminals. Damage to the DC input terminals may result. The maximum torque setting is **80 in-lbf (9 N-m)**. **Failure to follow these instructions can damage the unit and/or equipment.**

NOTICE

REVERSE POLARITY DAMAGE

Check cable polarity at both the battery and the Freedom XC before making the final DC connection. Positive must be connected to positive; negative must be connected to negative. Reversing the positive and negative battery cables will blow a fuse in the Freedom XC and void your warranty. **Failure to follow these instructions can damage the unit and/or equipment.**

12. Before proceeding, double check that the cable you have just installed connects the positive DC terminal of the inverter to the disconnect/battery selector switch, fuse holder, and that the other end of the fuse holder is connected to the positive terminal of the battery.



⚠️ WARNING

FIRE HAZARD

Do not complete the next step if flammable fumes are present. Explosion or fire may result if the disconnect/battery selector switch is not in the off position. Thoroughly ventilate the battery compartment before making this connection.

Failure to follow these instructions can result in death or serious injury.

13. Route the negative cable through the right side strain relief clamp and connect the cable from the negative post of the battery to the negative DC terminal of the inverter.
14. Fasten the DC terminal nut (set aside earlier) to the terminal bolt. Tighten the nut to a torque of 71–80 in-lbf (8–9 N-m). Do not overtighten. Make the connection snug enough so the cable lug does not move around on the DC terminal. Center it through the DC knockout hole and do not let it touch the edge.
15. Replace the DC compartment cover.

DC Grounding

To connect the DC ground:

The equipment grounding lug on the DC end of the Freedom XC is used to connect the chassis of the Freedom XC to your system's DC negative connection or grounding bus point as required by electrical regulations. Use copper wire that is either bare or provided with green insulation. Do not use the DC Ground Lug for your AC grounding. See the AC wiring instructions in this section.

Follow the guidelines below that correspond to the specific type of installation. These guidelines assume you are using the DC supply cable and fuse sizes recommended in this manual. If you are using different sizes, refer to the applicable installation code for DC grounding details.

Recreational Vehicle Use 8AWG copper wire and connect it between the Chassis Ground lug and the vehicle's DC grounding point (usually the vehicle chassis or a dedicated DC ground bus).

Marine Use copper wire that is bare or has insulation rated minimum 105 °C, and connect it between the Chassis Ground lug and the boat's DC grounding bus or engine negative bus. For the Freedom XC 1000, use a wire of gauge 3AWG minimum. For the Freedom XC 2000, use a wire of gauge 1/0AWG minimum.

This section for use by qualified personnel only.

Basic Installation Procedures

Connecting to ACC Signal

The Freedom XC can be wired to inhibit inverter operation in the absence of a vehicle's (or vessel's) ignition control signal. This feature can avoid unnecessary battery drain that would otherwise occur if the inverter 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 vehicle's user manual for proper instructions on how to disconnect the battery cables.
3. Locate the vehicle's ignition control wire from the vehicle's ignition circuit. This wire must be fused appropriately at no more than 5 amps. Refer to the vehicle's user manual for guidance.
4. Locate the ACC input (ignition signal input) terminal. See Figure 6.

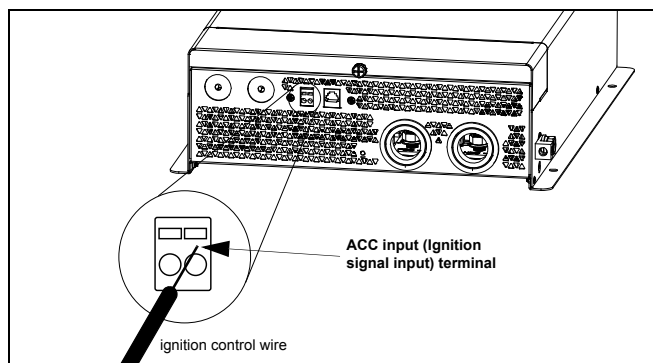


Figure 6 Ignition Signal (ACC) Input Terminal

5. Using a 3mm slot long neck screwdriver, push into the rectangular slot to release the spring clamp.
6. Insert the ignition control wire into the round ACC input terminal slot.
7. Pull the screwdriver out to engage the spring clamp and secure the wire to the terminal.



This section for use by qualified personnel only.

Description of Ignition Control Features

For information about the features and instructions on changing the ignition control features, see “Inverter and Charger Operation” on page 39.

Ignition Auto-on (AEO)	This setting allows the inverter to operate (Battery mode) automatically when an ignition control wire is connected to the ACC input and a valid ignition signal is constantly detected. The inverter works in tandem with the vehicle’s ignition circuit.
Ignition Lock-out (LOE)	This setting allows the inverter to operate (Battery mode) when an ignition control wire is connected to the ACC input terminal and a valid ignition signal is constantly detected. When enabled, you have to manually press the Power button on the display panel to operate the inverter.
Off (OFF)	To completely disable the ignition control features do the following: 1. Set Ignition Control to Off (OFF) using the Select buttons on the Display panel.

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Basic Installation Procedures

Step 7: Connecting to a Remote Panel

To connect the remote panel:

- ◆ Plug the Freedom X Remote panel (PN: 808-0817) to the RJ12 Remote port on the unit.

NOTE:

When the remote panel is connected, turn the inverter’s power button to the OFF position. This allows the remote panel to control the inverter’s power status.

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Freedom XC Owner’s Guide



Step 8: Testing Your Installation

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Pressing the Power button to turn OFF the Freedom XC inverter function on display panel does not disconnect DC or AC input power to the Freedom XC. 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 or serious injury.

There are two tests to be performed. The first test verifies that the Freedom XC 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. This test verifies that the Freedom XC 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, close the DC fuse and Disconnect or the DC circuit breaker to supply DC power to the Freedom XC.

Testing in Battery Mode

To test the Freedom XC in invert mode:

1. For hard wired installations, ensure shore power is not present.
2. Press the Power button to turn the inverter 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 into the Freedom XC GFCI or an AC outlet hard wired to the Freedom XC.
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, proceed to “Testing in Grid Mode”.

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

This section for use by qualified personnel only.

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Basic Installation Procedures

Testing in Grid Mode

To test the Freedom XC in shore power mode:

- ◆ With the test load from the previous test still connected and operating, connect the shore power source.

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

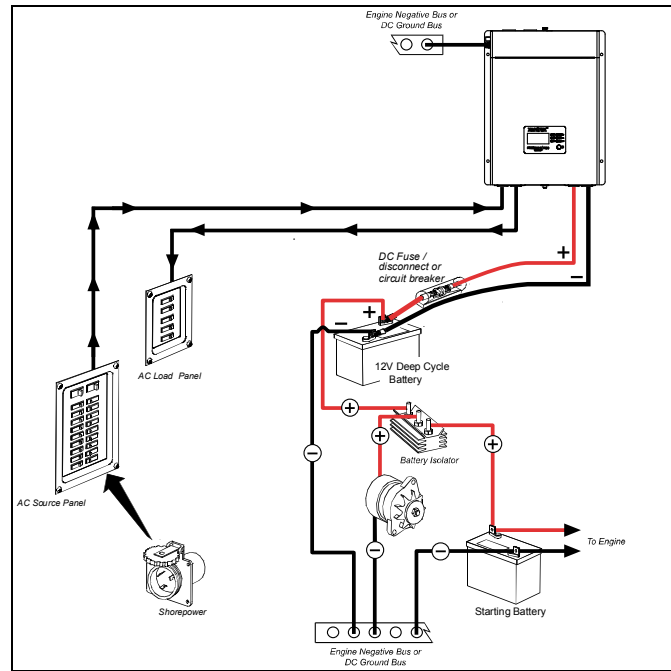
NOTE: Whether or not the Power button is turned ON, shore power will pass through the Freedom XC to the output when shore power is within normal operating range. The unit also starts charging the battery after the transfer to grid mode.



Marine Installation

Figure 7 illustrates a typical marine installation with the following components:

1. AC power supplied from a shore power connector
2. An AC source panel that includes a max 30A (or a 15A if using a GFCI) circuit breaker that supplies the Freedom XC
3. An AC load panel with branch circuit breakers that supply only loads that run off the Freedom XC
4. Engine negative bus / DC ground bus
5. DC power supplied by a battery bank and protected by a DC fuse in the positive cable
6. Battery isolator
7. DC alternator
8. Starting battery
9. Drip shield (see next page)



This section for use by qualified personnel only.

Figure 7 Typical Marine Installation

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Marine Installation

Drip Shield Installation

The drip shields help to protect the unit from dripping or splashing liquids, which will cause a shock hazard when moisture comes in contact with electrical circuits in the unit. The drip shields are especially useful in marine installations where water from condensation, rain, or sea may come into contact with the Freedom XC.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Place this unit in normally dry areas only. Operating the unit under wet conditions may expose you to a shock hazard. Installing drip shields may not entirely protect you from this hazard. Do not operate the unit when it is wet.

Failure to follow these instructions can result in death or serious injury.

You may purchase the drip shield set by contacting customer support. When ordering, mention part number 808-1050.

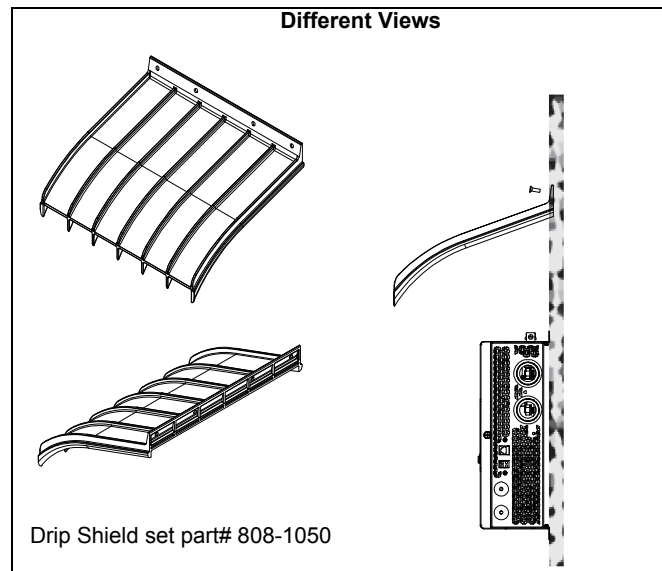


Figure 8 Drip Shields

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To install the drip shields:

1. Gather the four screws needed to fasten a single drip shield to a wall.
2. Locate an appropriate setting for the drip shields above the Freedom XC making sure you cover the entire width of the unit.
You can overlay the shields as shown in Figure 9 below.
3. Fasten the screws through the holes in the drip shield into the wall. See Figure 8.

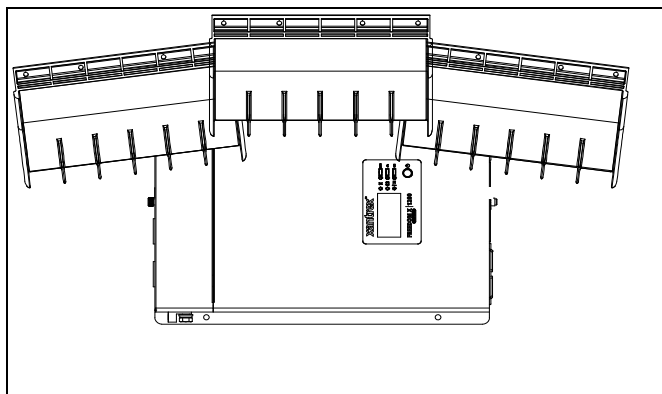


Figure 9 Typical Drip Shield Placement on a Freedom XC 1000

This section for use by qualified personnel only.

Inverter and Charger Operation

Freedom XC Display Panel

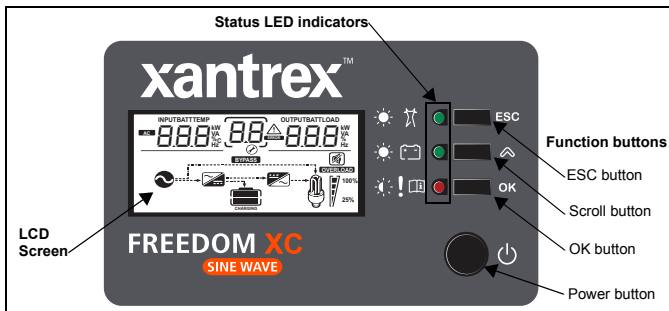






Figure 10 Display Panel

Status LED Indicators





Indicator	Definition
 ←	Indicates grid mode in which shore power is available and passing through to the loads and charging the battery.
 ←	Indicates Battery mode (Inverter mode) in which the inverter is running and supplying power to the loads from the battery.
 ←	Indicates error or fault mode and is accompanied by an error code displayed on the LCD screen. For a list of error codes, see “Warning Messages” on page 64.
 ←	Indicates a Warning condition and is accompanied by an error code and a sounding alarm. For a list of error codes, see “Warning Messages” on page 64.

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Inverter and Charger Operation

Function Buttons

Button	Definition
	return to default screen or exit setting mode
	next screen or next selection
	to enter the setting mode or to confirm the setting
	turns the inverter on or off

LCD Screen

The LCD Screen changes depending on the operating mode of the inverter.

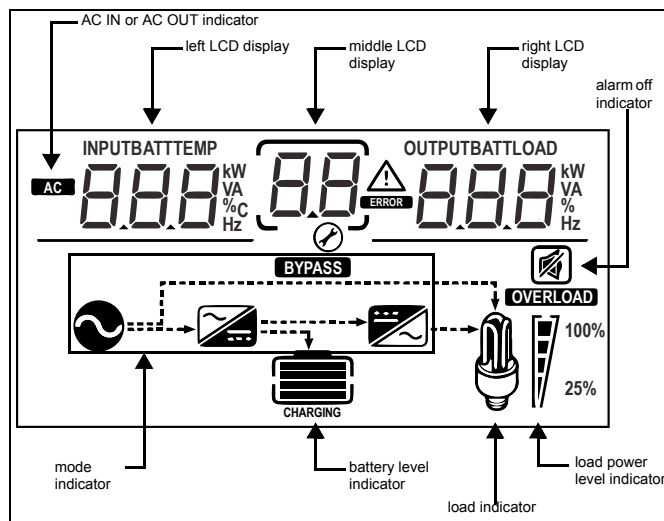


Figure 11 Parts of the LCD Screen

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LCD Screen Icons

Icon	Definition
AC	AC input and output indicator.
	The wrench icon underneath a number is displayed during configuration mode.
	An error event with its corresponding number is displayed here.
	A warning event with its corresponding number is displayed here.
CHARGING	The charging indicator is displayed when the unit is in charger mode.
	The battery icon indicates remaining battery power. One bar = 1-25%, two bars = 25-50%, three bars = 50-75%, and four bars = 75-100%.
OVERLOAD	Shows an overload condition.

Icon	Definition
	The load icon is displayed if there is voltage available at the AC output.
	The bar represents load consumption levels. 100% is an indication of full capacity and 25% indicates low consumption. All the bars disappear at < 20 watts, and AC load indicates zero watt power.
	Shows up in grid mode when AC shore power is present. If the power is being qualified, then this icon will flash.
BYPASS	Shows that the unit is in grid mode and is bypassing shore power directly to the loads.
	This icon shows when there is power conversion from AC to DC - charging.
	This icon shows when there is power conversion from DC to AC - inverting.
	The alarm buzzer is muted.

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Viewing Information During Battery Mode

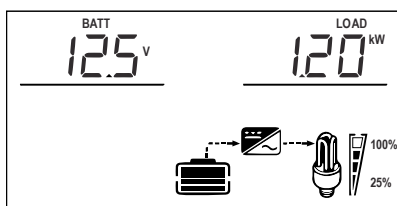
The LCD screen displays information related to battery mode operation.

◆ Press the Scroll button to move from screen to screen.

Info and Setting LCD Screen

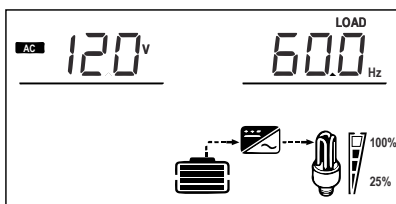
Screen 1 of 4 - Battery Voltage/ Load Wattage

This is the home screen.



battery voltage = 12.5V, AC load = 1.2kW

Screen 2 of 4 - AC Output Voltage/Frequency

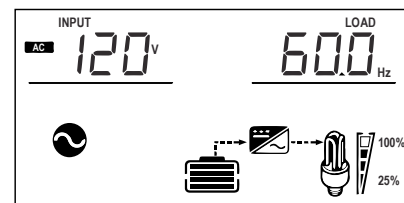


output voltage = 120V, output frequency = 60Hz

Info and Setting LCD Screen

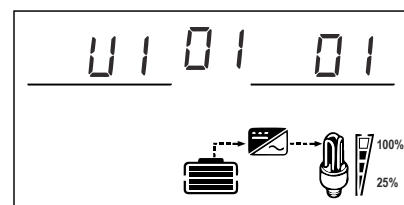
Screen 3 of 4 - AC Input Voltage/ Frequency

Screen shows up when utility AC is connected.



input voltage = 120V, input frequency = 60Hz

Screen 4 of 4 - Firmware version




Firmware version = U1 1.01

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Viewing Information During Grid Mode

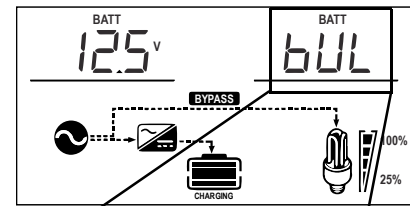
The LCD screen displays information related to AC bypass or charger operation.

1. Press the Scroll  button to move from screen to screen.
2. Press **ESC** to return to the home screen.

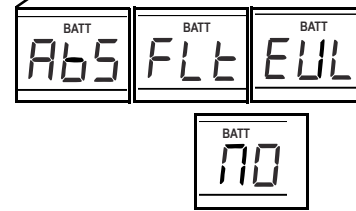
NOTE: After one minute of inactivity in the other screens, the LCD will go back to the home screen.

Info and Setting LCD Screen

Screen 1 of 5 - Battery Voltage/Charging Stage



This is the home screen.



battery voltage = 12.5V, charging stages = bulk, absorption, float, equalization, and no charging

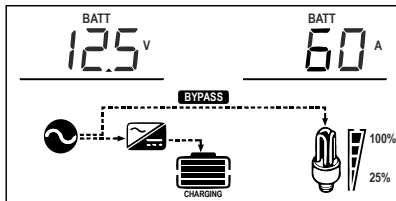
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Viewing Information During Grid Mode

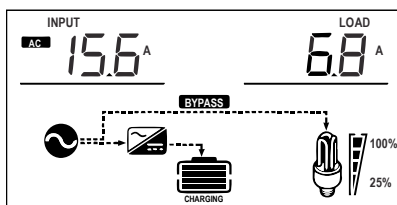
Info and Setting LCD Screen

Screen 2 of 5 - Battery Voltage/Charging Current



battery voltage = 12.5V, charging current = 60A

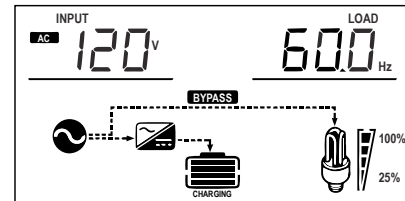
Screen 3 of 5 - AC input current/AC load current



input current = 15.6A, load current = 6.8A

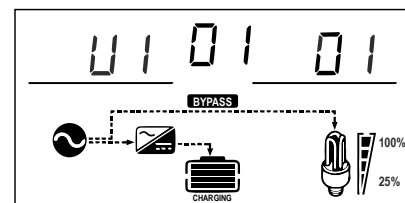
Info and Setting LCD Screen

Screen 4 of 5 - AC input voltage/AC input frequency



input voltage = 120V, input frequency = 60Hz

Screen 5 of 5 - Firmware version



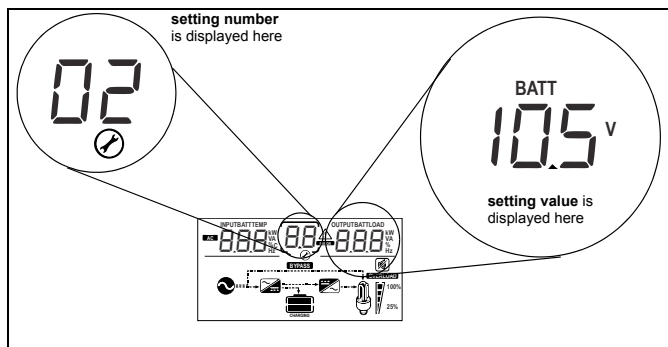
Firmware version = U1 1.01



Adjusting Feature Settings in Configuration Mode

The **OK**, Scroll **▲**, and **ESC** buttons can be used to cycle through the various feature settings:

1. Press and hold the **OK** button for three seconds to enter the feature settings mode.
2. Press the Scroll **▲** button to move through the different feature settings.



Adjusting Feature Settings in Configuration Mode

Settings

Setting Name	Setting Number	Default Value	Range of Values	Description
Inverter Ignition Control	01	OFF	OFF, L0t, Rt0	See “Description of Ignition Control Features” on page 31.
LBCO Voltage	02	10.5	10.1 to 12.8	The voltage setting value can be adjusted by 0.1 increments. The low battery warning is triggered at LBCO voltage + 0.5 volts. The low battery warning goes away at LBCO voltage + 1.0 volts.
LBCO Shutdown Delay Timer	03	300	1 to 300	When the range is from 1 to 20, the timer setting value can be adjusted by 1-second increments. When the range is from 20 to 300, the timer setting value can be adjusted by 10-second increments.
LBCO Recovery Voltage	04	13.1	12.0 to 16.0	The range is from LBCO voltage + 0.5 to 16, adjusted by 0.1 increments. Selecting a higher value than the battery’s actual fully-charged voltage level will not activate the auto-recovery feature. You may manually reset the inverter when the low battery cut off event occurs.
Power Save Time	05	25	OFF, 1 to 25	The range is from 1 to 25, adjusted by 1-hour increments. The next setting after 25 is OFF.
Power Save (Load Sensing) Mode	06	d1 5	EnA (enable), d1 5 (disable)	When enabled, the inverter’s “no load” loss can be reduced further when total load is less than 25 watts.
Output Frequency	07	60	60, 50	After changing the output frequency setting, turn the unit off and then on again, in order for the change to take effect.
Output Voltage	08	120	120, 110, 108	



Setting Name	Setting Number	Default Value	Range of Values	Description
Inverter Output Power Limit (Freedom XC 1000)	09	1.0	100 to 1.0	The wattage setting value can be adjusted by 100-watt increments. Use with Inverter Output Power Limit Timer especially when pairing with a lithium ion battery.
Inverter Output Power Limit (Freedom XC 2000)	09	2.0	100 to 2.0	
Inverter Output Power Limit Timer	10	300	1 to 300, OFF	When the range is from 1 to 20, the timer setting value can be adjusted by 1-second increments. When the range is from 20 to 300, the timer setting value can be adjusted by 10-second increments. Use with Inverter Output Power especially when pairing with a lithium ion battery. The timer is automatically disabled if the maximum Inverter Output Power limit is selected.
Transfer Mode	11	APL	APL (appliance), UPS (UPS)	Selecting <i>APL</i> - appliance sets the transfer time from line to battery to 20 ms. Selecting <i>UPS</i> (uninterruptible power supply) sets the transfer time from line to battery to 10 ms.
Utility AC Under Voltage Level	12	90	85 to 110	
Inverter Shutdown Recovery	13	RAE	RAE (auto-restart), RAE (manual restart)	The inverter shuts down when there is an over temperature, overload, and short circuit condition. Selecting <i>RAE</i> (auto-restart) will allow the inverter to recover automatically from a shutdown up to three times maximum. Selecting <i>RAE</i> (manual restart) allows the user to restart the inverter by performing a manual reset, that is, by acknowledging the restart via the display panel.
Audible Alarm	14	bOn	bOn (Audible), bOff (Mute)	The alarm beeps once every five seconds.

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Adjusting Feature Settings in Configuration Mode



Setting Name	Setting Number	Default Value	Range of Values	Description
Battery Type	20	FLd	FLd (Flooded), AGM (AGM), GEL (Gel), USE (Custom)	
Battery Temperature	21	H0t	CLd (Cold), wRm (Warm), H0t (Hot)	Selecting Cold from Warm will increase charger voltage by 0.4V. Selecting Cold from Hot will increase charger voltage by 0.8V.
Custom Absorption Voltage	22	14.5	12.0 to 18.0	The voltage setting value can be adjusted by 0.1 increments. Available only when custom battery type is selected.
Custom Float Voltage	23	13.5	12.0 to 18.0	
Charger Current (Freedom XC 2000)	24	80	5 to 80	The current setting value can be adjusted by 5A increments.
Charger Current (Freedom XC 1000)	24	50	5 to 50	
Charger Ignition Control	25	OFF	OFF (OFF), RAE (Auto-ON)	When set to <i>EnA</i> (Enabled), the charger operates only in tandem with the vehicle's ignition circuit.
Equalize Charging for Flooded Battery	27	d15	EnA (enable), d15 (disable)	This setting is only available when Flooded battery type is selected. It allows only one hour of equalize charging once.
AC Input Breaker for Load Share	28	30	5 to 30	The load share feature prioritizes the AC load by reducing the charge current in order to maintain the total input current to less than the load share setting.
Reset all settings to their default values	99	dEF	ndF (as is), dEF (default)	

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To change the default value to a different value:

1. Press and hold the **OK** button for three seconds to enter the feature settings mode.
2. Press the Scroll  button to move through the different feature settings.
3. Press the **OK** button to select a setting number and change its value.
4. Press the Scroll  button to change the value until you reach the desired value.
5. Press the **OK** button to confirm the change.
6. Repeat the previous steps to set other feature settings.
7. Press the **ESC** button to exit the feature settings mode.

Operating in Battery Mode

The Freedom XC is in Battery Mode (also called Inverter Mode) when all the following conditions exist:

- inverter power button is ON  (down position) or ignition auto-on is activated
- shore power is not presently available 
- battery has sufficient power 

Inverter operation means that DC battery power is presently being converted to utility grade AC power, powering equipment and appliances connected to the AC output terminal of the unit.

The green status LED lights up to indicate the Freedom XC is using the battery to power the equipment and appliances.



Turning Inverter Operation ON and OFF

There are two ways to operate the Freedom XC's inverter.

- Press the Power button to a down position (it is Off in the up position).
- When the inverter's Ignition Control feature is set to Auto-on (**Auto**)^a, a +12VDC signal is present^b.

WARNING

ELECTRICAL SHOCK HAZARD

Turning the Power button off does not disconnect DC battery power from the Freedom XC. You must disconnect both AC and DC power before working on any circuits connected to the unit.

Failure to follow these instructions can result in death or serious injury.

To prevent unnecessary battery discharge, press the Power button to turn it off when you are not using the Freedom XC.

a. See "Adjusting Feature Settings in Configuration Mode" on page 45.

b. When the vehicle's ignition switch is On or the vehicle's engine is running.



Power Save Timer

The Power Save Timer is an adjustable countdown timer from 1 to 25 hours (25 hours is the default) that automatically shuts down inverter operation to reduce battery discharge and preserve battery life. During continuous inverter operation, the countdown is initiated when power from the AC load drops to less than approximately 50 watts and remains below this level. After reaching the end of the countdown timer the inverter automatically shuts down.

To change the countdown timer, see “To change the default value to a different value:” on page 49.

Power Save Mode: By enabling the power save mode, the inverter can automatically go to load sense mode by sending short pulses to further reduce the battery discharge. Power save mode ends when a load greater than 25 W is connected.

Checking Battery Status

During inverter operation (in battery mode), you can check the battery status by observing the battery capacity indicator on the LCD screen. The battery voltage appears in the left side of LCD screen.

The normal operating battery voltage range is between 11 and 15 volts.

Checking Output Power

When the inverter is in operation (in battery mode), you can check how much power (displayed in kW) the Freedom XC is supplying to the connected loads by observing the load capacity indicator on the LCD screen. The battery discharge amperage appears in the right side of the LCD screen.

Operating Several Loads at Once

If you are going to operate several loads from the Freedom XC, turn them on one at a time after you have turned the inverter on.

Turning loads on separately helps to ensure that the inverter does not have to deliver the starting current for all the loads at once, and will help prevent an overload shutdown.

Turning the Audible Alarm ON or OFF

The Freedom XC’s audible alarm can be muted. See “Adjusting Feature Settings in Configuration Mode” on page 45.

Any warnings such as error or fault conditions or imminent shutdown are both displayed on the LCD screen and sounded on the alarm speakers. See “To manually reset the alarm:” below.

Audible alarm for warning: The unit beeps once when a warning condition is detected.

Audible alarm for error: The unit beeps once every five seconds for one minute.

To mute the alarm:

- ◆ Press any one of the three function buttons.

The alarm is automatically muted after one minute. But the error code continues to be displayed until the error is cleared.

To manually reset the alarm:

1. Press the Power button to turn it Off (from a down position to up) and press again to turn it On to reset an active alarm and clear the error or error.
2. If the Inverter Ignition Control is set to auto-on, toggle the ignition signal to clear the alarm and error.
3. Toggle the AC input power to force the transition between grid mode and battery mode. This action clears the alarm and error.



Operating in Grid Mode

Battery Charger Functions

When AC power is available, the Freedom XC can operate as a 12-volt battery charger. Different battery types and chemistries require different charging voltage levels. Not charging batteries at the required levels can shorten battery life or damage the batteries. The Freedom XC is configured at the factory to work with the battery types recommended for inverter applications. If the default settings do not work for your specific installation, you can adjust the charge stage settings (as recommended by the battery manufacturer) on the Custom (Battery) Settings menu (see page 57).

NOTE: This information is provided for guidance only. Variations in battery chemistry and site-specific environmental considerations mean that you should consult your system designer or battery manufacturer for specific recommendations for appropriate battery voltage and current settings.

Battery Types

Freedom XC charges flooded (or wet) lead-acid, Gel, AGM (absorbed glass mat), and custom batteries.

- Flooded (or wet) batteries have removable battery caps for refilling with distilled water and testing the electrolyte.
- Gel batteries have the electrolyte in the form of a gel rather than a liquid and do not require topping up. Gel batteries are sealed and the battery caps are not removable.
- AGM (Absorbed Glass Mat) batteries are similar to gel batteries except that the electrolyte is absorbed into a fiberglass matting.
- Custom battery is configured by the dealer, factory, or service center for battery types other than those listed above.

NOTICE

RISK OF BATTERY DAMAGE
Do not mix battery types. The Freedom XC can only select one battery type setting for all batteries connected to its bank. All connected batteries should either be: Flooded (or wet) *or* Gel *or* AGM *or* Custom.

Failure to follow these instructions can damage the unit and/or damage other equipment.

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Operating in Grid Mode

3-Stage Charging Algorithm

When enabled, the Freedom XC will charge batteries in a sequence known as three-stage charging. Whenever qualified AC power is present at the inverter's input, it passes power through to the connected load and begins charging the batteries. The charging voltage delivered to the battery depends on the battery's:

- Type setting
- Temperature (by switch setting)
- State of charge

The three automatic stages are:

- Bulk
- Absorption
- Float

See Figure 12 for a graph of the three-stage charging profile.

There is a fourth stage, equalization, which is initialized manually as it is only performed occasionally and only on flooded (or wet) batteries.

The charging cycle is a multistage (three-stage) process. Whenever qualified AC power is present at the inverter's input, it passes power through to the connected load and begins charging the batteries.

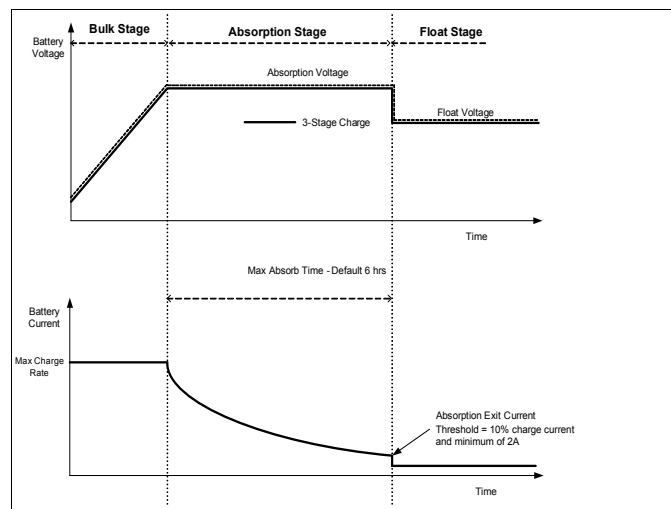


Figure 12 Three-Stage Battery Charging Cycle

NOTE:

When the charge cycle is interrupted, the charger will restart charging at the beginning of the multistage algorithm. Charge current during equalize state (optional state not shown here) is normally limited to 10A for 60 minutes.

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Freedom XC Owner's Guide



Bulk Stage

Bulk charge is the first stage in the charging process and provides the batteries with a controlled, constant current. Once the battery voltage rises to the absorption voltage threshold, the charger switches to the absorption stage.

Absorption Stage

During the absorption stage, the Freedom XC begins operating in constant voltage mode and the current falls gradually as the amp hours are returned to the battery.

Table 6 Preset Absorption Voltage Settings

Battery Type	Preset Absorption Voltage
Flooded	14.0V (Hot), 14.4V (Warm), 14.8V (Cold)
Gel	13.8V (Hot), 14.2V (Warm), 14.6V (Cold)
AGM	14.0V (Hot), 14.3V (Warm), 14.6V (Cold)
Custom Absorption	14.6 (default), changeable between 12.0 to 18.0

The Freedom XC transitions to the float stage if either one of the following two conditions are met:

1. The charge current allowed by the batteries falls below the exit current threshold, which is equal to 10% of the programmed charge current and a minimum of 2A.
2. The Freedom XC has been in absorption for the programmed maximum absorption time limit. The default is 6 hours.

NOTE: If there are DC loads on the batteries, the charger's current may never decrease to a level to initiate the next stage of charging. In this case, the charger would stay in absorption until the Absorb Time setting is reached.

Float Stage

Float charge maintains the batteries slightly above the self discharge voltage of the batteries. The charge current in float is the current necessary to maintain the batteries at the Float Voltage setting, limited only by the inverter's capability or other settings that limit the inverter's maximum charge rate. Float charging reduces battery gassing, minimizes watering requirements (for flooded batteries), and makes sure the batteries are in a constant state of readiness. The charger automatically switches to the float stage after the batteries have received a bulk and absorption charge (see Figure 12). The batteries are maintained at the default float voltage level for the selected battery type or the voltage selected under Float Voltage on the Custom Battery Settings menu.

Operating in Grid Mode

Table 7 Preset Float Voltage Settings

Battery Type	Preset Float Voltage
	Freedom XC 1000
Flooded	13.5
Gel	13.8
AGM	13.4
Custom Float	13.5 (default), changeable between 12.0 to 18.0

NOTE: The battery voltage can increase above the float voltage when using an external charging device such as PV arrays, wind turbines, and micro-hydro generators. Be sure to include appropriate charge management equipment with all external DC sources.

Equalize Charging

Many battery manufacturers recommend periodic equalize charging to counter cell charge imbalance and capacity-robbing electrolyte stratification. Equalizing helps to improve battery performance and lifespan by encouraging more of the battery material to become active.

Battery equalization is a controlled overcharging method that mixes up stratified electrolyte and reactivates unused areas of the plate material. Periodic equalizing can help to regularly restore batteries to a full and healthy state of charge.

Consult the battery manufacturer's recommendation for equalize charging settings. Sealed batteries should **never** be equalized. Consult the battery manufacturer for optimal charging procedures when using sealed batteries.

When Equalization is enabled, the battery is charged from bulk to absorption, and then to the equalize phase. The Freedom XC will transition from the absorption phase to equalize at an equalize current set to 10 amps.

After absorption, this constant current charge will continue until the voltage has increased to 16 volts DC.

Equalization duration is fixed at one hour.



Custom Battery Settings Menu

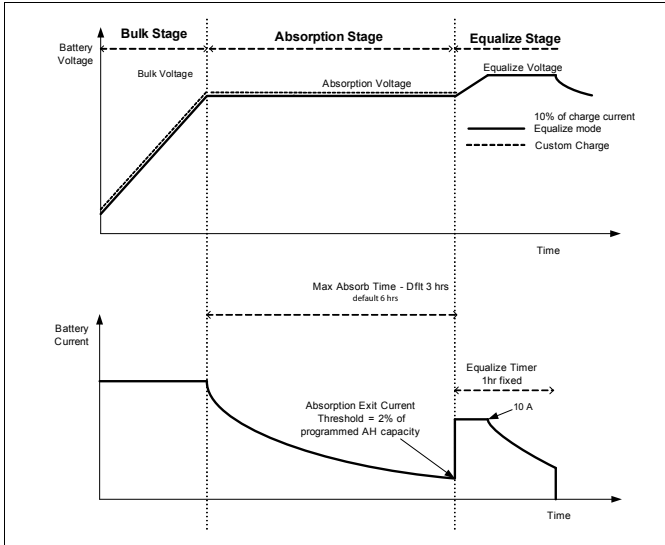


Figure 13 Equalize Charging

NOTICE

EQUIPMENT DAMAGE

To avoid damaging your batteries during charging or equalization, consult your battery manufacturer and associated documentation before setting a custom battery type.

Failure to follow these instructions can damage the unit and/or damage other equipment.

Custom battery type can be selected by the setting number 20 (see “Settings” on page 46). After the custom battery is selected, you can then adjust the value of custom absorption (setting number 22) and custom float (setting number 23) accordingly.

Operating During Transition Between Grid Mode and Battery Mode

The Freedom XC’s advanced power management is capable of transitioning power from an AC source to DC source within a fraction of a second and vice-versa.

The Freedom XC automatically detects when shore power is present and when it becomes unavailable or drops to less than 90 volts AC.

The transfer time can be set to two settings. For details see “Adjusting Feature Settings in Configuration Mode” on page 45.

NOTICE

EQUIPMENT DAMAGE

When the transfer mode is set to *UPS*, connect only sensitive digital equipment that requires fast AC transfer times.

Appliances with motors, compressors, and heating elements do not require a transfer mode of *UPS*. Set *RPL* for these devices to avoid damaging the transfer relay.

Failure to follow these instructions may cause equipment damage.

Transitioning from Grid Mode to Battery Mode

When the unit is operating in grid mode and shore power is lost, the Freedom XC has less than 20 milliseconds (default) to switch to operating in battery mode (if the Power button is pressed in the On position) and starts drawing power from the battery.

The operating mode indicator will change to Battery Mode and the green Status LED for Battery Mode will light up.

However, if the Power button is in the Off position, this transition does not happen and the display panel turns off.

Transitioning from Battery Mode to Grid Mode

When the unit is operating in Battery Mode and shore power becomes available, the Freedom XC begins a 20-second countdown to verify the stability of the shore power. If shore power remains stable for a 20-second countdown, at the end of the countdown, the Freedom XC will switch to shore power mode within 20 milliseconds and start drawing power from the AC source.

The operating mode indicator will change to grid mode and the green Status LED for grid mode will light up.



Operating Limits


Power Output

The Freedom XC can deliver up to 1000 watts (Freedom XC 1000) and 2000 watts (Freedom XC 2000) of continuous utility grade sine wave AC power. The wattage rating applies to resistive loads such as incandescent lights.

Input Voltage

The allowable Freedom XC input battery voltage ranges are shown in the following table:

Operating Condition	Battery Voltage	Comment
Full Operating Range	LBCO – 18.0 volts	Assuming the battery is full, the inverter will operate until battery voltage goes past below LBCO ^a and LBCO Shutdown delay timer ^b .
Low Voltage Alarm	< LBCO+0.5 volts	A low battery warning shows error code E05 on the LCD screen.
Low Voltage Shutdown	< LBCO	The buzzer sounds a single one-second low battery alarm beep and the LCD screen shows error code E01. After LBCO Shutdown delay timer runs out, the unit shuts down inverter output. The buzzer stops beeping and the LCD screen shows error code E01.

Operating Condition	Battery Voltage	Comment
Instant Low Voltage Shutdown	< 10.2 volts	After two seconds below the limit, the unit shuts down inverter output completely. LCD screen turns off completely.
High Voltage Shutdown	18.0 volts	The display shows error code E02 alternating with the battery voltage. The red status LED turns on.  NOTE: Although the Freedom XC incorporates over-voltage protection, it can still be damaged if input voltage exceeds 18.0 volts.

a. To set LBCO, see “Adjusting Feature Settings in Configuration Mode” on page 45.
 b. To set LBCO Shutdown Delay Timer, see “Adjusting Feature Settings in Configuration Mode” on page 45.

Operating During Transition Between Grid Mode and Battery Mode

Overload Conditions

There are two kinds of overload conditions:

- an overload warning
- an overload shutdown

Overload Warning When the Freedom XC’s AC load is approximately 100 W below the overload shutdown limit of rated watts, the audible alarm beeps once and the LCD screen shows a error code E06.

Overload Shutdown When the Freedom XC’s AC load increases to near ~1100 W (Freedom XC 1000) and ~2100 W (Freedom XC 2000), the audible alarm beeps every five seconds for one minute and the LCD screen shows a error code E03. The Status LED turns solid RED.

High Surge Loads

Some induction motors used in freezers, pumps, and other motor-operated equipment require high surge currents to start. The Freedom XC may not be able to start some of these motors even though their rated steady state current draw is within the inverter’s limits. The unit will shut down and indicate an overload shutdown.

Over-temperature Conditions

During inverter operation, when the Freedom XC’s internal temperature starts to approach its preset shutdown limit, the display will show error code E07. If the over-temperature condition persists, the display will show error code E04. The Status LED turns solid RED and the inverter will shut down to prevent damage to the inverter and protect the battery from being over-discharged.



Routine Maintenance

Freedom XC Unit

Minimal maintenance is required to keep your Freedom XC operating properly. Periodically you should:

- Clean the exterior of the unit with a damp cloth to prevent the accumulation of dust and dirt.
- Ensure that the DC cables are secure and fasteners are tight.
- Make sure the ventilation openings are not clogged.



Troubleshooting

⚠ WARNING

ELECTRICAL SHOCK HAZARD
Do not disassemble the Freedom XC. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in an electrical shock or burn.
Failure to follow these instructions can result in death or serious injury.

IMPORTANT: To obtain service go to “Contact Information” on page i.

This section will help you narrow down the source of any problem you encounter. Before contacting customer service, please work through the steps listed below:

1. Check for any error codes displayed on the LCD screen. If a message is displayed, record it before doing anything further.
2. As soon as possible, record the conditions at the time the problem occurred so you can provide details when you contact customer service for help. Include the following information:
 - What loads the Freedom XC was running or attempting to run
 - What the battery condition was at the time (voltage, etc.) if known
 - Recent sequence of events

- Any known unusual AC shore power factors such as low voltage, unstable generator output, etc.
 - Whether any extreme ambient conditions existed at the time (temperature, vibrations, moisture, etc.)
3. If your Freedom XC is not displaying an error code, check the following to make sure the present state of the installation allows proper operation:
 - Is the inverter located in a clean, dry, adequately ventilated place?
 - Are the battery cables adequately sized as recommended in the Installation guide?
 - Is the battery in good condition?
 - Are all DC connections tight?
 - Are the AC input and output connections and wiring in good condition?
 - Are the configuration settings correct for your particular installation?
 - Are all disconnects and AC breakers closed and operable?
 - Have any of the fuses blown in the installation?
 4. Contact customer support for further assistance. Please be prepared to describe details or your system installation and to provide the model and serial number of the unit.

Warning Messages

Warning messages in the form of audible alarms and error codes that appear on the LCD screen to alert you to an impending system change. Warnings do not affect operation.

With the exception of the error codes displayed on the screen, only the audible alarm can be turned ON or OFF. Follow the steps in “Turning the Audible Alarm ON or OFF” on page 52 to change the alarm settings.

The error codes are listed in Table 8 below. The text in the **Error Code** column appears on the LCD screen of the display panel.

Table 8 Error Codes Displayed on the LCD Screen

Error Code	Condition	Mode	Action
E01	Low battery voltage shutdown is imminent depending on the setting, see “Operating Limits” on page 59.	Battery mode (inverting)	<ul style="list-style-type: none"> • Check battery status and recharge if necessary. • Check for proper DC cable sizing. • Check for loose connections and tighten if necessary.
E02	High battery voltage shutdown > 18.0 volts DC	Battery mode (inverting)	<ul style="list-style-type: none"> • Check for external charging sources, such as a PV charger and an over voltage alternator. Disconnect, if necessary.
E03	AC output overload shutdown	Battery mode (inverting)	<ul style="list-style-type: none"> • Reduce the loads connected to the AC outlet of the unit. • Check appliances that have high-surge ratings and disconnect if necessary.
E04	Over-temperature shutdown	Battery mode (inverting)	<ul style="list-style-type: none"> • Reduce the loads connected to the AC outlet of the unit. • Check that the ventilation grille is not blocked. • Check for ambient temperature and move the unit to a cooler location whenever possible.



Table 8 Error Codes Displayed on the LCD Screen

Error Code	Condition	Mode	Action
E05	Low battery voltage detected depending on setting, see “Operating Limits” on page 59.	Battery mode (inverting)	<ul style="list-style-type: none"> Check battery status and recharge if necessary. Check for proper DC cable sizing. Check for loose connections and tighten if necessary.
E06	AC output overload warning	Battery mode (inverting)	<ul style="list-style-type: none"> Reduce the loads connected to the AC outlet of the unit.
E07	Over-temperature alarm and fan lock alarm	Battery mode (inverting)	<ul style="list-style-type: none"> Reduce the loads connected to the AC outlet of the unit. Check that the ventilation grille is not blocked. Check for ambient temperature and move the unit to a cooler location whenever possible. Check the fan for any obstruction and remove it.
E08	Fan lock error	Grid mode (bypass)	<ul style="list-style-type: none"> If there is no issue with the fan, disconnect the unit from its DC and AC power sources, then reconnect, and then restart the unit. Perform “Step 8: Testing Your Installation” on page 33. If error detection persists, contact customer service.
E09	Dead battery alarm	Grid mode (bypass)	<ul style="list-style-type: none"> Replace the battery.
E 10 to E 19	Internal hardware error	Battery and grid modes	<ul style="list-style-type: none"> If error detection persists, contact customer service.

For error code E01: after the LBCO shutdown delay, the unit will immediately stop inverting

For error codes E02 to E04: the unit will stop inverting

Troubleshooting Reference

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Do not disassemble the Freedom XC. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in an electrical shock or burn.

Failure to follow these instructions can result in death or serious injury.

NOTICE

INVERTER DAMAGE

Avoid continually overloading the inverter and subjecting it to over temperature conditions. Although provided with integral protection against overloads continual overloading can damage the circuitry.

Failure to follow these instructions can damage the inverter.

Table 9 Troubleshooting Reference

Problem	Possible Cause	Solution
Alarm does not sound when an error is encountered.	Alarm is turned OFF.	See “Turning the Audible Alarm ON or OFF” on page 52 and follow instructions to turn the alarm buzzer on again.



Table 9 Troubleshooting Reference

Problem	Possible Cause	Solution
No output voltage. The status LED is red.	AC shore power is not available or out of operating range and the inverter has shut down with the LCD screen showing one of the following error codes:	
	<ul style="list-style-type: none"> Low input voltage (error code E01) 	<ul style="list-style-type: none"> Check the DC connections and the cable. Recharge the battery.
	<ul style="list-style-type: none"> High input voltage (error code E02) 	<ul style="list-style-type: none"> Verify the unit is connected to a 12V battery. Check the voltage regulation of the external charging system (if any).
	<ul style="list-style-type: none"> Unit overload or AC output short circuit (error code E03) Thermal shutdown (error code E04) 	<ul style="list-style-type: none"> Reduce the load. Make sure the load does not exceed the output rating. Allow the unit to cool off. Reduce the load if continuous operation is required. Improve ventilation. Make sure the inverter's ventilation openings are not blocked.

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Troubleshooting Reference

Table 9 Troubleshooting Reference

Problem	Possible Cause	Solution
No output voltage is shown in the LCD screen but the green status LED for Battery mode is illuminated.	GFCI (when installed) has tripped or supplementary breaker has tripped.	Check load and reset the GFCI or supplementary breaker.
	Circuit breaker on the AC load panel or AC output disconnect has tripped.	Reset the circuit breaker or check the AC output disconnect circuits.
	Battery voltage is too low (depending on setting, see "Operating Limits" on page 59) to start inverting. LCD screen may show DC voltage as 000.	Check DC connections and cable. Recharge battery.
No output voltage is shown in the LCD screen and neither of the green status LEDs (for Grid mode and Battery mode) is illuminated.	AC shore power is not available or out of operating range and the inverter is OFF.	<ul style="list-style-type: none"> Check AC shore power. Turn the inverter ON.
	AC shore power is not available and the inverter is OFF due to a shutdown for more than 30 seconds.	<ul style="list-style-type: none"> Check AC shore power and battery voltage. Turn the inverter ON and look at the LCD screen for any error code. See Table 8, "Error Codes Displayed on the LCD Screen" on page 64.
No output voltage. The status LED is not lighting up.	Ignition lock (ACC) signal is not present.	If the ignition control feature is in use, ensure the vehicle's ignition is On and the ignition control switch on the front of the Freedom XC 1000 unit is On (I).

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Freedom XC Owner's Guide



Table 9 Troubleshooting Reference

Problem	Possible Cause	Solution
The fan turns on and off during AC shore power mode.	<ul style="list-style-type: none"> The battery is discharged. AC pass-through current is high. 	Do not be alarmed, the unit is performing normally.
The fan turns on and off during inverter mode.	The inverter is running continuously at high power.	Do not be alarmed, the unit is performing normally. The fan is activated automatically.

Inverter Applications

The Freedom XC performs differently depending on the AC loads connected to it. If you are having problems with any of your loads, read this section.

Resistive Loads

These are the loads that the inverter finds the simplest and most efficient to drive. Voltage and current are in phase (that is, in step with one another). Resistive loads usually generate heat in order to accomplish their tasks. Toasters, coffee pots, and incandescent lights are typical resistive loads. It is usually impractical to run larger resistive loads—such as electric stoves and water heaters—from an inverter due to their high current requirements. Even though the inverter can most likely accommodate the load, the size of battery bank required would be impractical if the load is to be run for long periods.

Motor Loads

Induction motors (that is, motors without brushes) require two to six times their running current on start up. The most demanding are those that start under load, for example, compressors and pumps. Of the capacitor start motors (typical in drill presses, band saws, etc.), the largest you can expect to run is ½ hp (the transfer relays are rated at 2 hp). Universal motors are generally easier to start. Since motor characteristics vary, only testing will determine whether a specific load can be started and how long it can be run.

If a motor fails to start within a few seconds or loses power after running for a time, it should be turned off. When the inverter attempts to start a load that is greater than it can handle, it will turn itself off after a few seconds.

Long Transfer Times The Freedom XC may take a long time (~ 0.1–0.2 seconds) to transfer to Battery Mode when shore power is cut off while powering a motor load. Motor loads typically “freewheel” when power is removed (for example, a grinder) and causes a longer transfer time. The longer transition from shore power to inverter power may cause connected computers or other sensitive equipment to operate incorrectly. To avoid this effect, do not connect motor loads together with sensitive equipment to the inverter for power.

Specifications

NOTE: Specifications are subject to change without prior notice.

Physical Specifications	Freedom XC 1000	Freedom XC 2000
L × W × H	14.2" (360mm) × 10.6" (270mm) × 3.7" (95mm)	15.4" (390mm) × 10.8" (275mm) × 4.0" (102mm)
Net Weight	13.4 lbs (6.1 kg)	16.3 lbs (7.4 kg)

Environmental Specifications	Freedom XC 1000	Freedom XC 2000
Ambient Temperature: Operating Temperature Range Storage Temperature Range	-4 –140 °F (-20 –60 °C), with output derated above 104 °F (40 °C) -40 –158 °F (-40 –70 °C)	-4 –140 °F (-20 –60 °C), with output derated above 104 °F (40 °C) -40 –158 °F (-40 –70 °C)
Humidity: Operation/Storage	5–95% RH, non-condensing	5–95% RH, non-condensing

System Specifications	Freedom XC 1000	Freedom XC 2000
Transfer relay rating	30A surge, 24A continuous	30A surge, 24A continuous
Transfer time (shore to inverter)	<20 milliseconds ^a	<20 milliseconds ^a
Transfer time (inverter to shore)	<20 milliseconds with a 20-second delay	<20 milliseconds with a 20-second delay
Transfer voltage (shore to inverter)	<85 V and >135 V	<85 V and >135 V
Transfer voltage (inverter to shore)	<130 V and >90 V	<130 V and >90 V
Cooling	Fan, activated by any of the following: •High internal temperature •High AC output power	Fan, activated by any of the following: •High internal temperature •High AC output power

a. To change the AC Transfer time (mode), see “Adjusting Feature Settings in Configuration Mode” on page 45.

Specifications

DC Input (For Inverting)	Freedom XC 1000	Freedom XC 2000
Operating voltage range	LBCO voltage ^a –18.0 VDC	LBCO voltage ^a –18.0 VDC
Maximum non-operating voltage	24 VDC	24 VDC
Nominal voltage	12.0 VDC	12.0 VDC
Nominal current at full load	100 ADC	192 ADC

AC Output (For Inverting)	Freedom XC 1000	Freedom XC 2000
Output voltage options	120, 110, 108 VAC	120, 110, 108 VAC
Continuous power	1000 W ^b @ 40 °C	2000 W ^b @ 40 °C
Continuous current	8.4 A	16.7 A
Surge power	2000 W	4000 W
Frequency	60 (or 50) Hz ^c	60 (or 50) Hz ^c
Wave shape	True Sine Wave	True Sine Wave
Peak efficiency	91%	91%
Full load efficiency	≥ 87.3%	≥ 87.5%

a. To set LBCO, see “Adjusting Feature Settings in Configuration Mode” on page 45.

b. Power derates to 85% when output voltage is set to 110/108 VAC.

c. To set the AC Frequency, see “Adjusting Feature Settings in Configuration Mode” on page 45.



AC Input (For Charging)	Freedom XC 1000	Freedom XC 2000
Operating voltage range	85–140 VAC	85–140 VAC
Safe non-operating voltage range	up to 240 VAC	up to 240 VAC
Full load maximum current	7 Arms	11 Arms
Nominal frequency	60 Hz	60 Hz
Power factor at full charge	> 98%	> 98%

DC Output (For Charging)	Freedom XC 1000	Freedom XC 2000
Nominal voltage	12.0 VDC	12.0 VDC
Min battery voltage for charging	0.0 VDC	0.0 VDC
Max output voltage	18.0 VDC (custom battery type)	18.0 VDC (custom battery type)
Nominal output current	User selectable: 5 to 50A ^a	User selectable: 5 to 80A ^a
Charger current derating	May reduce charger current depending on ambient temperature.	May reduce charger current depending on ambient temperature.
Efficiency at nominal output	≥90.1%	≥91%

a. Charger current is rated to 14.4 VDC output only. The charger derates if a high DC output voltage is selected.

Regulatory Approvals	Freedom XC 1000	Freedom XC 2000
EMC and Safety	ETL listed to CSA 107.1 UL458 and UL458 Marine Supplement (drip shield with product number 808-1050 required) ABYC E11, A20, A25, A31	ETL listed to CSA 107.1 UL458 and UL458 Marine Supplement (drip shield with product number 808-1050 required) ABYC E11, A20, A25, A31
EMI	FCC Class B	FCC Class B

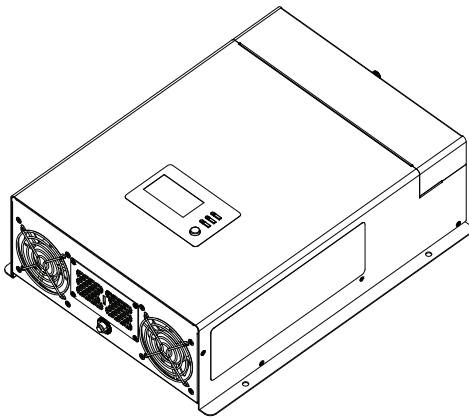
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Owner's Guide

Freedom XC PRO Inverter/Charger

Freedom XC PRO 2000 **818-2010**
Freedom XC PRO 3000 **818-3010**

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Document Number: 975-0799-01-01

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Date: November 2019

Product Name and Part Number

Freedom XC PRO 2000 (818-2010)

Freedom XC PRO 3000 (818-3010)

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Information About Your System

As soon as you open your product, record the following information and be sure to keep your proof of purchase.

Serial Number _____
 Product Number _____
 Purchased From _____
 Purchase Date _____

To view, download, or print the latest revision, visit the website shown under **Contact Information**.

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Purpose

The purpose of this Owner's Guide is to provide explanations and procedures for installing, operating, configuring, maintaining, and troubleshooting a Freedom XC PRO Inverter/Charger for Recreational, Commercial and Fleet Vehicle, or Marine installations.

Scope

The guide provides safety and operating guidelines as well as information on installing and configuring the inverter/charger. It also provides information about troubleshooting the unit. It does not provide details about particular brands of batteries. You need to consult individual battery manufacturers for this information.

Audience

The guide is intended for users and operators of the Freedom XC PRO Inverter/Charger. The Installation section starting *on page 17* is intended for qualified personnel.

Qualified personnel have training, knowledge, and experience in:

- Installing electrical equipment.
- Applying all applicable installation codes.
- Analyzing and reducing the hazards involved in performing electrical work.
- Selecting and using Personal Protective Equipment (PPE).

Abbreviations and Acronyms

A	Amperes
---	---------

AC	Alternating Current [~]
ACC	Accessory in vehicle ignition system
AGM	Absorbed Glass Mat (a battery type)
BTS	Battery Temperature Sensor
DC	Direct Current [—]
GFCI	Ground Fault Circuit Interrupter
in-lb	inch-pound force (a unit of torque)
kW	Kilowatts (1000 watts)
LBCO	Low Battery Cutout (or Cutoff)
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LFP	LiFePO ₄ (lithium iron phosphate – a battery type)
N-m	Newton-meters (a unit of torque)
PN	Product Number
PPE	Personal Protective Equipment
PV	Photovoltaic (Solar)
V, VAC, VDC	Voltage, Volts AC, Volts DC
W	Wattage

Related Information

You can find more information about Xantrex products and services at <http://www.xantrex.com/>.



IMPORTANT SAFETY INSTRUCTIONS

READ AND SAVE THIS OWNER'S GUIDE FOR FUTURE REFERENCE.

This guide contains important safety instructions for the Freedom XC PRO that must be followed during installation, operation, maintenance, and troubleshooting.

Read these instructions carefully and look at the equipment to become familiar with the device before installing, operating, configuring, maintaining, and troubleshooting it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER
DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE
NOTICE is used to address practices not related to physical injury.

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Product Safety Information

Product Safety Information

1. Before using the inverter/charger, read all instructions and cautionary markings on the unit, the batteries, and all appropriate sections of this guide.
2. Use of accessories not recommended or sold by the manufacturer may result in a risk of fire, electric shock, or injury to persons.
3. The inverter/charger is designed to be connected to both DC and AC electrical systems. The manufacturer recommends that all wiring be done by a certified technician or electrician to ensure adherence to the local and national electrical codes applicable in your jurisdiction.
4. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the inverter/charger with damaged or substandard wiring.
5. Do not operate the inverter/charger if it has been damaged in any way.
6. This unit does not have any user-serviceable parts. Do not disassemble the inverter/charger except where noted for connecting wiring and cabling. See your warranty for instructions on obtaining service. Attempting to service the unit yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
7. To reduce the risk of electrical shock, disconnect both AC and DC power from the inverter/charger before attempting any maintenance or cleaning or working on any components connected to the inverter/charger. Do not disconnect under

- load. Turning the inverter/charger to Standby mode using the Power button on the front panel will not reduce an electrical shock hazard.
8. The inverter/charger must be provided with an equipment-grounding conductor connected to the AC input ground.
9. Do not expose this unit to rain, snow, or liquids of any type. This product is designed for dry-locations-use only. Damp environments will significantly shorten the life of this product and corrosion caused by dampness will not be covered by the product warranty.
10. To reduce the chance of short-circuits, always use insulated tools when installing or working with this equipment.
11. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with electrical equipment.
12. For marine applications, this unit must be installed with a drip shield. Refer to *Marine Installation on page 49* for details.

⚠ DANGER
ELECTRICAL SHOCK AND FIRE HAZARD
Installation must be done by qualified personnel to ensure compliance with all applicable installation and electrical codes and regulations. Instructions for installing the Freedom XC PRO Inverter/Charger are provided here for use by qualified personnel only.
Failure to follow these instructions will result in death or serious injury.



⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, BURN, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Never operate energized with the wiring compartment cover removed.
- Energized from multiple sources. Before removing the wiring compartment cover - identify all sources, de-energize, and wait 2 min for circuits to discharge.
- Always use a properly rated voltage sensing device to confirm all circuits are de-energized.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

FIRE AND EXPLOSION HAZARD

- Unit's components may produce arcs or sparks.
- Do not install near batteries, in machinery space, or in an area in which ignition-protected equipment is required.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Areas include any space containing gasoline-powered machinery, fuel tanks, as well as joints, fittings, or other connections between components of the fuel system.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

- Replace the wiring compartment cover before turning on power to this equipment.
- Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb torque to ensure a proper ground connection and a required tool access to the wiring compartment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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Precautions When Working With Batteries

⚠ CAUTION

PHYSICAL INJURY HAZARD

This Freedom XC PRO Inverter/Charger is not intended for use by persons (including children) with reduced physical, sensory, or mental capabilities or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

Failure to follow these instructions can result in injury or equipment damage.

Precautions When Working With Batteries

IMPORTANT: Battery work and maintenance must be done by qualified personnel knowledgeable about batteries to ensure compliance with battery handling and maintenance safety precautions.

⚠ WARNING

BURN FROM HIGH SHORT-CIRCUIT CURRENT, FIRE AND EXPLOSION FROM VENTED GASES HAZARDS

- Always wear proper, non-absorbent gloves, complete eye protection, and clothing protection. Avoid touching your eyes and wiping your forehead while working near batteries. See note #4.
- Remove all personal metal items, like rings, bracelets, and watches when working with batteries. See notes #5 and #6 below.
- Never smoke or allow a spark or flame near the engine or batteries.
- Never charge a frozen battery.
- Never charge a Lithium Ion type battery with an ambient of 0 °C (-32 °F) or colder.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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⚠ CAUTION

PHYSICAL INJURY HAZARD

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- Never charge a Lithium Ion type battery with an ambient of 0 °C (-32 °F) or colder.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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Regulatory

NOTICE

RISK OF INVERTER/CHARGER DAMAGE

- Never allow battery acid to drip on the inverter/charger when reading gravity, or filling battery.
- Never place the Freedom XC PRO unit directly above batteries; gases from a battery will corrode and damage the inverter/charger.
- Do not place a battery on top of the inverter/charger.

Failure to follow these instructions can result in equipment damage.

Regulatory

The Freedom XC PRO inverter/charger is certified to appropriate US and Canadian standards. For more information see *Regulatory approvals on page 98*.

The Freedom XC PRO inverter/charger is intended to be used for mobile or commercial applications. This inverter/charger is designed for marine applications only when additional drip protection is installed in certain orientations. See the section on Specifications for information.

FCC Information to the User

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC / CAN ICES-003 Class B Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

⚠ CAUTION

Unauthorized changes or modifications to the equipment could void the user's authority to operate the equipment.

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End of Life Disposal

The Freedom XC PRO Inverter/Charger is designed with environmental awareness and sustainability in mind. At the end of its useful life, the Freedom XC PRO can be decommissioned and disassembled. Components which can be recycled must be recycled and those that cannot be recycled must be disposed of according to local, regional, or national environmental regulations.

Many of the electrical components used in the Freedom XC PRO Inverter/Charger are made of recyclable material like steel, copper, aluminum, and other alloys. These materials can be auctioned off to traditional scrap metal recycling companies who resell reusable scraps.

Electronic equipment such as the circuit boards, connectors, and fuses can be broken down and recycled by specialized recycling companies whose goal is to avoid having these components end up in the landfill.

For more information on disposal, contact Xantrex.



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1 INTRODUCTION

The Freedom XC PRO Inverter/Charger is designed with integrated inverting functions and power management features suitable for marine, recreational, and commercial/fleet vehicle installations.

Please read this section to familiarize yourself with the main performance and protection features of the Freedom XC PRO.

This section includes:

Materials List	2
Key Features	2



Materials List

The Freedom XC PRO base package includes the following items:

- one Freedom XC PRO unit
- one Owner's Guide and extra safety labels
- one pre-installed DC ground enclosure lug (not shown)
- one set of plastic bushings for large DC cables (not shown)
- two AC knockout hole plugs (not shown)

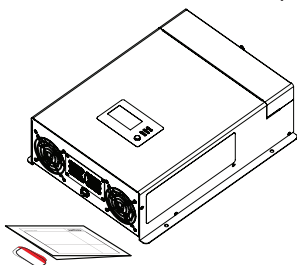


Figure 1 What's In The Box

NOTE: If any of the items are missing, contact Xantrex or any authorized Xantrex dealer for replacement. See *Contact Information on page ii*.

Key Features

Power for Most Appliances

The Freedom XC PRO inverter/charger provides up to 2000 watts (Freedom XC PRO 2000) or 3000 watts (Freedom XC PRO 3000) of continuous utility grade, sine wave power derived from a battery bank. It is designed to handle loads such as microwave ovens, TVs, DVD/Blu-ray players, and power tools. In addition, the Freedom XC PRO's high-surge capability lets you handle many hard-to-start loads, including full size residential refrigerators.

The built-in transfer switch automatically transfers between inverter power and shore power from recreational facilities such as boat docks or campsites to ensure power is always available.

Back-up Capability

If incoming shore power is interrupted by external events like brownouts, the Freedom XC PRO automatically becomes an independent power source¹ that supplies utility grade AC power to your loads.

¹Assuming the inverter/charger is connected to a battery source with an adequate charge at the time of the power interruption.

Comprehensive Protection

The Freedom XC PRO's built-in protection features safeguard your batteries (from unnecessary drain) such as the low battery voltage alarm and shutdown and protect equipment such as a configurable AC transfer speed.

- **Selectable Low Battery Shutdown:** The low battery shutdown for the inverter/charger can be manually selected by the user from 10.1 to 12.8 VDC.
- **Low Voltage Shutdown Delay Timer:** Configurable from 1 to 300 s to reduce an unnecessary shutdown of inverter operation such as during cranking or other brief but heavy discharge of battery.
- **Inverter Power Save:** The Freedom XC PRO can be programmed to automatically turn off after 1 to 25 h of continued operation of loads that are under 50 W. It is designed, with LBCO (low battery cut off), to prevent the battery from deep discharge.

Configurable AC Transfer Speed

The Freedom XC PRO allows two speed settings for the AC transfer from Grid Mode to Battery Mode and vice versa which avoids nuisance resetting of appliances. The normal transfer rate is for common appliances and the faster transfer rate is designed for more sensitive digital equipment like a desktop computer.

Overload Alarm and Shutdown

During Battery Mode (also called Inverter Mode), the Freedom XC PRO automatically alerts you if the loads that are connected and drawing power from the unit are close to approaching the maximum operating limit. If so, the Freedom XC PRO automatically shuts down when the maximum operating limit is exceeded. See *Troubleshooting Reference on page 86* for precautions.

Over temperature Alarm and Shutdown

During Battery Mode, the Freedom XC PRO automatically alerts you if it is overheating and approaching the over-temperature shutdown limit. The Freedom XC PRO automatically shuts down when the limit is exceeded. See *Troubleshooting Reference on page 86* for precautions.



XANTREX FREEDOM XC PRO INVERTER

Materials List

Built-in Charge Formulas	For the inverter/charger to perform at the highest level, the batteries must be charged correctly. The Freedom XC PRO has optimized algorithms for flooded, gel, AGM, custom, and lithium iron phosphate [LFP (or LiFePO ₄)] batteries.
Manual Equalization	Over a period of time, the cells in a flooded battery can develop uneven chemical states. This can result in a weak (undercharged) cell which, in turn, can reduce the overall capacity of the battery. To improve the life and performance of a non-sealed, flooded battery, the Freedom XC PRO multi-stage charging cycle includes a manual equalize mode that can be used, if recommended by the battery manufacturer.
Dead Battery Charging	Another feature of the Freedom XC PRO is dead battery charging. This is the ability to recharge batteries, even if the battery voltage has reached 0 VDC.

Ignition Control	The Freedom XC PRO provides two user-selectable options for ignition control: <ul style="list-style-type: none"> ■ Ignition Auto-on: The Freedom XC PRO can automatically turn the inverter/charger on and off in tandem with the vehicle's ignition circuit or a manually operated remote switch. ■ Ignition Lockout: The Freedom XC PRO features the ability to inhibit the inverter/charger from operating in the absence of a voltage signal from a vehicle's ignition circuit. This is particularly useful if the inverter/charger is required to operate only when a vehicle's engine is running.
Configurable AC Output Frequency and Voltage	The Freedom XC PRO is factory set to 60 Hz AC output frequency and 120 V AC output voltage. It can be configured to 50 Hz for use in regions outside the USA and Canada. The AC voltage setting can also be configured to either of three settings: 108, 110, or 120 volts.

Materials List

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Load Management

The Freedom XC PRO has a built-in 30A transfer relay (Freedom XC PRO 2000) and 50A transfer relay (Freedom XC PRO 3000) that connects the inverter/charger output or AC input from the AC generator to the loads. Because the usual AC power sources such as small generators often have limited current availability, having the capability to manage your AC loads is extremely valuable. The Freedom XC PRO provides a number of features to facilitate 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 charge current and maintaining the total input current to less than the breaker setting.

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2 FEATURES

This section identifies the default settings and the hardware features of the Freedom XC PRO Inverter/Charger.

This section includes:

Default Settings	8
AC/DC and GFCI Panel	10
Display Panel	12
Side Panel	13

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XANTREX FREEDOM XC PRO INVERTER

Default Settings

Default Settings

Table 1 lists the default settings for the Freedom XC PRO system.

You may record your settings in the right-hand column after you have configured the Freedom XC PRO.

Table 1 Freedom XC PRO Default Values

Program	Item	Default Setting		Setting
01	Inverter ignition control	Off	OFF	
02	Low battery cutoff (LBCO) voltage	10.5 volts DC	10.5	
03	LBCO shutdown delay timer	300 seconds	300	
04	LBCO recovery voltage	13.1 volts DC	13.1	
05	Power save time	25 hours	25	
06	Load sensing	Disabled	d .5	
07	Inverter output frequency	60 Hz	60	
08	Inverter output voltage	120 volts AC	120	
09	Inverter power limit Freedom XC PRO 2000	2 kW	2	
	Freedom XC PRO 3000	3 kW	3	
10	Inverter power limit timer	300 seconds	300	
11	Transfer mode	Appliance	APL	

Program	Item	Default Setting		Setting
12	Utility AC under-voltage level	90 volts AC	90	
13	Inverter fault recovery	Manual	MAN	
14	Audible alarm	On	On	
20	Battery type	Flooded	Fld	
21	Battery temperature	Hot	Hot	
22	Custom absorption voltage	14.4 volts DC	14.4	
23	Custom float voltage	13.5 volts DC	13.5	
24	Charger current	80 amps DC	80	
25	Charger algorithm	2-stage	2-5t9	
		3-stage	3-5t9	
26	Charger ignition control	Off	OFF	
27	Equalize charge for flooded battery type	Disabled	d .5	
28	AC input breaker	30 amps	30	



AC/DC and GFCI Panel

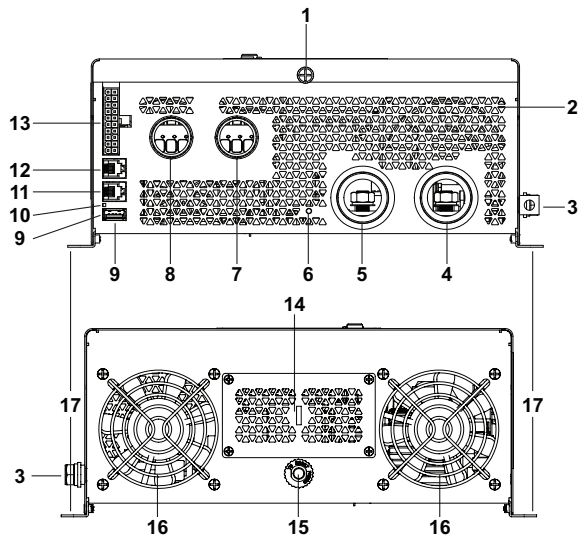


Figure 2 AC/DC and GFCI Panel

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb (0.56 N-m) torque of force to ensure a proper ground connection and a required tool access to the wiring compartment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Table 2 AC/DC and GFCI Panel Features

Item	Description
1	Captive nut panel screw holds the AC compartment cover in place. See WARNING above.
2	Ventilation grille (openings) must not be obstructed.
3	Grounding lug provides a ground path for the Freedom XC PRO chassis to the DC system ground. See WARNING.
4	DC terminal opening for routing (-) negative DC cable.
5	DC terminal opening for routing (+) positive DC cable.
6	LED indicator for reverse DC polarity.
7	AC output terminal opening for routing AC output wiring.
8	AC input terminal opening for routing AC input wiring.

Item	Description
9	USB port can only be used for updating the unit's firmware. It is not used for powering USB devices.
10	LED indicator for communication and control activation.
11	BTS port can be used for plugging in a battery temperature sensor [BTS (PN: 808-0232-01), sold separately].
12	Remote port allows you to connect the Freedom X Remote Panel with cable (PN: 808-0817-01) (sold separately) which is a remote control device accessory.
13	20-pin CC (communications and control) port connects with the optional 20-pin Communications Harness (PN: 808-0820) (sold separately).
14	GFCI cover is removed when installing a qualified GFCI device.
15	20 A supplementary protector with reset button provides overload protection for the Freedom XC PROGFCI Kit (PN: 808-9817) (sold separately) option. Press to recover from an overload condition. In a hard wired installation, the supplementary protector does not protect output wiring.

Item	Description
16	Ventilation grille (openings) must not be obstructed for the proper operation of the cooling fan and inverter/charger. When the inverter/charger is mounted, the ventilation grille must not point up or down. Cooling fans turn on when the internal temperature reaches a set point temperature.
17	Mounting flanges on both sides allow you to mount the inverter/charger permanently on deck or on a wall.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

- Use a torque screwdriver to tighten the bolt on the DC ground lug to a torque of 23 in-lb (2.6 N-m) of force.
- Apply an anti-corrosion compound to the copper wire prior to connecting to the DC ground lug.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



XANTREX FREEDOM XC PRO INVERTER

Display Panel

Display Panel

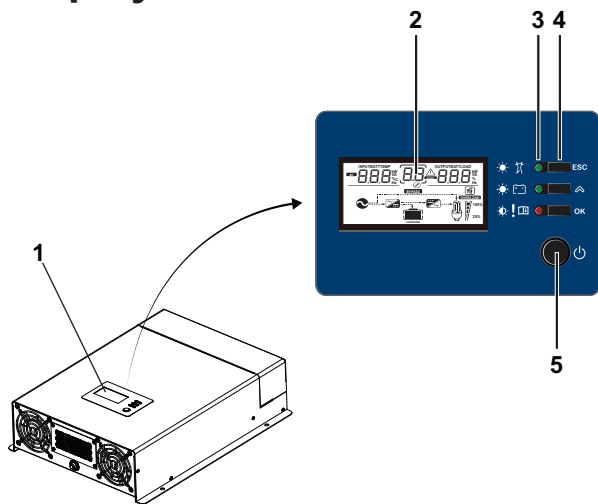


Figure 3 Display Panel

Table 3 Display Panel Features

Item	Description
1	Display panel displays status information on the screen. It is comprised of a display screen, LEDs, and buttons.
2	Multi-function LCD screen shows status information and error codes.
3	Status LEDs indicate the mode of operation.
4	Three function buttons change status information displayed on the screen. Also, changes inverter/charger settings. See <i>Freedom XC PRO Display Panel on page 52</i> for detailed information on the panel's buttons.
5	Power button is pressed for turning on the unit. The inverter turns on for the loads and when applicable, the charger turns on automatically.

Side Panel

Side Panel

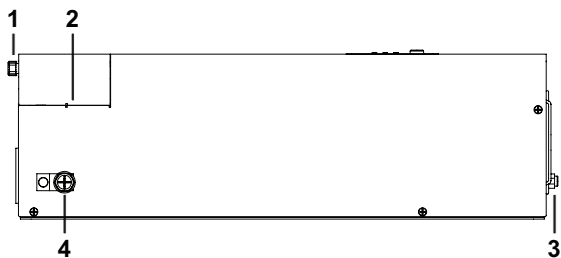


Figure 4 Side Panel

Table 4 Side Panel Features

Item	Description
1	Captive nut panel screw holds the wiring compartment cover in place. See WARNING above.
2	Wiring compartment cover protects the wiring compartment from debris and keeps the cables secure. Using the captive nut panel screw, the cover can be opened and lifted out during wiring. See WARNING on the left.
3	20 A supplementary protector with reset button provides overload protection for the Freedom XC PRO GFCI Kit (PN: 808-9817) (sold separately) option. Press to recover from an overload condition. In a hard wired installation, the supplementary protector does not protect output wiring.
4	Grounding lug provides a ground path for the Freedom XC PRO chassis to the DC system ground. See WARNING.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

- Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb torque to ensure a proper ground connection and a required tool access to the wiring compartment.
- Use a torque screwdriver to tighten the bolt on the DC ground lug to a torque of 23 in-lb (2.6 N-m) of force.
- Apply an anti-corrosion compound to the copper wire prior to connecting to the DC ground lug.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



3 INSTALLATION

Please read this section for safety information and installation instructions regarding your Freedom XC PRO.

This section includes:

Before You Begin the Installation	16
Installation Codes	16
Installation Tools and Materials	17
Basic Installation Procedures	18
Step 1: Designing the Installation	19
Step 2: Choosing a Location for the Unit	25
Step 3: Mounting the Unit	26
Step 4: Connecting the AC Input Wires	28
Step 5: Connecting AC Output to an Existing AC Circuit	32
Step 6: Connecting the DC Cables	36
Step 7: Connecting to Port(s) on the Freedom XC PRO	41
Step 8: Testing Your Installation	47
Marine Installation	49
Drip Shield Installation	50

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Before You Begin the Installation

Before You Begin the Installation

Before beginning your installation:

- Read this entire Installation section so you can plan the installation from beginning to end.
- Assemble all the tools and materials you require for the installation.
- Review the *Important Safety Instructions on page v*
- Be aware of all safety and electrical codes which must be met.

WARNING

ELECTRICAL SHOCK AND FIRE HAZARD

- All wiring should be done by qualified personnel to ensure compliance with all applicable installation codes and regulations.
- Do not connect to AC and DC power sources during installation. Disconnect from all power sources when servicing.
- Disable and secure all AC and DC disconnect devices and automatic generator starting devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage

Installation Codes

Governing installation codes vary depending on the specific location and application of the installation. Some examples include the following:

- The U.S. National Electrical Code (NEC)
- The Canadian Electrical Code (CEC)
- The U.S. Code of Federal Regulations (CFRs)
- Canadian Standards Association/CSA Group (CSA) and the RV Industry Association (RVIA) standards and codes for installations in RVs
- The American Boat and Yacht Council (ABYC) standards and US Coast Guard Regulations (33CFR183, Sub Part I) for Marine installations in the U.S.

It is the installer's responsibility to ensure that all applicable installation requirements are met.



Installation Tools and Materials

You will need the following to install the Freedom XC PRO:

- Wire stripper
- Mounting (#2) screws or bolts
- #2 Phillips torque screwdriver
- Torque wrench for DC terminals (1/2" or 13mm socket wrench)
- AC cable (that is, two-conductor-plus-ground cable), sized appropriately for load and application
- 1/2" (or 3/4") trade-size strain relief clamps (for the AC cable clamp holes)
- Wire nuts or crimp connectors if installing the 20-pin Communications Harness (PN: 808-0820) (sold separately)
- DC cable, sized appropriately for load and application
- Lugs for DC cables to fit 5/16" DC stud terminals as well as appropriate tools (like a crimping tool)
- AC and DC disconnects and over-current protective devices

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Basic Installation Procedures

Basic Installation Procedures

This section provides sample installation information as a guide for your installation. For your convenience, the overall procedure is divided into these main steps:

Step 1: Designing the Installation	19
Step 2: Choosing a Location for the Unit	25
Step 3: Mounting the Unit	26
Step 4: Connecting the AC Input Wires	28
Step 5: Connecting AC Output to an Existing AC Circuit ..	32
Step 6: Connecting the DC Cables	36
Step 7: Connecting to Port(s) on the Freedom XC PRO	41
Step 8: Testing Your Installation	47

NOTE: For marine applications, see additional installation instructions *on page 49*.

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Freedom XC PRO Owner's Guide



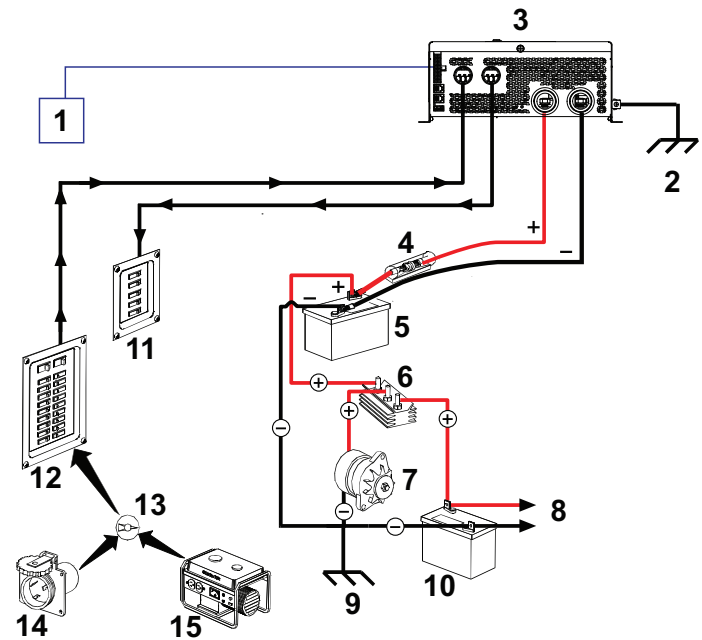
Step 1: Designing the Installation

Most Freedom XC PRO installations share common components, and some of these are briefly described in *Step 1: Designing the Installation*.

Figure 5 shows some components and their relationship to each other in a typical recreational vehicle or fleet vehicle installation. Also, see "Marine Installation" on page 49.

1	20-pin harness accessory
2	Equipment ground
3	Freedom XC PRO
4	DC fuse/disconnect/DC circuit breaker
5	12V deep cycle battery [house]
6	Battery isolator
7	Alternator
8	To engine
9	Equipment ground
10	Starting battery
11	AC load panel
12	AC source panel
13	Selector switch
14	Shore power
15	Generator

Figure 5 Typical Recreational Vehicle and Fleet Vehicle Installation



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Basic Installation Procedures

AC Shore Power

A source of 120 volts AC 60Hz sine wave alternating current provides energy to pass power through to AC loads. This source is usually the utility grid (power company) or an AC generator. An automatic or manual AC source selector switch can be used to switch between the multiple sources of shore power to the Freedom XC PRO system.

The AC source feeding the Freedom XC PRO must have the neutral conductor bonded to ground. When the inverter/charger passes shore power through, it will lift its internal bonding relay on the output and will rely on the input neutral being bonded in order to ensure that the power delivered to a sub panel is properly bonded. See *AC Output Neutral Bonding on page 22* for more information on bonding relay operation.

NOTE: Throughout this guide, the term "shore power" refers to AC input power from a utility grid, generator, or other AC source.

AC Disconnect and Over-Current Protection Device

Most safety requirements and electrical codes require the Freedom XC PRO's AC and DC inputs and outputs to be provided with over-current protection (such as circuit breakers or fuses) and disconnect devices.

AC Input The circuit breaker or fuse (connected through hard wiring) that is used to supply the Freedom XC PRO must be rated at no more than 30A (for the Freedom XC PRO 2000) or 50A (for the Freedom XC PRO 3000) and must be approved for use on 120 volts AC branch circuits. The wire used between the breaker and the Freedom XC PRO input must be sized adequately to carry current up to the rating of the input breaker and in accordance with the electrical codes or regulations applicable to your installation.



AC Output The circuit breaker or fuse must be rated at no more than the rating of the input breaker in the installation and must be approved for use on 120 volts AC branch circuits. The wire used between the Freedom XC PRO and the AC output breaker must be of adequate size to match the AC input circuit breaker's rating. The wiring from each AC output breaker to each of the loads must be adequately sized to carry the current rating of the individual AC output breaker.

Disconnect Devices Each system requires a method of disconnecting the AC circuits. If the over-current protection devices are circuit breakers, they will also serve as the disconnects. If fuses are used, separate AC disconnect switches will be needed ahead of the fuses. These will have to be a branch circuit rated for 120 volts AC and have an appropriate current rating.

AC Distribution Panels

Most systems incorporate distribution centers both ahead of the Freedom XC PRO (the AC source panel) and between the Freedom XC PRO and the loads (the AC load panel). An AC source panel includes a main circuit breaker, which serves as over-current protection and as a disconnect for the AC shore power supply line. Additional circuit breakers serve individual circuits, one of which serves the Freedom XC PRO. The AC load panel can incorporate an AC output circuit breaker and breakers for individual load circuits.

NOTICE

RISK OF INVERTER DAMAGE

Do not connect the Freedom XC PRO to a 120/240V, 3-pole, 4-wire circuit.

Failure to follow these instructions can result in equipment damage.

AC Cabling

AC cabling includes all the wires and connectors between the AC source and the Freedom XC PRO, as well as all AC cabling between the Freedom XC PRO and the AC output panels, circuit breakers, and loads. The type and size of the wiring varies with the installation and load. For example, in high vibration environments, such as marine or RV applications, wire nuts may not be acceptable, so crimp splices would be required. In other

Basic Installation Procedures

applications, flexible multiple-strand wire may be required. Installation codes usually specify solid or stranded, overall size of the conductors, and type and temperature rating of the insulation around the wire.

AC breakers and fuses must be sized to adequately protect the wiring that is installed on the input and output AC circuits of the Freedom XC PRO. All breakers and wiring must be sized and connected in accordance with the electrical codes or regulations applicable to your installation. *Table 5* gives some examples of wiring sizes based on the U.S. National Electrical Code and the Canadian Electrical Code. These examples are based on using a two-conductor-plus-ground copper cable rated at 60 °C, and assuming an ambient temperature of up to 30 °C. Ensure that your breakers and fuses have suitable temperature ratings for your wiring. Other codes and regulations may also be applicable to your installation.

Table 5 Required AC Wire Size vs Breaker Rating

Breaker Size (A)	10A	15A	20A	30A	50A
Minimum Wire Size (AWG)	14AWG	14AWG	12AWG	10AWG	6AWG

AC Output Neutral Bonding

The neutral conductor of the Freedom XC PRO's AC output circuit (that is, AC Output Neutral) is automatically connected to the safety ground during inverter operation. When AC utility power is present this connection is not present, so that the utility neutral (that is, AC Input Neutral) is only connected to utility ground at your source. This conforms to the National Electrical Code (NEC), which 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 in only one place. Check the regulations for your specific application to ensure that the installation will comply with the necessary requirements. In other words, the AC Input Neutral ground bonding and Output Neutral ground bonding must be isolated from each other.

AC Grounding

As per UL458 SA29.5, for all permanently connected marine inverters: The Freedom XC PRO should be connected to a grounded, metal, permanent wiring system. Also, make sure that an AC ground wire is connected to the AC ground terminal on the unit. Do not just connect the line and neutral wires.

All connections to the unit should comply with all regulations, directives, local codes and ordinances.



Ground Fault Circuit Interrupters (GFCIs)

A GFCI is a device that de-energizes a circuit when a current to ground exceeds a specified value that is less than that required to blow the circuit breaker. GFCIs are intended to protect people from electric shocks and are usually required in wet or damp locations.

Installations in marine and recreational vehicles require GFCI protection of branch circuits connected to the AC output of the Freedom XC PRO.

The Freedom XC PRO GFCI Kit (PN: 808-9817) (sold separately) option is available to use with the Freedom XC PRO inverter unit.

DC Cabling

This includes all the cables and connectors between the batteries, the DC disconnect and over-current protection device, and the Freedom XC PRO. Most mobile installations require multi-strand insulated cables for flexibility and durability in high vibration environments and require disconnects and over-current devices. Electrical wiring sizes in North America are indicated by AWG notation. In other parts of the world, the metric system is used. Under the AWG standard, a larger gauge number indicates a smaller wire diameter. Wire size is usually marked on the larger sized cables. *Table 6* specifies the minimum recommended DC cable size and maximum fuse size for the Freedom XC PRO. **The DC cables must be stranded, copper, and must be rated 90 °C minimum.** The cables should be terminated with lugs that fit the DC stud terminals snugly ($\frac{5}{16}$ " hole size) and properly torqued according to manufacturer-specified torque setting.

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Basic Installation Procedures

Table 6 Required Cable Sizes

Inverter/charger	Cable Length: Battery to Inverter (one way)	Minimum Cable Size	Maximum battery Fuse Size
Freedom XC PRO 2000	Less than 5 feet (1.5 meters)	No. 2/0 AWG	250 A DC
Freedom XC PRO 3000	Less than 5 feet (1.5 meters)	No. 4/0 AWG	350 A DC

NOTE: It is not recommended using a cable longer than 5 feet (1.5 meters) in each direction. North American cable sizes above are based on the US National Electrical Code Table 310.17 - 75 °C cables, assuming an ambient temperature of 30 °C cables.

IMPORTANT: Using the correct cable size is critical to achieving the rated performance of the Freedom XC PRO unit. When starting a heavy load the Freedom XC PRO can draw current surges from the battery of up to 400A. If the DC wiring is too small the voltage drop from this surge will result in a voltage at the Freedom XC PRO terminals that is too low for the Freedom XC PRO to operate correctly. The Freedom XC PRO may appear to operate correctly with smaller cables until a heavy load such as a microwave or refrigerator attempts to start - then the unit may work correctly sometimes and not work correctly other times.

DC Disconnects and Over-Current Devices

The DC circuit from the battery to the Freedom XC PRO must be equipped with a disconnect and over-current device. This usually consists of a circuit breaker, a "fused-disconnect", or a separate fuse and DC disconnect. **Do not confuse AC circuit breakers with DC circuit breakers.** They are not interchangeable. The rating of the fuse or breaker must be matched to the size of cables used in accordance with the applicable installation codes. The breaker or disconnect and fuse should be located as close as possible to the battery, in the positive cable. Applicable codes may limit how far the protection can be from the battery.

Batteries

The Freedom XC PRO uses 12-volt battery banks. Every Freedom XC PRO system is recommended to have a deep-cycle battery (house) or group of batteries with a total capacity of 100 Ah or more which provides the DC current that the Freedom XC PRO converts to AC.

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Freedom XC PRO Owner's Guide



Step 2: Choosing a Location for the Unit

⚠ WARNING

FIRE AND EXPLOSION HAZARDS

- Do not install the Freedom XC PRO in compartments containing batteries or flammable materials, or in locations that require ignition-protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connections between components of the fuel system. This equipment contains components that tend to produce arcs or sparks.
- Do not install on or over combustible surfaces.
- Do not cover or obstruct the ventilation openings.
- Do not install the Freedom XC PRO in a zero-clearance compartment. Overheating may result.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The Freedom XC PRO should only be installed in locations that meet the following requirements:

- **Dry.** Do not allow water or other fluids to drip or splash on the Freedom XC PRO. **Do not mount the Freedom XC PRO in an area subject to splashing water or bilge water.**

- **Cool.** Normal air temperature should be between 20 °C and 40 °C (-4 °F and 104 °F)—the cooler the better.
- **Ventilated.** Allow at least 5 inches of clearance at the fan end of the Freedom XC PRO for air flow, 1 inch on each side, and 2 inches at the wiring access (AC and DC) end. The more clearance for ventilation around the unit, the better the performance. Do not allow the ventilation openings on the ends of the unit to become obstructed.
- **Safe.** Do not install the Freedom XC PRO in the same compartment as batteries or in any compartment capable of storing flammable liquids like gasoline.
- **Close to the battery compartment and the AC source and load panels.** Avoid excessive cable lengths (which reduce input and output power due to wire resistance). Use the recommended cable lengths and sizes, especially between the battery banks and the Freedom XC PRO.
- **Protected from battery acid and gases.** Never allow battery acid to drip on the Freedom XC PRO or its wiring when reading specific gravity or filling the battery. Also do not mount the unit where it will be exposed to gases produced by the batteries. These gases are very corrosive, and prolonged exposure will damage the Freedom XC PRO.

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Basic Installation Procedures

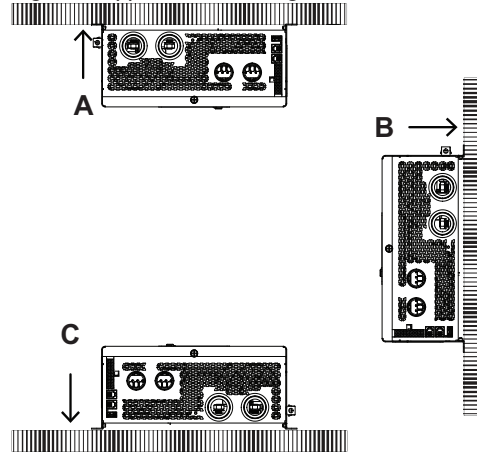
Step 3: Mounting the Unit

To mount the Freedom XC PRO:

1. Remove the Freedom XC PRO from its shipping container, verify that all components are present, and record relevant product information on "Information About Your System" in the Owner's Guide.
2. Select an appropriate mounting location and orientation (see *Figure 6*). To meet regulatory requirements, for use in on-land applications, the Freedom XC PRO must be mounted in one of the following orientations:
 - a. Under a horizontal surface (see A)
 - b. In a horizontal position on a vertical surface (see B)
 - c. On a horizontal surface (see C)

NOTE: For marine installations, only this orientation is allowed, due to the probability of moisture finding access into the enclosure.

Figure 6 Approved Mounting Orientations



3. Mark the desired number of mounting holes on the wall by placing the unit on the wall.
4. Pilot-drill the mounting holes.
5. Fasten the Freedom XC PRO to the mounting surface. If you are mounting the unit on a wall or bulkhead, use #12 or #14 pan-head wood or sheet metal screws to secure it to the framing behind the wall or bulkhead. Alternatively, use nut inserts and ¼"-20 machine screws.

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Connecting the Equipment Ground

⚠ WARNING

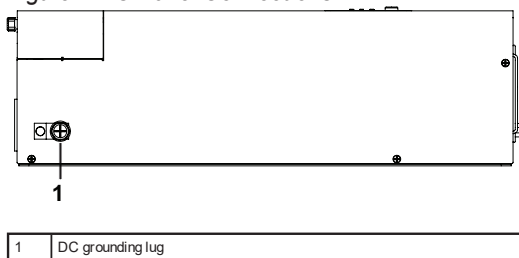
ELECTRIC SHOCK HAZARD

Never operate the Freedom XC PRO without properly connecting the equipment ground. A shock and energy hazard could result from improper grounding.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The Freedom XC PRO has a ground lug on the side of the unit as shown in *Connecting the Equipment Ground*. Follow the guidelines in *Connecting the Equipment Ground* to connect the inverter/charger's chassis to the ground.

Figure 7 DC Panel Connections



Grounding Locations

You must connect the equipment ground lug to a grounding point—usually the vehicle's chassis or DC negative bus ground—using recommended copper wire (if insulated then green insulation with or without one or more yellow stripes) or larger.

Make sure to tighten the bolt on the DC ground lug to a torque of 23 in-lb (2.6 N-m) of force. Apply an anti-corrosion compound to the copper wire prior to connecting to the DC ground lug.

For recommended equipment ground cable size, see below.

Table 7 Equipment DC ground cable size

Application	Minimum equipment ground cable size (Stranded copper cable is required)
Recreational Vehicle ^a	No. 8 AWG
Marine ^b	No. 2/0 AWG

NOTE: There are no restrictions on length for the equipment ground cable but try to make it as short as practical to a secure chassis connection. In general, the equipment ground cable size must not be smaller than one AWG size than the supply cable.

^aBased on US National Electrical Code NFPA70, Article 551, par. 551-20c and ANSI/RVIA LV, § 2-5.1.

^bBased on ABYC E-11 § 11.16 and A-31 § 31.6.5.

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Basic Installation Procedures

Step 4: Connecting the AC Input Wires

⚠ WARNING

ELECTRIC SHOCK AND FIRE HAZARDS

Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes. Do not connect the output terminals of the Freedom XC PRO to any incoming AC source.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

General AC Wiring Considerations

AC Wiring Connectors

Where applicable, connect AC wires with crimp-on splice connectors. The amount of insulation you strip off individual wires will be specified by the connector manufacturer and is different for different types of connectors.

AC and DC Wiring Separation

Do not mix AC and DC wiring in the same conduit or panel. Where DC and AC wires must cross, make sure they do so at 90° to one another. Consult applicable codes for details about DC and AC wiring in close proximity to each other.

AC Wiring and GFCIs

You can plug loads of up to 20 amps directly into the GFCI

receptacle on the front panel of the Freedom XC PRO. If installed, you can also connect the inverter to an existing AC installation and then plug loads into GFCI receptacles connected to that circuit.

If you plan to use the Freedom XC PRO GFCI kit on the unit, proceed to *General AC Wiring Considerations on page 28*.

AC wiring includes all the wires and connectors between the AC source and the Freedom XC PRO and all wiring between the inverter/charger, the AC panels, GFCI, and circuit breakers. The type and size of the wiring varies with the installation and load. For some RV applications, flexible multiple-strand copper wire is required.

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AC wiring must be sized appropriately using conductors with insulation rated at least 75 °C to carry full load current on the input and output AC circuits in accordance with the electrical codes or regulations applicable to your installation. *Table 8* is based on the U.S. National Electrical Code and the Canadian Electrical Code, assuming two-conductor-plus-ground cable, using 75 °C wiring, at an ambient temperature of 30 °C. Other codes and regulations may be applicable to your installation.

Table 8 Required AC wire size vs. required breaker rating

	Required Breaker Size (A)	Required Wire Size (AWG)
Freedom XC PRO 2000	30 A maximum 20 A maximum through a GFCI	10 AWG
Freedom XC PRO 3000	50 A maximum 20 A maximum through a GFCI	6 AWG

The AC input terminal is located inside the unit through the front panel's 1/2" trade-size hole (or 3/4" trade-size knockout) and is labeled properly as **AC IN** or **AC INPUT**. The unit comes with spring clamp-type terminals where individual wires can be attached securely.

NOTICE

EQUIPMENT DAMAGE

Make sure the wires are connected properly. The AC wiring terminal blocks are split into input and output sections.
Failure to follow these instructions can result in equipment damage.

When making the AC input and AC output connections, observe the correct color code for the appropriate AC wire, as described in *Table 9* below.

Table 9 Color codes for typical AC wiring

Color	AC Wire
Black/Red/Brown	Line
White/light blue	Neutral
Green, green/yellow, or bare copper	Ground

Basic Installation Procedures

NOTICE

REVERSE POLARITY DAMAGE

Make sure the wires are connected properly. Improper connections (connecting a line conductor to a neutral conductor, for example) will cause the Freedom XC PRO to malfunction and may permanently damage the inverter/charger. Damage caused by a reverse polarity connection is not covered by your warranty.
Failure to follow these instructions can result in equipment damage.

Wiring Knockouts

When installing wires to the AC terminals, the AC input and output holes are provided to accommodate 1/2" trade-size strain relief clamps. If larger cables and strain relief clamps are needed, remove the 3/4" trade-size knockout rings.

Make sure to seal the open knockout holes with the supplied knockout plugs by placing the plugs and firmly pressing them into the holes.

NOTICE

EQUIPMENT DAMAGE

Install the supplied AC knockout plugs over the knockout holes when not used for wiring to prevent objects and other material from entering the unit.
Failure to follow these instructions can result in equipment damage.

AC Input Connections

To make a permanent connection to existing AC wiring:

1. Ensure AC and DC power sources are turned off.
2. Install the required circuit breaker in the AC distribution panel supplying AC power to the unit.
3. Remove the wiring compartment cover by loosening the captive nut panel screw and lifting the cover up and out.

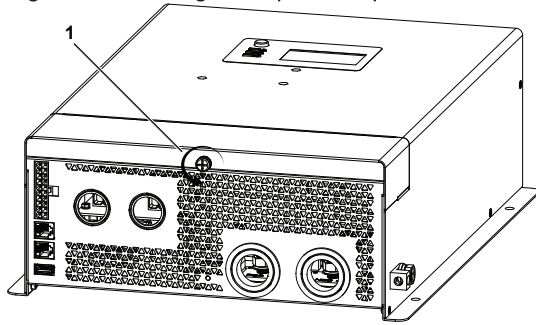
⚠ WARNING

ELECTRIC SHOCK HAZARD

Use a screwdriver to loosen the captive nut panel screw.
Failure to follow these instructions can result in death, serious injury, or equipment damage.



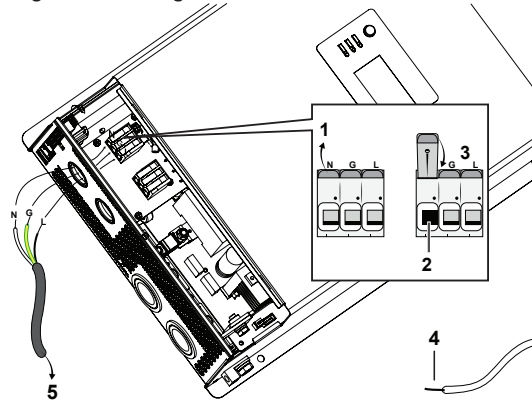
Figure 8 Loosening the captive nut panel screw



1	Captive nut panel screw
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4. Strip a single AC input wire, as appropriate. Strip 10 mm off the ends of each of the three the wires (tin the exposed copper wire with lead-free solder using a soldering iron).
5. Install a ½" (or ¾") strain relief clamp on the AC input hole.
6. Route the wires through the strain relief clamp (not shown in the figure).

Figure 9 Routing the wires



1	step 8a
2	step 8b
3	step 8c
4	15mm
5	to circuit breaker
NOTE: AC input hole - install a strain relief clamp (not shown).	

7. Locate the Neutral, Ground and Line terminals on the AC input terminal labeled as **N**, **G**, and **L** respectively.

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Basic Installation Procedures

8. Connect each AC wire into its corresponding terminal on the no-tool cage clamp terminal block.
 - a. Lift the terminal lever (as shown in the previous figure).
 - b. Insert the wire fully into the open slot.
 - c. Lower the terminal lever to secure the wire in the slot.
9. Make sure that each AC wire is matched and connected to the Neutral (**N**), Ground (**G**), and Line (**L**) connections.
10. Tighten the strain relief clamp to secure the wires.
11. Replace the wiring compartment cover onto the unit (using a #2 Phillips torque screwdriver - see WARNING), if you are not connecting other wires such as for the AC Output. Otherwise, keep the AC compartment open and proceed to the next step.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb (0.56 N-m) torque of force to ensure a proper ground connection and a required tool access to the wiring compartment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

12. Connect the other end of the wires to the circuit breaker in the AC distribution panel supplying AC power to the unit.

Step 5: Connecting AC Output to an Existing AC Circuit

⚠ WARNING

ELECTRIC SHOCK AND FIRE HAZARDS

- Make sure wiring is disconnected from all electrical sources before handling. All wiring must be done in accordance with local and national electrical wiring codes.
- A manufacturer-tested and approved GFCI must be connected to the Freedom XC PRO AC output, and GFCI protection must be provided on every receptacle connected to the AC hard wired installation. Other types may fail to operate properly when connected to the Freedom XC PRO. See *Ground Fault Circuit Interrupters (GFCIs)* on page 23.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



NOTICE

EQUIPMENT DAMAGE

- Do not connect any AC source (such as a generator or utility power) to the **AC output wiring** of the Freedom XC PRO.
- The Freedom XC PRO will not operate if its output is connected to AC voltage from another source, and potentially hazardous or damaging conditions may occur. These conditions can occur even if the inverter/charger is off.

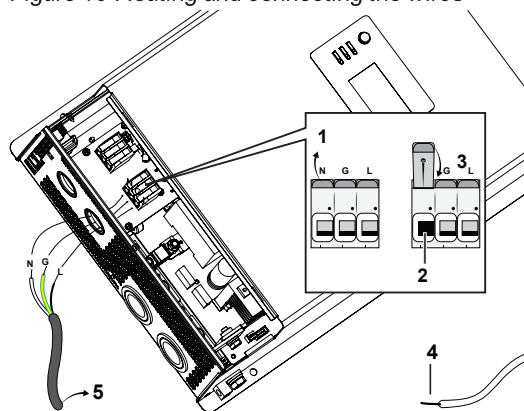
Failure to follow these instructions can result in equipment damage.

Do not connect the Freedom XC PRO to an AC branch circuit that has high-power consumption loads.

The Freedom XC PRO will not operate electric heaters, air conditioners, stoves, and other electrical appliances that consume more than its rated output wattage.

AC Output Connections

Figure 10 Routing and connecting the wires



1	step 7a
2	step 7b
3	step 7c
4	15mm
5	to circuit breaker
NOTE: AC Output hole - install a bushing (supplied) or a strain-relief device.	

To make a permanent connection to existing AC wiring:

- Ensure AC and DC power sources are turned off, if not already done from *AC Output Connections on page 33*.

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Basic Installation Procedures

- Install the required circuit breaker in the inverter/charger distribution panel receiving AC power from the inverter/charger.
- Remove the wiring compartment cover, if not already done from *AC Output Connections on page 33*.

⚠ WARNING

ELECTRIC SHOCK HAZARD

Use a screwdriver to loosen the captive nut panel screw.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

- Strip a single AC output wire, as appropriate. Strip 10 mm off the ends of each of the three the wires (tin the exposed copper wire with lead-free solder using a soldering iron).
- Install a 1/2" (or 3/4") strain relief clamp on the AC output hole.
- Route the wires through the strain relief clamp (not shown in the figure)
- Connect each AC wire into its corresponding terminal on the no-tool cage clamp terminal block.
 - Lift the terminal lever (as shown on the figure).
 - Insert the wire fully into the open slot.
 - Lower the terminal lever to secure the wire in the slot.
- Make sure that each AC wire is matched and connected to the Neutral (N), Ground (G), and Line (L) connections.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb (0.56 N-m) torque of force to ensure a proper ground connection and a required tool access to the wiring compartment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

- Connect the other end of the wires to a circuit breaker in AC distribution panel providing AC power to the loads.

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GFCI Connections

1. Remove the GFCI cover plate by removing the four screws holding it in place.
2. Set the four screws aside.
3. Install the GFCI kit according to its wiring diagram shown on the device. See *Ground Fault Circuit Interrupters (GFCIs) on page 23* for information on compatibility.
4. Secure the GFCI device to the wiring panel using the four screws set aside earlier.
5. Prepare a 4" (100 mm) black AC wire (for line) and connect one end to the AC OUT **L** terminal.
6. Splice three black Line wires together using a twist-on wire connector: the other end of the black AC wire (in step 6), the AC Output Line wire, and one end of the 15 A breaker wire.
7. Connect the other end of the 15 A breaker wire to the GFCI's **L** terminal.
8. Prepare a 4" (100 mm) white AC wire (for neutral) and connect one end to the GFCI's **N** terminal.
9. Prepare a 4" (100 mm) white AC wire (for neutral) and connect one end to the AC OUT **N** terminal.
10. Splice three white Neutral wires together using a twist-on wire connector: the other end of the white AC wire (in step 9), the other end of the white AC wire (in step 10), and the AC Output Neutral wire.
11. Prepare a 4" (100 mm) green/bare AC wire (for ground) and connect one end to the GFCI's **G** terminal.
12. Prepare a 4" (100- mm) green/bare AC wire (for ground) and connect one end to the AC OUT **G** terminal.

13. Splice three green/bare ground wires together using a twist-on wire connector: the other end of the green/bare AC wire (in step 12), the other end of the green/bare AC wire (in step 13), and the AC Output Ground wire.
14. Return to Step 10 on page 34.

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Basic Installation Procedures

Step 6: Connecting the DC Cables

NOTICE

REVERSE POLARITY

- Check cable polarity at both the battery and the Freedom XC PRO before making the final DC connection. Positive must be connected to positive; negative must be connected to negative. Check to see if the reverse polarity LED (see *Step 6: Connecting the DC Cables*) is not illuminated.
- Reversing the positive and negative battery cables will blow a fuse in the Freedom XC PRO and void your warranty.

Failure to follow these instructions can result in equipment damage.

WARNING

FIRE HAZARD

Use only stranded, copper wire rated minimum 75 °C (105 °C for marine installations). Make sure all DC connections are tight to a torque of 71–80 in-lb (8–9 Nm) of force. Loose connections will overheat.

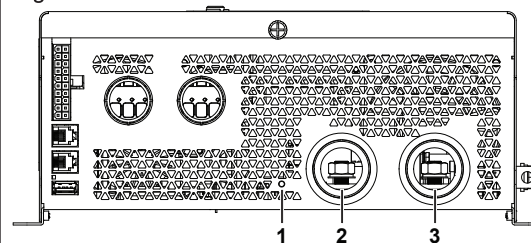
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Follow the procedure given below to connect the battery leads to the terminals on the DC end. The cables should be as short as possible and large enough to handle the required current, in accordance with the electrical codes or regulations applicable to your installation. *Table 6* specifies the minimum DC cable size and maximum fuse size for the Freedom XC PRO.

If at all possible, minimize routing your DC cables through an electrical distribution panel, battery isolator, or other device that will cause additional voltage drops which can degrade the inverter/charger's ability to operate the loads.

Figure 11 shows the DC end for your reference. The reverse polarity LED will light up when the DC cables were reversed during installation. Reversing the connections may void the warranty.

Figure 11 DC End



1	reverse polarity LED
2	positive (+)
3	negative (-)

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To make the DC connections:

1. Make sure the inverter/charger is off and no AC or DC is connected to the unit.
2. Remove the wiring compartment cover by loosening the captive nut panel screw.

⚠ WARNING

ELECTRIC SHOCK HAZARD

Use a screwdriver to loosen the captive nut panel screw.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

3. Loosen the DC terminal nuts from the terminal bolts and set them aside for later.
4. Strip ½" (13 mm) to ¾" (19 mm) insulation from one end of each cable. The amount stripped off will depend on the terminals chosen.
5. Attach the connectors that will secure the cables to the battery, to the disconnect/battery selector switch, and the fuse block. The connectors you use must create a permanent, low-resistance connection. It is recommended to use approved and certified cable ring lugs. Use the tool recommended by the terminal manufacturer. Make sure no stray wires protrude from the lug or terminal.
NOTE: You may find it more convenient to have the cable lugs attached by the company that sells you the cable and/or connectors.

6. Strip ½" (13 mm) to ¾" (19 mm) of insulation from each cable end that will be connected to the inverter/charger cable. The amount stripped off will depend on the terminals chosen.
7. Attach the cable ring lug that will join the cable to the inverter/charger DC terminal. Cover the lug stem with heat shrink insulation (see *Step 6: Connecting the DC Cables*) to ensure that the lug does not touch the enclosure.
8. Install a fuse and fuse holder in the cable that will be used for the positive side of the DC circuit. The fuse must:
 - a. be as close to the battery positive terminal as possible
 - b. be rated for DC circuits
 - c. have an Ampere Interrupting Capacity (AIC) that exceeds the short-circuit current available from the battery (that is, Class T fuse)
9. To prevent sparking when making the connection, ensure the disconnect/battery selector switch is off.
10. Route the positive cable through the left side strain relief clamp and attach the cable lug on the positive cable to the positive DC terminal on the inverter/charger.
11. Fasten the DC terminal nut (set aside earlier) to the terminal bolt. Tighten the nut to a torque of 8–9 N-m (71–80 in-lb) of force. Do not overtighten. Make the connection snug enough so the cable lug does not move around on the DC terminal. Center it through the DC knockout hole and do not let it touch the edge. See *Step 6: Connecting the DC Cables on page 36*.

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⚠ WARNING

ELECTRICAL SHOCK HAZARD

- Tighten the nuts on the DC terminals properly. Loose connections cause excessive voltage drop and may cause overheated wires and melted insulation.
- Do not over-tighten the nut on the DC input terminals because damage to the DC input terminals may result. Use a torque screwdriver to tighten the nut to a maximum torque of 80 in-lb (9 N-m) of force.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

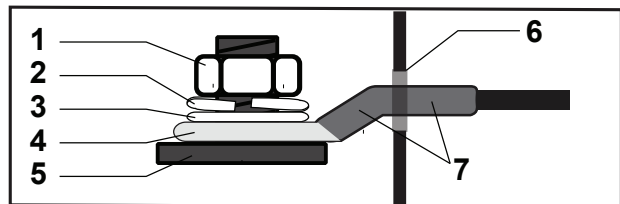
NOTICE

REVERSE POLARITY

- Check cable polarity at both the battery and the Freedom XC PRO before making the final DC connection. Positive must be connected to positive; negative must be connected to negative. Check to see if the reverse polarity LED (see *Step 6: Connecting the DC Cables*) is not illuminated.
- Reversing the positive and negative battery cables will blow a fuse in the Freedom XC PRO and void your warranty.

Failure to follow these instructions can result in equipment damage.

Figure 12 DC Cable Connections



1	DC terminal bolt nut
2	lock washer
3	flat washer
4	cable ring lug
5	DC terminal
6	DC knockout hole
7	DC cable with heat shrink insulation covering the lug stem

NOTE: The DC cable lug stem must be fully insulated with the heat shrink.

12. Before proceeding, double check that the cable you have just installed connects the positive DC terminal of the inverter/charger to the disconnect/battery selector switch, fuse holder, and that the other end of the fuse holder is connected to the positive terminal of the battery.



⚠ WARNING

FIRE HAZARD

Do not complete the next step if flammable fumes are present. Explosion or fire may result if the disconnect/battery selector switch is not in the off position. Thoroughly ventilate the battery compartment before making this connection.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

13. Route the negative cable through the right side strain relief clamp and connect the cable from the negative post of the battery to the negative DC terminal of the inverter/charger.
14. Fasten the DC terminal nut (set aside earlier) to the terminal bolt. Tighten the nut to a torque of 8–9 N-m (71–80 in-lb) of force. Do not overtighten. Make the connection snug enough so the cable lug does not move around on the DC terminal. Center it through the DC knockout hole and do not let it touch the edge.

15. Replace the wiring compartment cover by tightening the captive nut panel screw. See the following electrical shock hazard warning.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Use a torque screwdriver to tighten the captive nut panel screw to 5 in-lb (0.56 N-m) torque of force to ensure a proper ground connection and a required tool access to the wiring compartment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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Basic Installation Procedures

DC Grounding

To connect the DC ground:

1. The equipment grounding lug (DC ground lug) on the DC end of the Freedom XC PRO is used to connect the chassis of the Freedom XC PRO to your system's DC negative connection or grounding bus point as required by electrical regulations.
2. Use copper wire that is either bare or provided with green insulation. Do not use the DC ground lug for your AC grounding. See the AC wiring instructions in this section.
3. Follow the guidelines below that correspond to the specific type of installation. These guidelines assume you are using the DC supply cable and fuse sizes recommended in this guide. If you are using different sizes, refer to the applicable installation code for DC grounding details.
4. See *Figure 7* for the location of the DC ground lug. Make sure to tighten the bolt on the DC ground lug to a torque of 23 in-lb (2.6 N-m) of force. Apply an anti-corrosion compound to the copper wire prior to connecting to the DC ground lug.

Recreational Vehicle

Use 8AWG 8.36mm² minimum-sized, stranded copper wire and connect it between the Chassis Ground lug and the vehicle's DC grounding point (usually the vehicle chassis or a dedicated DC ground bus). See regulatory references below.

Marine

Use copper wire that is bare or has insulation rated minimum 105 °C, and connect it between the Chassis Ground lug and the boat's DC grounding bus or engine negative bus. Use a wire of gauge 2/0AWG minimum. See regulatory references below.

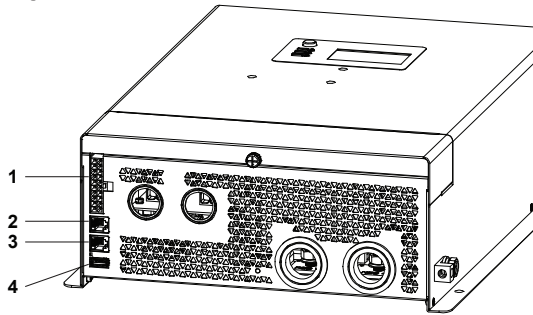
Regulatory references

For DC voltage systems under 50 VDC in an RV installation, an 8AWG copper bonding conductor would be acceptable for the inverter/charger enclosure ground bonding only per UL458 §63.6; §30.10 standard [≤ 150 mV @ 30A connection, per §63.9; §63.10] and per ANSI/RVIA LV code §2-5.1 Bonding Voltage Converter Enclosures. The "house" battery system must, however, be ground bonded per ANSI/RVIA LV code §2-4 Auxiliary Battery Grounding; and For DC voltage systems under 50 VDC in a marine installation, [UL458 §SA7.2] a DC Grounding conductor shall not be smaller than one size under that required for current carrying conductors supplying the device per ABYC E-11 §11.16.2 but not less than 8AWG [USGC 46 CFR §111.05-31].



Step 7: Connecting to Port(s) on the Freedom XC PRO

Figure 13 Freedom XC PRO Ports



1	20-pin CC port
2	Remote port
3	BTS port
4	USB port

NOTICE

EQUIPMENT DAMAGE

Do not use pinouts (see Figure 16 on page 42) that are designated "NOT USED" to connect to equipment not currently supported.

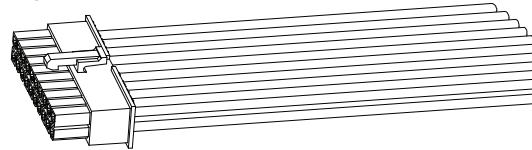
Failure to follow these instructions can result in equipment damage.

Connecting to the 20-pin Communications and Control (20-pin CC) Port

The 20-pin CC port of the Freedom XC PRO accepts a corresponding 20-pin Communications Harness (PN: 808-0820) (see Figure 15) which enables the unit to:

- control the vehicle's ignition control system (commonly referred to as ACC) via one control wire (see on page 41);
- connect to a vehicle's onboard display via three wires using the CANbus/RV-C, J1939 protocol.

Figure 14 20-pin Communications Harness



Basic Installation Procedures

Figure 15 20-pin Communications Harness Pinouts

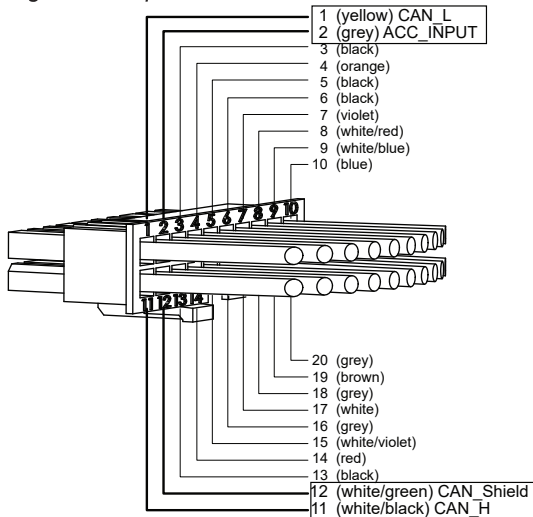
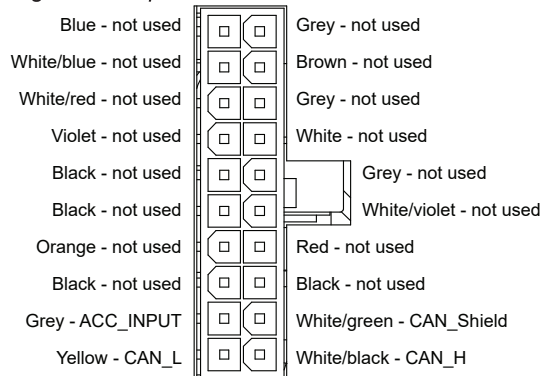


Figure 16 20-pin CC Port Pinouts



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



vehicle's user manual for proper instructions on how to disconnect the battery cables.

3. Locate the vehicle's ignition control wire from the vehicle's ignition circuit. This wire must be fused appropriately at no more than 5 A. Refer to the vehicle's user manual for guidance.
4. Locate the ACC input (white) wire and connect to the vehicle's (or vessel's) +12VDC ignition control wire.

Description of Ignition Control Features

For information about the features and instructions on changing the ignition control features, see *Operation on page 51*.

Table 10 Ignition Control Features

Ignition Auto-on (ALT)	This setting allows the inverter/charger to operate (Battery mode) automatically when an ignition control wire is connected to the ACC input and a valid ignition signal is constantly detected. The inverter works in tandem with the vehicle's ignition circuit.
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Ignition Lock-out (LOL)	This setting allows the inverter/charger to operate (Battery mode) when an ignition control wire is connected to the ACC input from the 20-pin CC adapter wire and a valid ignition signal is constantly detected. When enabled, you have to manually press the Power button on the display panel to operate the inverter/charger.
Off (OFF)	To completely disable the ignition control features do the following: Set Ignition Control to Off (OFF) using the Select buttons on the Display panel.

Connecting to the Remote Port

The Freedom XC PRO can accommodate the Freedom X Remote Panel with cable (PN: 808-0817-01) (sold separately; comes with 25ft-cable) or the Freedom X Remote Panel unit (PN: 808-0817) (sold separately; unit only without cable).

To connect the remote panel to the remote port:

- Plug the remote panel unit's cable connector to the RJ12 Remote port on the unit.

NOTE: When the remote panel is connected, turn the inverter/charger's Power button to the Standby mode (up position). This allows the remote panel to control the inverter/charger's power status.

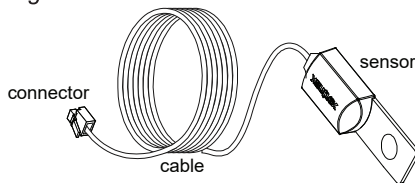
Basic Installation Procedures

Connecting to the BTS Port

Installing a battery temperature sensor (BTS) extends the life of a battery by preventing overcharging in warm temperatures and undercharging in cold temperatures. With a BTS monitoring the battery temperature, the voltage delivered to the battery is adjusted according to the battery's actual temperature.

The BTS (PN: 808-0232-01) has a self-adhesive backing and attaches to the side of the battery. A 25-foot (7.6 m) cable is supplied with this optional accessory.

Figure 17 BTS with Cable



NOTICE

EQUIPMENT DAMAGE

Use only the Freedom XC PRO-compatible Battery Temperature Sensor (BTS). To order a spare BTS, call customer service and order PN: 808-0232-01.

Failure to follow these instructions can result in equipment damage.

Mounting Options

You can mount the BTS (PN: 808-0232-01) in one of two ways:

- Mounting the sensor to the negative battery post allows the internal battery temperature to be sensed and provides the most accurate results (on page 44).
- Attaching the sensor to the side of the battery using the self-adhesive backing also provides good results in most situations (on page 45).

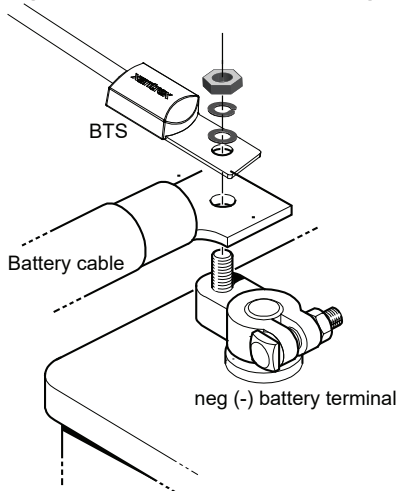
To mount the sensor on the negative battery terminal:

1. Select the battery to be monitored. The BTS should be connected to the battery bank that is directly connected to the Freedom XC PRO.
2. Switch off all devices operating from the battery, or open the battery switch (if present) to disconnect the battery.
3. Wait ten minutes for any explosive battery gases to dissipate.
4. Remove the nut, lock washer, and flat washer that connect the existing wiring ring terminal to the battery negative terminal stud.
5. Move or reorient the existing wiring ring terminal on the battery negative terminal stud, so there is a flat surface on which to seat the BTS mounting plate.
6. You may need to bend the ring terminal crimp and/or wires slightly downward to allow the sensor to seat flush to the top surface of the upper ring terminal.
7. Mount the sensor directly on top of the ring terminal, as shown in *Figure 18*, then the flat washer, lock washer, and nut. Tighten the terminal nut to a torque of 80 in-lb (9 Nm). A



loose connection can cause excessive heating. Always follow your battery manufacturer's torque specifications.

Figure 18 BTS Mounted on the Negative Battery Terminal



8. Check to ensure that the sensor and all wires are held firmly and cannot be moved.
9. Turn the battery switch on again (if you opened it in Step 2.)
10. Route the sensor cable to the Freedom XC PRO and plug it into the BTS port. Secure the cable along its length.

To mount the sensor on the battery case:

⚠ WARNING

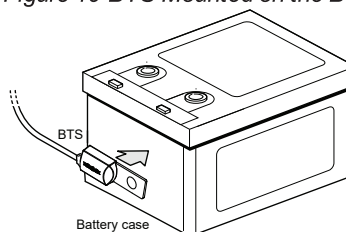
ELECTRICAL SHOCK AND BURN HAZARD

Do not drill into the battery.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

1. Select the battery to be monitored. The BTS should be connected to the battery bank that is directly connected to the Freedom XC PRO.
2. Switch off all devices operating from the battery, or open the battery switch (if present) to disconnect the battery.
3. Wait ten minutes for any explosive battery gases to dissipate.
4. Select a side suitable for attaching the sensor.

Figure 19 BTS Mounted on the Battery Case



Basic Installation Procedures

5. The surface where the sensor is to be mounted must be flat and free from reinforcing ribs or other raised features. This surface must be in direct internal contact with the battery electrolyte. Do not install the sensor near the top of the battery or on the battery's top surface.
6. Clean the selected area thoroughly to remove any oil or grease that could prevent the sensor from adhering to the battery case. Allow the battery case to dry thoroughly.
7. Peel the protective backing from the self-adhesive strip on the rear of the sensor.
8. Press the sensor firmly against the clean side of the battery to fix it in place, as shown in *Connecting to the BTS Port*.
9. Route the sensor cable to the Freedom XC PRO and plug it into the BTS port. Secure the cable along its length.

Connecting to the USB Port

The USB port is reserved for firmware updates to the Freedom XC PRO and must not be used for powering and charging USB devices.

To update the firmware:

1. Download the latest firmware package from <http://www.xantrex.com> to a PC/laptop.
2. Format a USB stick (at least 2GB).
3. Unzip the firmware package into the USB stick.
4. Turn off all AC loads and turn off the vehicle engine before the next step while keeping the Freedom XC PRO on Standby mode (button in up position).
5. Insert the USB stick into the USB port on the Freedom XC PRO.
NOTE: Once inserted the firmware update is initiated automatically. See detailed instructions in the *Readme.txt* file.
6. Wait ten minutes and remove the USB stick from the USB port.



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.

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Basic Installation Procedures

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.

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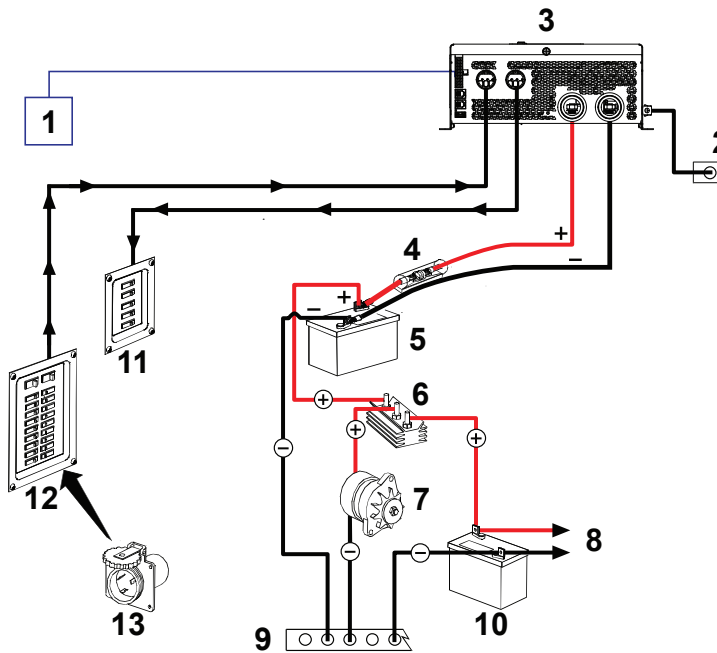


Marine Installation

Figure 20 illustrates a typical marine installation with the following components:

1	20-pin harness accessory
2	Equipment ground – Engine negative bus / DC ground bus
3	Freedom XC PRO
4	DC fuse/disconnect/DC circuit breaker
5	12V deep cycle battery bank (house) and protected by a DC fuse in the positive cable
6	Battery isolator
7	DC alternator
8	To engine
9	Equipment ground – Engine negative bus / DC ground bus
10	Starting battery
11	AC load panel with branch circuit breakers that supply only loads that run off the Freedom XC PRO
12	AC source panel that includes a max 30A (Freedom XC PRO 2000), 50A (Freedom XC PRO 3000), or a 20A (if using a GFCI) circuit breaker that supplies the Freedom XC PRO
13	Shore power – AC power supplied from a shore power connector
Not shown	Drip shield (see next page)

Figure 20 Typical Marine Installation



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Marine Installation

Drip Shield Installation

The drip shields help to protect the unit from dripping or splashing liquids, which will cause a shock hazard when moisture comes in contact with electrical circuits in the unit. The drip shields are especially useful in marine installations where water from condensation, rain, or sea may come into contact with the Freedom XC PRO.

⚠ WARNING

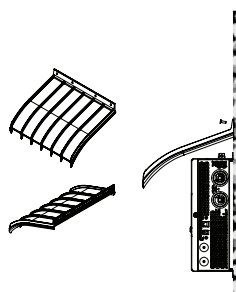
ELECTRICAL SHOCK HAZARD

Place this unit in normally dry areas only. Operating the unit under wet conditions may expose you to a shock hazard. Installing drip shields may not entirely protect you from this hazard. Do not operate the unit when it is wet.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

You may purchase the drip shield set by contacting customer support. When ordering, mention part number 808-1050.

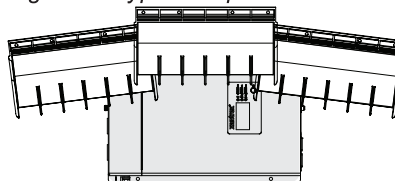
Figure 21 Drip shields



To install the drip shields:

1. Gather the four screws needed to fasten a single drip shield to a wall.
2. Locate an appropriate setting for the drip shields above the Freedom XC PRO making sure you cover the entire width of the unit. You can overlay the shields as shown in Figure 22.
3. Fasten the screws through the holes in the drip shield into the wall. See Figure 21.

Figure 22 Typical Drip Shield Placement on a Freedom XC PRO



4 OPERATION

This section includes descriptions of the different modes and settings of the Freedom XC PRO Inverter/Charger.

This section includes:

- Freedom XC PRO Display Panel** 52
 - Status LED Indicators 52
 - Function Buttons 53
 - LCD Screen 53
 - LCD Screen Icons 54
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 - Turning Inverter Operation ON and OFF 55
 - Power Save Timer 56
 - Power Save Mode 56
 - Checking Battery Status 56
 - Checking Output Power 56
 - Operating Several Loads at Once 56
 - Turning the Audible Alarm ON or OFF 57
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 - Battery Charger Functions 58

- Battery Types 58
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- Operating During Transition Between Grid Mode and Battery Mode** 63
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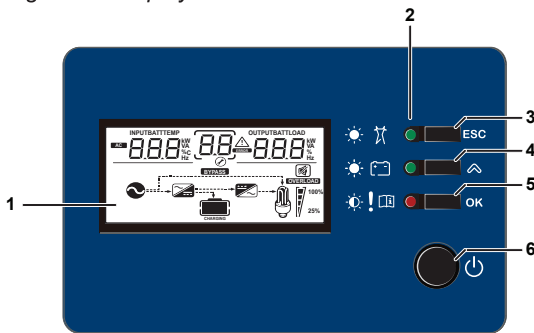
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Freedom XC PRO Display Panel

Freedom XC PRO Display Panel





Figure 23 Display Panel



1	LCD screen
2	Status LED indicators
3	ESC see "Function Buttons" on the facing page
4	 see "Function Buttons" on the facing page
5	OK see "Function Buttons" on the facing page
6	 see "Function Buttons" on the facing page

NOTE: Briefly pressing any function button activates backlight illumination. After 60 seconds of inactivity, backlight illumination turns off.

Status LED Indicators

Indicator	Definition
	Solid green. Indicates grid mode in which shore power is available and passing through to the loads and charging the battery.
	Solid green. Indicates Battery mode (Inverter mode) in which the inverter/charger is running and supplying power to the loads from the battery.
	Solid red. Indicates error or fault mode and is accompanied by an error code displayed on the LCD screen. For a list of error codes, see <i>Motor Loads</i> on page 90.
	Flashing red. Indicates a Warning condition and is accompanied by an error code and a sounding alarm. For a list of error codes, see <i>Motor Loads</i> on page 90.



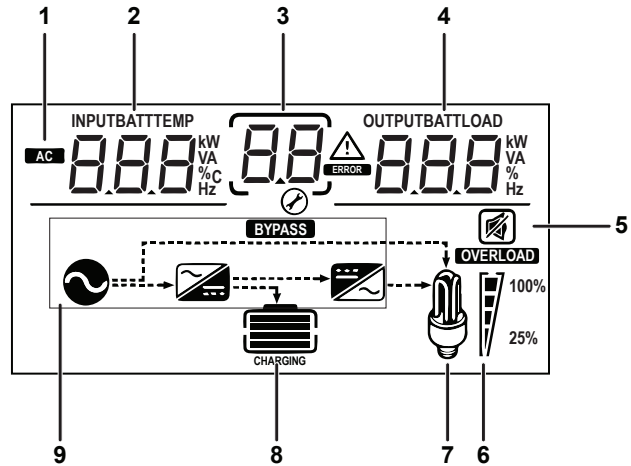
Function Buttons

Button	Definition
	Return to default screen or exit setting mode
	Next screen or next selection Press and hold for three seconds to go back one step
	To enter the setting mode or to confirm the setting
	Turns on inverter/charger operation or to Standby mode

LCD Screen

The LCD Screen changes depending on the operating mode of the inverter/charger.

Figure 24 Parts of the LCD Screen



1	AC IN or AC OUT indicator	6	load power level indicator
2	left part of LCD display	7	load indicator
3	middle part of LCD display	8	battery level indicator
4	right part of LCD display	9	mode indicator
5	alarm off indicator		

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Freedom XC PRO Display Panel

LCD Screen Icons

Icon	Definition
	AC input and output indicator.
	The wrench icon underneath a number is displayed during configuration mode.
	An error event with its corresponding number is displayed here.
	A warning event with its corresponding number is displayed here.
	The charging indicator is displayed when the unit is in charger mode.
	The battery icon indicates remaining battery power. One bar = 1-25%, two bars = 25-50%, three bars = 50-75%, and four bars = 75-100%.
	Shows an overload condition.

Icon	Definition
	The load icon is displayed if there is voltage available at the AC output.
	The bar represents load consumption levels. 100% is an indication of full capacity and 25% indicates low consumption. All the bars disappear at < 20 watts, and AC load indicates zero watt power.
	Shows up in grid mode when AC shore power is present. If the power is being qualified, then this icon will flash.
	Shows that the unit is in grid mode and is bypassing shore power directly to the loads.
	This icon shows when there is power conversion from AC to DC - charging.
	This icon shows when there is power conversion from DC to AC - inverting.
	The alarm buzzer is muted.

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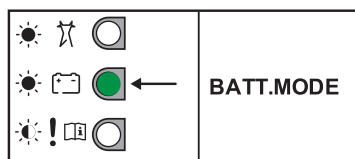


Operating in Battery Mode

The Freedom XC PRO is in Battery Mode (also called Inverter Mode) when all the following conditions exist:


- inverter power button is ON  (down position) or ignition auto-on is activated
- shore power is not presently available 
- battery has sufficient power

Inverter operation means that DC battery power is presently being converted to utility grade AC power, powering equipment and appliances connected to the AC output terminal of the unit. The green status LED lights up to indicate the Freedom XC PRO is using the battery to power the equipment and appliances.




Turning Inverter Operation ON and OFF

There are two ways to operate the Freedom XC PRO's inverter function.

1. Press the Power button to a down position (it is in Standby mode in the up position).
2. When the inverter/charger's Ignition Control feature is set to Auto-on (A-E ^a), a +12VDC signal is present on the ACC input^b.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Turning the Power  button to Standby mode does not disconnect DC battery power from the Freedom XC PRO. You must disconnect from all power sources before working on any circuits connected to the unit.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

To prevent unnecessary battery discharge, press the Power button to Standby mode when you are not using the Freedom XC PRO.

^aSee *Adjusting Feature Settings in Configuration Mode* on page 72.

^bWhen the vehicle's ignition switch is On or the vehicle's engine is running.

Operating in Battery Mode

Power Save Timer

The Power Save Timer is an adjustable countdown timer from 1 to 25 h (25 h is the default) that automatically shuts down inverter operation to reduce battery discharge and preserve battery life. During continuous inverter operation, the countdown is initiated when power from the AC load drops to less than approximately 50 W and remains below this level. After reaching the end of the countdown timer the inverter/charger automatically shuts down.

To change the countdown timer, see *Settings on page 73*.

Power Save Mode

By enabling the power save mode, the inverter/charger can automatically go to load sense mode by sending short pulses to further reduce the battery discharge. Power save mode ends when a load greater than 25 W is connected.

Checking Battery Status

During inverter operation (in battery mode), you can check the battery status by observing the battery capacity indicator on the LCD screen. The battery voltage appears in the left side of LCD screen.

The normal operating battery voltage range is between 11 and 15 volts.

Checking Output Power

When the inverter/charger is in operation (in battery mode), you can check how much power (displayed in kW) the Freedom XC PRO is supplying to the connected loads by observing the load capacity indicator on the LCD screen. The battery discharge amperage appears in the right side of the LCD screen.

Operating Several Loads at Once

If you are going to operate several loads from the Freedom XC PRO, turn them on one at a time after you have turned the inverter/charger on.

Turning loads on separately helps to ensure that the inverter/charger does not have to deliver the starting current for all the loads at once, and will help prevent an overload shutdown.



Turning the Audible Alarm ON or OFF

The Freedom XC PRO's audible alarm can be muted. See *Adjusting Feature Settings in Configuration Mode on page 72*.

Any warnings such as error or fault conditions or imminent shutdown are both displayed on the LCD screen and sounded on the alarm speakers. See *To manually reset the alarm: on page 57*.

Audible alarm for warning: The unit beeps once when a warning condition is detected.

Audible alarm for error: The unit beeps once every 5 s for 1 min.

To mute the alarm:

- Press any one of the three function buttons.

The alarm is automatically muted after 1 min. But the error code continues to be displayed until the error is cleared.

To manually reset the alarm:

1. Press the Power button to turn it Off (from a down position to up) and press again to turn it On to reset an active alarm and clear the error.
2. If the Inverter Ignition Control is set to auto-on, toggle the ignition signal to clear the alarm and error.
3. Toggle the AC input power to force the transition between grid mode and battery mode. This action clears the alarm and error.

Operating in Grid Mode

Battery Charger Functions

When AC power is available, the Freedom XC PRO can operate as a 12-V $\overline{=}$ battery charger. Different battery types and chemistries require different charging voltage levels. Not charging batteries at the required levels can shorten battery life or damage the batteries. The Freedom XC PRO is configured at the factory to work with the battery types recommended for inverter applications. If the default settings do not work for your specific installation, you can adjust the charge stage settings (as recommended by the battery manufacturer) on the Custom (Battery) Settings menu (see *on page 58*).

NOTE: This information is provided for guidance only. Variations in battery chemistry and site-specific environmental considerations mean that you should consult your system designer or battery manufacturer for specific recommendations for appropriate battery voltage and current settings.

Battery Types

The Freedom XC PRO Inverter/Charger charges flooded (or wet) lead-acid, Gel, AGM (absorbed glass mat), custom, and lithium iron phosphate (LFP) batteries.

- Flooded (or wet) batteries have removable battery caps for refilling with distilled water and testing the electrolyte. **NOTE:** Add distilled water in each cell until battery acid reaches the level specified by the battery manufacturer. This helps purge excessive gas from cells. Do not overfill. For a battery without cell caps, carefully follow the battery manufacturer's recharging instructions.
- Gel batteries have the electrolyte in the form of a gel rather than a liquid and do not require topping up. Gel batteries are sealed and the battery caps are not removable.
- AGM (Absorbed Glass Mat) batteries are similar to gel batteries except that the electrolyte is absorbed into a fiberglass matting.
- Custom battery is configured by the dealer, factory, or service center for battery types other than those listed above.
- Lithium iron phosphate (LFP) must only be selected with a lithium iron phosphate battery module with a certified / listed Battery Management System (BMS).



NOTICE

BATTERY DAMAGE

Do not mix battery types. The Freedom XC PRO can only select one battery type setting for all batteries connected to its bank. All connected batteries should either be: Flooded (or wet) or Gel or AGM or Custom or LFP.

Failure to follow these instructions can result in equipment damage.

3-Stage Charging Algorithm

The Freedom XC PRO will charge batteries in a sequence known as three-stage charging. Whenever qualified AC power is present at the inverter/charger's input, it passes power through to the connected load and begins charging the batteries. The charging voltage delivered to the battery depends on the battery's:

- Type setting
- Temperature (by switch setting)
- State of charge

The three automatic stages are:

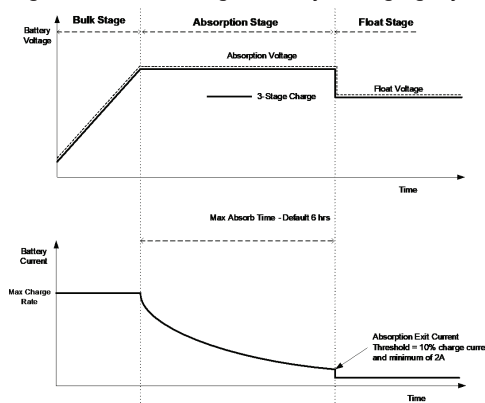
- Bulk
- Absorption
- Float

See *3-Stage Charging Algorithm* for a graph of the three-stage charging profile.

There is a fourth stage, equalization, which is initialized manually as it is only performed occasionally and only on flooded (or wet) batteries.

The charging cycle is a multistage (three-stage) process. Whenever qualified AC power is present at the inverter/charger's input, it passes power through to the connected load and begins charging the batteries.

Figure 25 Three-Stage Battery Charging Cycle



NOTE: When the charge cycle is interrupted, the charger will restart charging at the beginning of the multistage algorithm. Charge current during equalize state (optional state not shown here) is normally limited to 10A for 60 min.

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Operating in Grid Mode

Bulk Stage

Bulk charge is the first stage in the charging process and provides the batteries with a controlled, constant current. Once the battery voltage rises to the absorption voltage threshold, the charger switches to the absorption stage.

Absorption Stage

During the absorption stage, the Freedom XC PRO begins operating in constant voltage mode and the current falls gradually as the amp hours are returned to the battery.

Table 11 Preset Absorption Voltage Settings

Battery Type	Preset Absorption Voltage
Flooded	14.0V (Hot), 14.4V (Warm), 14.8V (Cold)
Gel	13.8V (Hot), 14.2V (Warm), 14.6V (Cold)
AGM	14.0V (Hot), 14.3V (Warm), 14.6V (Cold)
LFP	14.6
Custom	14.6 (default), changeable between 12.0 to 18.0

The Freedom XC PRO transitions to the float stage if either one of the following two conditions are met:

The charge current allowed by the batteries falls below the exit current threshold, which is equal to 10% of the programmed charge current and a minimum of 2A.

The Freedom XC PRO has been in absorption for the programmed maximum absorption time limit. The default is 6 h.

NOTE: If there are DC loads on the batteries, the charger's current may never decrease to a level to initiate the next stage of charging. In this case, the charger would stay in absorption until the Absorb Time setting is reached.

Float Stage

Float charge maintains the batteries slightly above the self discharge voltage of the batteries. The charge current in float is the current necessary to maintain the batteries at the Float Voltage setting, limited only by the inverter/charger's capability or other settings that limit the inverter/charger's maximum charge rate. Float charging reduces battery gassing, minimizes watering requirements (for flooded batteries), and makes sure the batteries are in a constant state of readiness. The charger automatically switches to the float stage after the batteries have received a bulk and absorption charge (see *Float Stage*). The batteries are maintained at the default float voltage level for the selected battery type or the voltage selected under Float Voltage on the Custom Battery Settings menu.

Table 12 Preset Float Voltage Settings

Battery Type	Preset Float Voltage
Flooded	13.5
Gel	13.8



Battery Type	Preset Float Voltage
AGM	13.4
LFP	13.6
Custom	13.5 (default), changeable between 12.0 to 18.0

NOTE: The battery voltage can increase above the float voltage when using an external charging device such as PV arrays, wind turbines, and micro-hydro generators. Be sure to include appropriate charge management equipment with all external DC sources.

Equalize Charging

Many battery manufacturers recommend periodic equalize charging to counter cell charge imbalance and capacity-robbing electrolyte stratification. Equalizing helps to improve battery performance and lifespan by encouraging more of the battery material to become active.

Battery equalization is a controlled overcharging method that mixes up stratified electrolyte and reactivates unused areas of the plate material. Periodic equalizing can help to regularly restore batteries to a full and healthy state of charge.

Consult the battery manufacturer's recommendation for equalize charging settings. Sealed batteries should **never** be equalized. Consult the battery manufacturer for optimal charging procedures when using Lithium and Sealed batteries.

When Equalization is enabled, the battery is charged from bulk to absorption, and then to the equalize phase. The Freedom XC PRO will transition from the absorption phase to equalize at an equalize current set to 10 A.

After absorption, this constant current charge will continue until the voltage has increased to 16 volts DC.

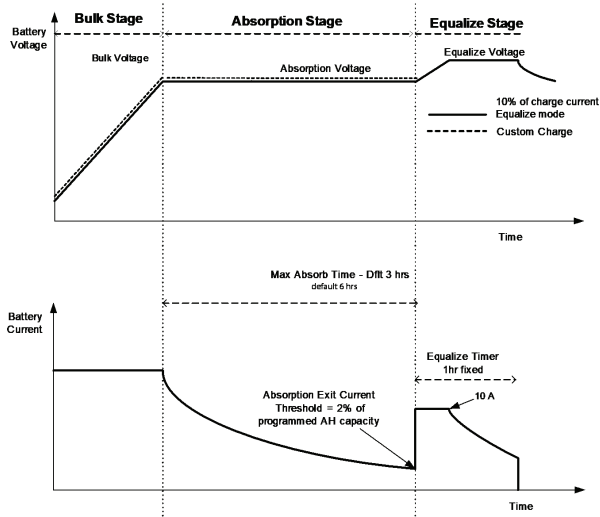
Equalization duration is fixed at one hour.

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Operating in Grid Mode

Figure 26 Equalize charging



Custom Battery Settings Menu

NOTICE

REVERSE POLARITY

To avoid damaging your batteries during charging or equalization, consult your battery manufacturer and associated documentation before setting a custom battery type.

Failure to follow these instructions can result in equipment damage.

Custom battery type can be selected by the setting number 20 (see *Custom Battery Settings Menu* on page 62). After the custom battery is selected, you can then adjust the value of custom absorption (setting number 22) and custom float (setting number 23) accordingly.

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Operating During Transition Between Grid Mode and Battery Mode

The Freedom XC PRO's advanced power management is capable of transitioning power from an AC source to DC source within a fraction of a second and vice-versa.

The Freedom XC PRO automatically detects when shore power is present and when it becomes unavailable or drops to less than 106 volts AC.

The transfer time can be set to two settings. For details see *Adjusting Feature Settings in Configuration Mode on page 72.*

NOTICE

EQUIPMENT DAMAGE

- When the transfer mode is set to *UPS*, connect only sensitive digital equipment that requires fast AC transfer times.
- Appliances with motors, compressors, and heating elements do not require a transfer mode of *UPS*. Set *RPL* for these devices to avoid damaging the transfer relay.

Failure to follow these instructions can result in equipment damage.

Transitioning from Grid Mode to Battery Mode

When the unit is operating in grid mode and shore power is lost, the Freedom XC PRO has less than 20 milliseconds (default) to switch to operating in battery mode (if the Power button is pressed in the On position) and starts drawing power from the battery.

The operating mode indicator will change to Battery Mode and the green Status LED for Battery Mode will light up.

However, if the Power button is in Standby mode, this transition does not happen and the display panel turns off.

Transitioning from Battery Mode to Grid Mode

When the unit is operating in Battery Mode and shore power becomes available, the Freedom XC PRO begins a 20-second countdown to verify the stability of the shore power. If shore power remains stable for a 20-second countdown, at the end of the countdown, the Freedom XC PRO will switch to shore power mode within 20 milliseconds and start drawing power from the AC source.

The operating mode indicator will change to grid mode and the green Status LED for grid mode will light up.

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Operating Limits

Operating Limits

These are the operating limits of the Freedom XC PRO:

- *Power Output*
- *Input Voltage*
- *Overload Conditions*
- *High Surge Loads*
- *Over-temperature Conditions*

Power Output

The Freedom XC PRO can deliver up to 2000 watts (Freedom XC PRO 2000) or 3000 watts (Freedom XC PRO 3000) of continuous utility grade sine wave AC power. The wattage rating applies to resistive loads such as incandescent lights.

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Freedom XC PRO Owner's Guide



Input Voltage

The allowable Freedom XC PRO input battery voltage ranges are shown in the following table:

Table 13 Input battery voltage range

Operating Condition	Battery Voltage	Comment
Full Operating Range	LBCO – 18.0 volts	Assuming the battery is full, the inverter/charger will operate until battery voltage goes past below LBCO ^c and LBCO Shutdown delay timer ^d .
Low Voltage Recovery	< LBCO+0.2 volts	Inverter is able to recover and continue to operate.


^cTo set LBCO, see *Adjusting Feature Settings in Configuration Mode* on page 72.
^dTo set LBCO Shutdown Delay Timer, see *Input Voltage* on page 65.

Operating Condition	Battery Voltage	Comment
Low Voltage Shutdown	< LBCO	The buzzer sounds a single one-second low battery alarm beep and the LCD screen shows error code E01. After LBCO Shutdown delay timer runs out, the unit shuts down inverter output. The buzzer stops beeping and the LCD screen shows error code E01.
Instant Low Voltage Shutdown	< 9.0 volts	After two seconds below the limit, the unit shuts down inverter output completely. LCD screen turns off completely.

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Operating Limits

Operating Condition	Battery Voltage	Comment
High Voltage Shutdown	18.0 volts	The display shows error code E02 alternating with the battery voltage. The red status LED turns on.  NOTE: Although the Freedom XC PRO incorporates over-voltage protection, it can still be damaged if input voltage exceeds 18.0 (or 32.0) volts.

Overload Conditions

There are two kinds of overload conditions – an overload warning and an overload shutdown.

Overload Warning When the Freedom XC PRO's AC load is approximately 100 W below the overload shutdown limit of rated watts, the audible alarm beeps once and the LCD screen shows a warning code E05.

Overload Shutdown When the Freedom XC PRO's AC load increases to near ~2100 W (Freedom XC PRO 2000) and ~3200 W (Freedom XC PRO 3000), the audible alarm beeps every five seconds for one minute and the LCD screen shows a error code E03. The Status LED turns solid RED.

High Surge Loads

Some induction motors used in freezers, pumps, and other motor-operated equipment require high surge currents to start. The Freedom XC PRO may not be able to start some of these motors even though their rated steady state current draw is within the inverter/charger's limits. The unit will shut down and indicate an overload shutdown.

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Over-temperature Conditions

During inverter operation, when the Freedom XC PRO's internal temperature starts to approach its preset shutdown limit, the display will show error code $E07$. If the over-temperature condition persists, the display will show error code $E04$. The Status LED turns solid RED and the inverter/charger will shut down to prevent damage to the inverter/charger and protect the battery from being over-discharged.

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Viewing Information During Battery Mode

Viewing Information During Battery Mode

The LCD screen displays information related to battery mode operation.

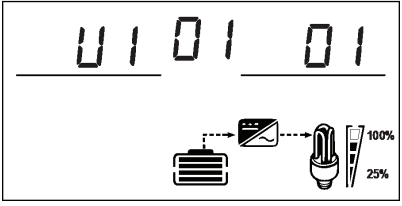
- Press the Scroll button to move from screen to screen. Press and hold for three seconds to go back one step.

Info and Setting	LCD Screen
Screen 1 of 4 - Battery Voltage/Load Wattage This is the home screen.	<p>battery voltage = 12.5V, AC load = 1.2kW</p>

Info and Setting	LCD Screen
Screen 2 of 4 - AC Output Voltage/Frequency	<p>output voltage = 120V, output frequency = 60Hz</p>
Screen 3 of 4 - AC Input Voltage/Frequency Screen shows up when utility AC is connected.	<p>input voltage = 120V, input frequency = 60Hz</p>

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Info and Setting	LCD Screen
Screen 4 of 4 - Firmware version	 <p>Firmware version = U1 1.01</p>

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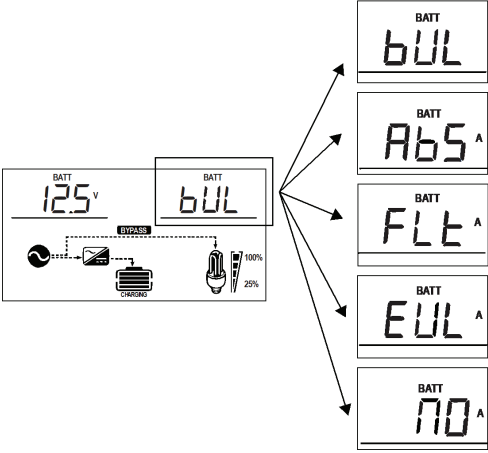
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Viewing Information During Battery Mode

Viewing Information During Grid Mode

1. The LCD screen displays information related to AC bypass or charger operation.
2. Press the Scroll  button to move from screen to screen.
3. Press **ESC** to return to the home screen.

NOTE: After one minute of inactivity in the other screens, the LCD will go back to the home screen.

Info and Setting	LCD Screen
Screen 1 of 5 - Battery Voltage/ Charging Stage This is the home screen.	 <p>battery voltage = 12.5V, charging stages = bulk, absorption, float, equalization, and no charging</p>

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Info and Setting	LCD Screen
Screen 2 of 5 - Battery Voltage/Charging Current	<p>battery voltage = 12.5V, charging current = 60A</p>
Screen 3 of 5 - AC input current/AC load current	<p>input current = 15.6A, load current = 6.8A</p>

Info and Setting	LCD Screen
Screen 4 of 5 - AC input voltage/AC input frequency	<p>input voltage = 120V, input frequency = 60Hz</p>
Screen 5 of 5 - Firmware version	<p>Firmware version = U1 1.01</p>

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Adjusting Feature Settings in Configuration Mode

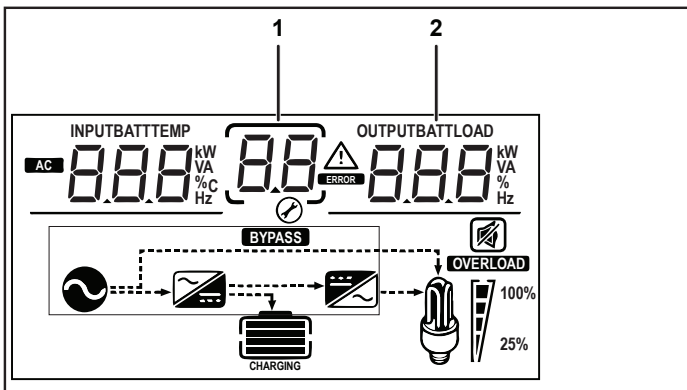
Adjusting Feature Settings in Configuration Mode

The **OK**, Scroll , and **ESC** buttons can be used to cycle through the various feature settings:

1. Press and hold the **OK** button for three seconds to enter the feature settings mode.
2. Press the Scroll button to move through the different feature settings. Press and hold for three seconds to go back one step.

To change the default value to a different value:

1. Press and hold the **OK** button for three seconds to enter the feature settings mode.
2. Press the Scroll button to move through the different feature settings. Press and hold for three seconds to go back one step.
3. Press the **OK** button to select a setting number and change its value.
4. Press the Scroll button to change the value until you reach the desired value.
5. Press the **OK** button to confirm the change.
6. Repeat the previous steps to set other feature settings.
7. Press the **ESC** button to exit the feature settings mode.



1	setting number is displayed here
2	setting value is displayed here

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Settings

Setting Name	Setting Number	Default Value	Range of Values	Description
Inverter Ignition Control	01	OFF	OFF LOAD R&D	See Description of Ignition Control Features on page 43.
LBCO Voltage	02	10.5	10.0 to 12.8	The voltage setting value can be adjusted by 0.1 increments. The inverter is able to recover automatically at LBCO voltage + 0.2 volts.
LBCO Shutdown Delay Timer	03	300	1 to 300	When the range is from 1 to 20, the timer setting value can be adjusted by 1-second increments. When the range is from 20 to 300, the timer setting value can be adjusted by 10-second increments.
LBCO Recovery Voltage	04	13.1	10.2 to 16.0 and OFF	The range is from LBCO voltage + 0.2 to 16, adjusted by 0.1 increments. Selecting OFF or a higher value than the battery's actual fully-charged voltage level will disable the auto-recovery feature. You may manually reset the inverter/charger when the low battery cut off event occurs.
Power Save Time	05	25	OFF, 1 to 25	The range is from 1 to 25, adjusted by 1-hour increments. The next setting after 25 is OFF.
Power Save (Load Sensing) Mode	06	dl 5	EnA (enable), dl 5 (disable)	When enabled, the inverter/charger's "no load" loss can be reduced further when total load is less than 25 W.

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Adjusting Feature Settings in Configuration Mode

Setting Name	Setting Number	Default Value	Range of Values	Description
Output Frequency	07	60	60 50	After changing the output frequency setting, turn the unit off and then on again, in order for the change to take effect.
Output Voltage	08	120	120 110 108	
Inverter Output Power Limit (Freedom XC PRO 2000)	09	2.0	0.1 to 2.0	The wattage setting value can be adjusted by 100-watt increments. Use with Inverter Output Power Limit Timer especially when pairing with a lithium ion battery. 0.1 is equivalent to 100 watts.
Inverter Output Power Limit (Freedom XC PRO 3000)	09	3.0	0.1 to 3.0	The wattage setting value can be adjusted by 100-watt increments. Use with Inverter Output Power Limit Timer especially when pairing with a lithium ion battery. 0.1 is equivalent to 100 watts.
Inverter Output Power Limit Timer	10	300	1 to 300	When the range is from 1 to 20, the timer setting value can be adjusted by 1-second increments. When the range is from 20 to 300, the timer setting value can be adjusted by 10-second increments. Use with Inverter Output Power especially when pairing with a lithium ion battery. The timer is automatically disabled if the maximum Inverter Output Power limit is selected.

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Setting Name	Setting Number	Default Value	Range of Values	Description
Transfer Mode	11	A _{PL}	A _{PL} (appliance) U _{PS} (UPS)	Selecting A _{PL} - appliance sets the transfer time from line to battery to 20 ms. Selecting U _{PS} (uninterruptible power supply) sets the transfer time from line to battery to 10 ms. NOTE: Do not connect motor loads when in UPS transfer mode. See <i>Troubleshooting on page 81</i> .
Utility AC Under Voltage Level	12	90	85 to 110	
Inverter Shutdown Recovery	13	↻A _{RE}	A _{RE} (auto-restart) ↻A _{RE} (manual restart)	The inverter shuts down when there is an over temperature, overload, and short circuit condition. Selecting A _{RE} (auto-restart) will allow the inverter/charger to recover automatically from a shutdown up to three times maximum. Selecting ↻A _{RE} (manual restart) allows the user to restart the inverter/charger by performing a manual reset, that is, by acknowledging the restart via the display panel.
Audible Alarm	14	b _{ON}	b _{ON} (Audible) b _{OFF} (Mute)	The alarm beeps once every 5 s.
Battery Type	20	F _{Ld}	F _{Ld} (Flooded), A _{GM} (AGM), G _{EL} Gel U _{SE} (Custom) L _{F_P} (LiFePO ₄)	The use of L _{F_P} (LiFePO ₄) as a battery type requires a compatible BMS. See <i>on page 15</i> for safety warning instructions.

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Adjusting Feature Settings in Configuration Mode

Setting Name	Setting Number	Default Value	Range of Values	Description
Battery Temperature	21	H _{OT}	C _{LD} (Cold) W _{ARM} (Warm) H _{OT} (Hot)	Selecting Cold from Warm will increase charger voltage by 0.4V. Selecting Cold from Hot will increase charger voltage by 0.8V.
Custom Absorption Voltage	22	14.6	12.0 to 18.0	The voltage setting value can be adjusted by 0.1 increments. Available only when custom battery type is selected.
Custom Float Voltage	23	13.5	12.0 to 18.0	
Charger Current (Freedom XC PRO 2000)	24	100	5 to 100	The current setting value can be adjusted by 5A increments.
Charger Current (Freedom XC PRO 3000)	24	150	5 to 150	
Charger Ignition Control	25	OFF	OFF (OFF) A _{RE} (Auto-ON)	See <i>Description of Ignition Control Features on page 43</i> .
Equalize Charging for Flooded Battery	27	d ₁ 5	E _{NA} (enable) d ₁ 5 (disable)	This setting is only available when Flooded battery type is selected. It allows only one hour of equalize charging once.

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Setting Name	Setting Number	Default Value	Range of Values	Description
AC Input Breaker for Load Share Freedom XC PRO 2000	28	30	5 to 30	The load share feature prioritizes the AC load by reducing the charge current in order to maintain the total input current to less than the load share setting.
AC Input Breaker for Load Share Freedom XC PRO 3000	28	50	5 to 50	
Reset all settings to their default values	99	ndF	ndF (as is) dEF (default)	ndF refers to current settings. Choose dEF to restore all settings to their default values.



5 ROUTINE MAINTENANCE

Regular maintenance is required to keep your Freedom XC PRO operating properly.

This section includes:

Maintaining the Freedom XC PRO Unit 80



Maintaining the Freedom XC PRO Unit

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Turning the Power ⏻ button to Standby mode does not disconnect DC battery power from the Freedom XC PRO. You must disconnect from all power sources before working on any circuits connected to the unit.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Periodically you should:

- With all sources of power off, clean the exterior of the unit with a damp cloth to prevent the accumulation of dust and dirt.
- Ensure that the DC cables are secure and fasteners are tight.
- Make sure the ventilation openings are not clogged.



6 TROUBLESHOOTING

This section will help you narrow down the source of any problem you encounter. Before contacting customer service, please work through the steps listed in *Pre-service Checklist on page 82*.

This section includes:

Pre-service Checklist	82
Warning Messages	83
Troubleshooting Reference	86
Inverter Applications	90
Resistive Loads	90
Motor Loads	90



Pre-service Checklist

⚠️ WARNING

ELECTRICAL SHOCK HAZARD

Do not disassemble the Freedom XC PRO. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in an electrical shock or burn.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: To obtain service go to *Contact Information on page ii.*

Prior to obtaining service, see below:

1. Check for any error codes displayed on the LCD screen. If a message is displayed, record it before doing anything further.
2. As soon as possible, record the conditions at the time the problem occurred so you can provide details when you contact customer service for help. Include the following information:
 - What loads the Freedom XC PRO was running or attempting to run
 - What the battery condition was at the time (voltage, etc.) if known
 - Recent sequence of events
 - Any known unusual AC shore power factors such as low voltage, unstable generator output, etc.

- Whether any extreme ambient conditions existed at the time (temperature, vibrations, moisture, etc.)
3. If your Freedom XC PRO is not displaying an error code, check the following to make sure the present state of the installation allows proper operation:
 - Is the inverter/charger located in a clean, dry, adequately ventilated place?
 - Are the battery cables adequately sized as recommended in the Installation guide?
 - Is the battery in good condition?
 - Are all DC connections tight?
 - Are the AC input and output connections and wiring in good condition?
 - Are the configuration settings correct for your particular installation?
 - Are all disconnects and AC breakers closed and operable?
 - Have any of the fuses blown in the installation?
 4. Contact customer support for further assistance. Please be prepared to describe details of your system installation and to provide the model and serial number of the unit.

Warning Messages

Warning messages in the form of audible alarms and error codes that appear on the LCD screen to alert you to an impending system change. Warnings do not affect operation.

With the exception of the error codes displayed on the screen, only the audible alarm can be turned ON or OFF. Follow the steps in *Turning the Audible Alarm ON or OFF on page 57* to change the alarm settings.

The error codes are listed in *Table 14*. The text in the **Error Code** column appears on the LCD screen of the display panel.



Table 14 Error codes displayed on the LCD screen

Error Code	Condition	Mode	Action
E01	Low battery voltage shutdown is imminent depending on the setting, see <i>Maintaining the Freedom XC PRO Unit on page 80</i> .	Battery mode (inverting)	Check battery status and recharge if necessary. Check for proper DC cable sizing. Check for loose connections and tighten if necessary.
E02	High battery voltage shutdown > 18.0 volts DC	Battery mode (inverting)	Check for external charging sources, such as a PV charger and an over voltage alternator. Disconnect, if necessary.
E03	AC output overload shutdown	Battery mode (inverting)	Reduce the loads connected to the AC outlet of the unit. Check appliances that have high-surge ratings and disconnect if necessary.
E04	Over-temperature shutdown	Battery mode (inverting)	Reduce the loads connected to the AC outlet of the unit. Check that the ventilation grille is not blocked. Check for ambient temperature and move the unit to a cooler location whenever possible.
E06	AC output overload warning	Battery mode (inverting)	Reduce the loads connected to the AC outlet of the unit.

Error Code	Condition	Mode	Action
E07	Over-temperature alarm and fan lock alarm	Battery mode (inverting)	Reduce the loads connected to the AC outlet of the unit. Check that the ventilation grille is not blocked. Check for ambient temperature and move the unit to a cooler location whenever possible. Check the fan for any obstruction and remove it.
E08	Fan lock error	Grid mode (bypass)	If there is no issue with the fan, disconnect the unit from its DC and AC power sources, then reconnect, and then restart the unit. Perform <i>Drip Shield Installation on page 50</i> . If error detection persists, contact customer service.
E10 to E19	Internal hardware error	Battery and grid modes	If error detection persists, contact customer service.
E21	Battery temperature is high	Battery mode (inverting)	Error detection is possible and automatic charger temperature compensation is enabled only when the optional BTS (PN: 808-0232-01) is installed. When the BTS is present and the error is detected, stop inverting (meaning, discharging the battery) and wait a minimum of one hour for the battery temperature to go down before resuming inverting.

For error code E01, after the LBCO shutdown delay, the unit will immediately stop inverting.

For error codes E02 to E04 and E21, the unit will stop inverting.



Troubleshooting Reference

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Do not disassemble the Freedom XC PRO. It does not contain any user-serviceable parts. Attempting to service the unit yourself could result in an electrical shock or burn.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTICE

INVERTER/CHARGER DAMAGE

Avoid continually overloading the inverter/charger and subjecting it to over temperature conditions. Although provided with integral protection against overloads continual overloading can damage the circuitry.

Failure to follow these instructions can result in damage to the inverter/charger.

Table 15 Troubleshooting reference

Problem	Possible Cause	Solution
Alarm does not sound when an error is encountered.	Alarm is turned OFF.	See <i>Maintaining the Freedom XC PRO Unit</i> on page 80 and follow instructions to turn the alarm buzzer on again.
No output voltage. The status LED is red.	AC shore power is not available or out of operating range and the inverter/charger has shut down with the LCD screen showing one of the following error codes:	
	Low input voltage (error code E01)	Verify the unit is connected to a 12V battery. Check the DC connections and the cable. Recharge the battery.
	High input voltage (error code E02)	Verify the unit is connected to a 12V battery. Check the voltage regulation of the external charging system (if any).
	Unit overload or AC output short circuit (error code E03)	Reduce the load. Make sure the load does not exceed the output rating.
	Thermal shutdown (error code E04)	Allow the unit to cool off. Reduce the load if continuous operation is required. Improve ventilation. Make sure the inverter/charger's ventilation openings are not blocked.



Problem	Possible Cause	Solution
No output voltage is shown in the LCD screen but the green status LED for Battery mode is illuminated.	GFCI (when installed) has tripped or supplementary breaker has tripped.	Check load and reset the GFCI or supplementary breaker.
	Circuit breaker on the AC load panel or AC output disconnect has tripped.	Reset the circuit breaker or check the AC output disconnect circuits.
	Battery voltage is too low (depending on setting, see <i>Maintaining the Freedom XC PRO Unit on page 80</i>) to start inverting. LCD screen may show DC voltage as $\square\square\square$.	Check DC connections and cable. Recharge battery.
No output voltage is shown in the LCD screen and neither of the green status LEDs (for Grid mode and Battery mode) is illuminated.	AC shore power is not available or out of operating range and the inverter/charger is OFF.	Check AC shore power. Turn the inverter/charger ON.
	AC shore power is not available and the inverter/charger is OFF due to a shutdown for more than 30 s.	Check AC shore power and battery voltage. Turn the inverter/charger ON and look at the LCD screen for any error code. See "Problem" on the previous page.

Problem	Possible Cause	Solution
No output voltage. The status LED is not lighting up.	Ignition lock (ACC) signal is not present.	If the ignition control feature is in use, ensure the vehicle's ignition is On and the ignition control switch on the front of the Freedom XC PRO unit is On (I).
The fan turns on and off during AC shore power mode.	The battery is discharged. AC pass-through current is high.	Do not be alarmed, the unit is performing normally.
The fan turns on and off during inverter mode.	The inverter is running continuously at high power.	Do not be alarmed, the unit is performing normally. The fan is activated automatically.



Inverter Applications

The Freedom XC PRO performs differently depending on the AC loads connected to it. If you are having problems with any of your loads, read this section.

Resistive Loads

These are the loads that the inverter/charger finds the simplest and most efficient to drive. Voltage and current are in phase (that is, in step with one another). Resistive loads usually generate heat in order to accomplish their tasks. Toasters, coffee pots, and incandescent lights are typical resistive loads. It is usually impractical to run larger resistive loads—such as electric stoves and water heaters—from an inverter due to their high current requirements. Even though the inverter/charger can most likely accommodate the load, the size of battery bank required would be impractical if the load is to be run for long periods.

Motor Loads

Induction motors (that is, motors without brushes) require two to six times their running current on start up. The most demanding are those that start under load, for example, compressors and pumps. Of the capacitor start motors (typical in drill presses, band saws, etc.), the largest you can expect to run is ½ hp (the transfer relays are rated at 2 hp). Universal motors are generally easier to start. Since motor characteristics vary, only testing will determine whether a specific load can be started and how long it can be run. If a motor fails to start within a few seconds or loses power after running for a time, it should be turned off. When the inverter/charger attempts to start a load that is greater than it can handle, it will turn itself off after a few seconds.

Long Transfer Times

The Freedom XC PRO may take a long time (~ 0.1–0.2 s) to transfer to Battery Mode when shore power is cut off while powering a motor load. Motor loads typically “freewheel” when power is removed (for example, a grinder) and causes a longer transfer time. The longer transition from shore power to inverter power may cause connected computers or other sensitive equipment to operate incorrectly. To avoid this effect, do not connect motor loads together with sensitive equipment to the inverter/charger for power.



7 SPECIFICATIONS

This section summarizes the hardware and electrical specifications of the Freedom XC PRO Inverter/Charger.

This section includes:

Physical Specifications	92
Environmental Specifications	93
System Specifications	94
Regulatory Approvals	98

NOTE: Specifications are subject to change without prior notice.

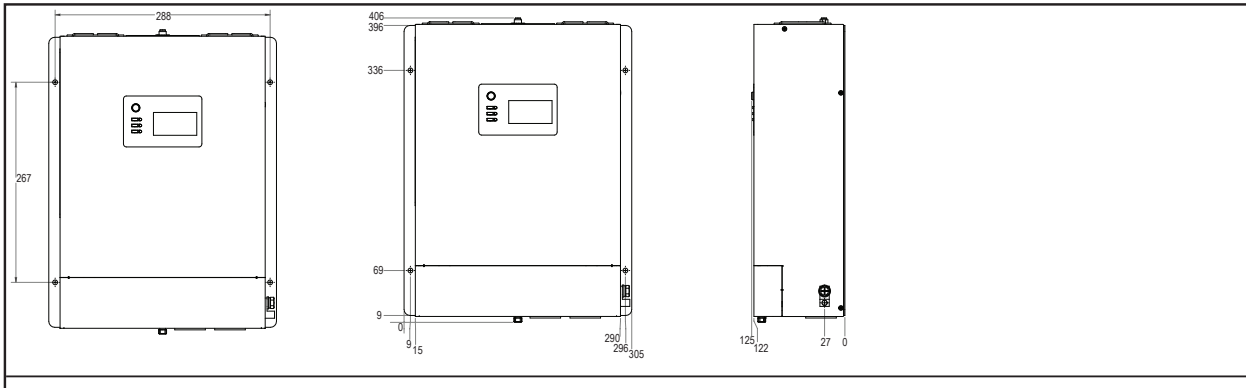


Physical Specifications

Table 16 Physical specifications

	Freedom XC PRO 2000	Freedom XC PRO 3000
L x W x H	16.0" x 12.0" x 4.9" (406mm x 305mm x 125mm)	16.0" x 12.0" x 4.9" (406mm x 305mm x 125mm)
	NOTE: Includes flanges.	NOTE: Includes flanges.
Net Weight	16.3 lbs (7.4 kg)	18.5 lbs (8.4 kg)

Table 17 Product dimensions



Environmental Specifications

Table 18 Environmental specifications

	Freedom XC PRO 2000	Freedom XC PRO 3000
Ambient Temperature:		
Operating Temperature Range ^a	-4 –140 °F (-20 –60 °C), with output derated above 104 °F (40 °C)	-4 –140 °F (-20 –60 °C), with output derated above 104 °F (40 °C)
Storage Temperature Range	-40 –158 °F (-40 –70 °C)	-40 –158 °F (-40 –70 °C)
Humidity: Operation/Storage	5–95% RH, non-condensing	5–95% RH, non-condensing

^aOperation may be limited based on the battery chemistry. For example, Lithium Iron Phosphate batteries have a limited charging temperature range. Follow specific battery manufacturer recommendations for the applicable chemistry.



System Specifications

Table 19 System specifications

	Freedom XC PRO 2000	Freedom XC PRO 3000
Transfer relay rating (A ^a)	30A (24A continuous)	50A (40A continuous)
Transfer time (milliseconds ^b)		
Shore to inverter:	<20 milliseconds	<20 milliseconds
Inverter to shore:	<20 milliseconds with a 20-second delay	<20 milliseconds with a 20-second delay
Transfer voltage (V)		
Shore to inverter:	<85 V and >140 V	<85 V and >140 V
Inverter to shore:	<135 V and >90 V	<135 V and >90 V
Cooling	Fan, activated by any of the following: High internal temperature High AC output power	Fan, activated by any of the following: High internal temperature High AC output power

^a Circuit breakers shall not carry more than 80% of their UL current rating continuously.

^b To change the AC Transfer time (mode), see *Adjusting Feature Settings in Configuration Mode* on page 72.

Table 20 DC input for inverting

	Freedom XC PRO 2000	Freedom XC PRO 3000
Operating voltage range	LBCO voltage ^a -18.0 VDC	LBCO voltage ^b -18.0 VDC
Maximum non-operating voltage	25.2 VDC	25.2 VDC
Nominal voltage	12.0 VDC	12.0 VDC
Nominal current at full load	192 ADC	304 ADC

^aTo set LBCO, see *Adjusting Feature Settings in Configuration Mode* on page 72.

^bTo set LBCO, see *Adjusting Feature Settings in Configuration Mode* on page 72.



Table 21 AC output for inverting

	Freedom XC PRO 2000	Freedom XC PRO 3000
Output voltage options	120, 110, 108 VAC	120, 110, 108 VAC
Continuous power ^c	2000 W @ 40 °C with output derated above 104 °F (40 °C)	3000 W @ 40 °C with output derated above 104 °F (40 °C)
Continuous current	16.7 A	25 A
Surge power (5 sec)	4000 W	6000 W
Frequency ^d	60 (or 50) Hz	60 (or 50) Hz
GFCI protection ^e	customer-provided	customer-provided
Wave shape	True Sine Wave	True Sine Wave
Peak efficiency	91%	91%
Full load efficiency	≥ 86%	≥ 84%

^c Power derates to 85% when output voltage is set to 110/108 VAC. .

^d To set the AC Frequency, see *Adjusting Feature Settings in Configuration Mode* on page 72.

^e See *Ground Fault Circuit Interrupters (GFCIs)* on page 23 for approved device/s.

Table 22 AC input for charging

	Freedom XC PRO 2000	Freedom XC PRO 3000
Operating voltage range	85–140 VAC	85–140 VAC
Safe non-operating voltage range	up to 240 VAC	up to 240 VAC
Full load maximum current	24 Arms	24 Arms
Nominal frequency	60 (or 50) Hz	60 (or 50) Hz
Power factor at full charge	> 98%	> 98%

Table 23 DC output for charging

	Freedom XC PRO 2000	Freedom XC PRO 3000
Nominal voltage	12.0 VDC	12.0 VDC
Min battery voltage for charging	0.0 VDC	0.0 VDC
Max output voltage	18.0 VDC (custom battery type)	18.0 VDC (custom battery type)
Nominal output current	User selectable: 5 to 100A ^f	User selectable: 5 to 150A ^g
Charger current derating	May reduce charger current depending on ambient temperature.	May reduce charger current depending on ambient temperature.
Efficiency at nominal output	≥91%	≥91%

^fCharger current is rated to 14.4 VDC output only. The charger derates if a high DC output voltage is selected.

^gCharger current is rated to 14.4 VDC output only. The charger derates if a high DC output voltage is selected.



Regulatory Approvals

Table 24 Regulatory approvals

	Freedom XC PRO 2000	Freedom XC PRO 3000
Safety	ETL-listed complies to CSA 107.1 UL458 and UL458 Marine Supplement (drip shield with product number 808-1050 required) ABYC E-11, A-31, A-32	ETL-listed complies to CSA 107.1 UL458 and UL458 Marine Supplement (drip shield with product number 808-1050 required) ABYC E-11, A-31, A-32
EMC	CFR 47, (FCC Part 15) Subpart B, Class B CAN ICES-3(B)/NMB-3(B)	CFR 47, (FCC Part 15) Subpart B, Class B CAN ICES-3(B)/NMB-3(B)



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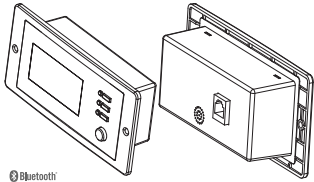
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XANTREX INVERTER REMOTE

Freedom X Remote Panel User Guide
PN: 808-0817 / 808-0817-02

<http://www.xantrex.com>



Bluetooth
808-0817-02 only

⚠ DANGER

HAZARD OF FIRE, ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

This Freedom X Remote Panel User Guide is in addition to, and incorporates by reference, the relevant product manuals for each product in the Freedom X series. Before reviewing this guide you must read the relevant product manuals. Unless specified, information on safety, specifications, installation, and operation is as shown in the primary documentation received with the product. Ensure you are familiar with that information before proceeding.
Failure to follow these instructions will result in death or serious injury.

Exclusion for Documentation

UNLESS SPECIFICALLY AGREED TO IN WRITING, SELLER (A) MAKES NO WARRANTY AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN THE MANUALS OR OTHER DOCUMENTATION; (B) ASSUMES NO RESPONSIBILITY OR LIABILITY FOR LOSSES, DAMAGES, COSTS OR EXPENSES, WHETHER SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL OR INCIDENTAL, WHICH MIGHT ARISE OUT OF THE USE OF SUCH INFORMATION; THE USE OF ANY SUCH INFORMATION WILL BE STRICTLY AT THE USER'S RISK; AND (C) REMINDS YOU THAT IF THIS MANUAL IS IN ANY LANGUAGE OTHER THAN ENGLISH, ALTHOUGH STEPS HAVE BEEN TAKEN TO MAINTAIN THE ACCURACY OF THE TRANSLATION, THE ACCURACY CANNOT BE GUARANTEED. APPROVED CONTENT IS CONTAINED WITH THE ENGLISH LANGUAGE VERSION WHICH IS POSTED AT [HTTP://WWW.XANTREX.COM](http://www.xantrex.com).

1 Introduction

Thank you for purchasing the Freedom X Remote Panel. This user guide will help you install and use the remote panel to operate and configure the Freedom X and XC series remotely.

What's In The Box

- Check that you have the following items in the box before proceeding.
- the Freedom X remote panel unit
 - user guide and mounting template
 - 25-ft. 6-conductor cable kit (808-0817-02 unit only)

FCC/IC Information to the User

This device complies with Part 15 of the FCC Rules/Canada Industry licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause harmful interference. (2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
RF Exposure: The equipment has been evaluated to meet general RF exposure requirement. The device can be used in portable condition without restriction.
FCC ID: 2A00L-FXPB-BT / IC: 23401-FXPB-BT

2 What's Required

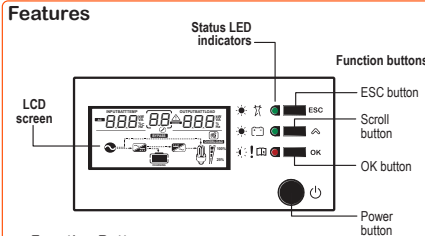
If you received the 808-0817 unit, you need to acquire one of the following 6-conductor cable kit from Xantrex. Go to <http://www.xantrex.com/power-products-support> to order.

- 25-ft. 6-conductor cable kit (PN: 31-6257-00)
- 50-ft. 6-conductor cable kit (PN: 31-6262-00)

Installation

1. Prepare the remote panel unit and the 6-conductor com cable kit.
2. Choose a location for the remote panel unit within reach of the com cable and the inverter unit.
3. Use the mounting template (in section A) to make the installation of the remote panel easier.
4. Mount the remote panel unit.
5. If you have a Freedom 458 unit, you may use it with the Freedom X Remote Panel. Installation instructions are available in section B.

3 Features



Function Buttons

- return to default screen or exit setting mode
- next screen or next selection
- to enter the setting mode or to confirm the setting
- turns the inverter unit on or standby
NOTE: Only when the inverter's Power button is off

NOTE: Briefly pressing any function button activates backlight illumination. After 60 seconds of inactivity, backlight illumination turns off.

Status LED Indicators

	Indicates grid mode in which shore power is available and passing through to the loads and charging the battery.
	Indicates battery mode (inverter mode) in which the inverter is running and supplying power to the loads from the battery.
	Indicates error or fault mode and is accompanied by an error code displayed on the LCD screen.
	Indicates a warning condition and is accompanied by an error code and a sounding alarm.

LCD Screen

	AC input and output indicator.
	The wrench icon underneath a number is displayed during configuration mode.
	An error event with its corresponding number is displayed here.
	A warning event with its corresponding number is displayed here.
	The battery icon indicates remaining battery power. One bar = 1-25%, two bars = 25-50%, three bars = 50-75%, and four bars = 75-100%.
	Shows an AC output overload condition.
	The load icon is displayed if there is voltage available at the AC output.

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09-2019

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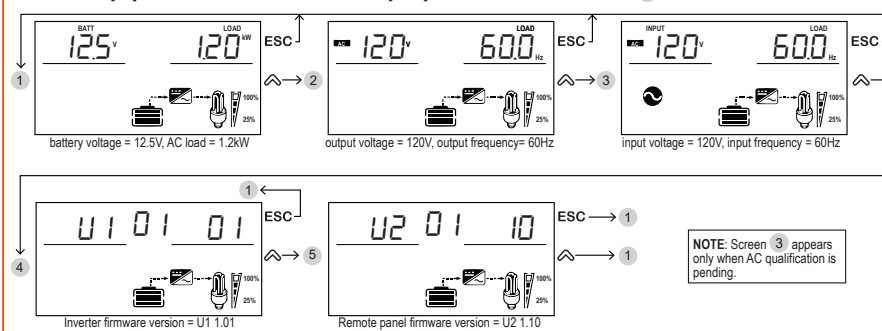
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<http://www.xantrex.com>

4 Viewing Information During Battery Mode

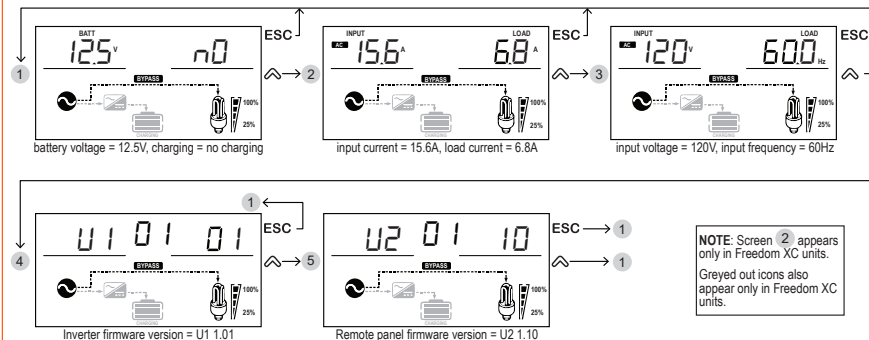
Press scroll (↗) to move to the next screen. Press [ESC] to return to the home screen 1.



NOTE: Screen 3 appears only when AC qualification is pending.

5 Viewing Information During Grid Mode

Press scroll (↗) to move to the next screen. Press [ESC] to return to the home screen 1.



NOTE: Screen 2 appears only in Freedom XC units. Greyed out icons also appear only in Freedom XC units.

6 Adjusting Feature Settings

1. Press and hold the [OK] button for three seconds to enter the feature settings mode.
2. Press the scroll (↗) button to move through the different feature settings.
3. Press the [OK] button to select a setting number and change its value.
4. Press the scroll (↗) button to change the value until you reach the desired value.
5. Press the [OK] button to confirm the change.
6. Repeat previous steps to set other feature settings.
7. Press [ESC] to exit the feature settings mode.

NOTE: See the Freedom X / XC Owner's Guide for information on the individual settings.

NOTE: It may take a minute for the settings to take effect on the inverter unit.

Contact Information
<http://www.xantrex.com>
Please contact your Xantrex Sales Representative or visit the Xantrex website at: <http://www.xantrex.com/power-products-support>

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09-2019

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Creating a Bluetooth Link with the Freedom X Remote Panel App

The Freedom X Remote Panel app (FXC Control) allows you to conveniently monitor and configure a Freedom X inverter (or a Freedom XC inverter/charger)^a with a compatible smart device^b using a Bluetooth connection.

1. Download and install the FXC Control app into a compatible Android or iOS smart device.



2. Turn on the Bluetooth enabled Freedom X Remote Panel by using the ON/OFF button on either its own front panel or the connected inverter's front panel.

3. Launch the FXC Control app on your smart device.

4. Turn on the smart device's Bluetooth through the Bluetooth toggle on the app. The app should now indicate that it is searching for devices.
5. On the Freedom X Remote Panel, press and hold the ESC button to enable Bluetooth pairing on the remote. Remote pairing can be observed by the two flashing horizontal lines underneath the left and right numbers.
6. When the app has detected the Bluetooth signal, it will display the connected inverter's serial number in the app. Click on the serial number to complete the pairing process.
7. To stop the Bluetooth connection, disable the smart device's Bluetooth connectivity.

^a List of compatible Freedom X/XC units:
817-1000, 817-2000, 817-2000S1, 817-2000,
817-1050, 817-2050, 818-2010, 818-3010, 806-1212

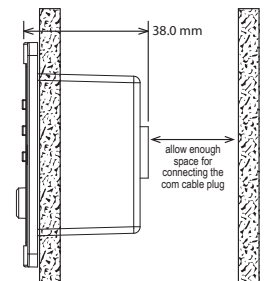
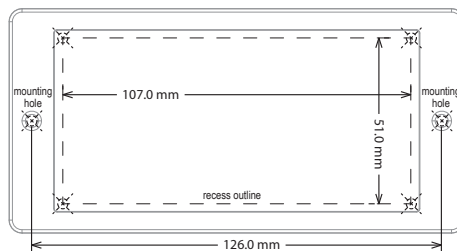
^b Compatible smart devices:
Phone or iPad running iOS 8 or higher,
Android phone or tablet running v4.0 or higher with Bluetooth
Low Energy compatibility

A

Installing the Remote Panel Unit on the Wall

1. Place the template on the wall.
2. Mark the corners (or trace the dotted lines) of the recess outline on the wall.
3. Mark the two mounting holes for the two screws on the wall.
4. Remove the template from the wall.
5. Cut along the recess outline on the wall to make a hole for the remote panel's body.
6. Pre-drill the mounting holes appropriate to the mounting screws (not provided) that will be used.
7. Connect the 6-conductor com cable to the RJ12 ports on the inverter and remote panel.
8. Mount the remote panel unit on the wall.

Mounting Template



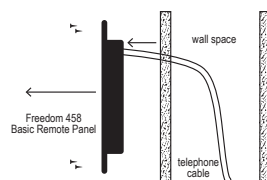
NOTE: Ensure the inside wall is free of obstructions, such as pipes, insulation, and electrical wiring. Ensure the recess depth is more than 50 mm.

B

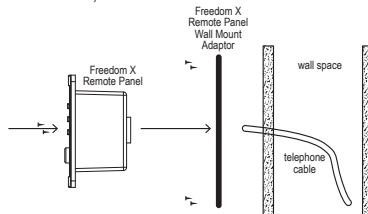
Installing the Freedom X Remote Panel with a Wall Mount Adaptor

The Freedom X Remote Panel Wall Mount Adaptor (PN: 808-0819) allows the installation of the Freedom X Remote Panel onto an adaptor bezel which then fits over the existing wall panel opening of a Freedom 458 Basic Remote Panel.

1. Unmount the Freedom 458 Basic Remote Panel from the wall by removing the four screws securing it to the wall. Set aside the four screws.



2. Detach the six-conductor telephone cable from the Freedom 458 Basic Remote Panel.
3. Install the Freedom X Remote Panel Wall Adaptor to the wall at the outer corners with the four screws in step 1. Alternatively, use optional counter-sink screws, if needed.



4. Take the Freedom X Remote Panel and attach the six-conductor telephone cable from the wall opening.
5. Mount the Freedom X Remote Panel to the Freedom X Remote Panel Wall Adaptor securing it with the two supplied mounting screws.
6. Complete the inverter installation and start up procedure in the Freedom X/XC Owner's Guide.



ZAMP CHARGE CONTROLLER

ZAMP  SOLAR®

Solar Controller / Battery Charger

ZS-30A / ZS-40A

Input: DC12 / 24V Solar panel (Max. 50V)

Output: DC 12 / 24V 30A (ZS-30A)

DC 12 / 24V 40A (ZS-40A)

User's Manual



FEATURE

- Advanced MCU control pulse width modulated (PWM) technology, high efficiency operation.
- Target for LiFePO4, LTO (Lithium Titanium Oxide), LI-95, Gel, AGM, Conventional lead-acid (WET) Batteries.
- Integrated regulator to prevent your battery from being overcharged. Overcharging occurs when the charge voltage is unregulated. This can result in premature battery failure.
- Integrated regulator to prevent your battery from being under charged, The unit provides an automatic Equalization feature for deeply drained Conventional lead acid battery, as well as provides a cycling automatic Equalizing feature every 28 days.
- Can be connected to the battery permanently to keep the battery fully charged by using a process called “floating”. This means the controller will stop charging when the battery is full and will automatically start charging the battery as required. This process will also reduce water loss and help prevent the battery from ‘drying out’.
- Protects your battery from discharge at night. Under low light or no light conditions the solar panel voltage could be less than the battery voltage. The unit contains a special circuit which prevents current flowing back from the battery and into the solar panel.
- Colored LED’s to easily indicate the operational status and battery conditions.
- Digital LCD to directly display battery voltage, charging current, charging capacity (Amp hour), battery types and faulty codes.
- Provides plug-in remote digital display meter (Optional).
- Provides external battery temperature sensor (Optional).
- Multi charging protections against reverse polarity, short circuit, over temperature, over voltage, etc.
- Surface Mount or Flush Panel Mount options.
- Conformal-coating circuit boards and plated terminals apply to hostile environments.



For use with 12 / 24 Volt Solar Panel; Suitable for Solar panels up to 1020 Watts / ZS-30A; 1360 Watt / ZS-40A



WARNING – IMPORTANT PLEASE READ

- This charger is designed for indoor use only and should never be exposed to rain or moisture.
- Do not disassemble the controller. Contact Zamp Solar Technical Services if you suspect an issue with the controller.
- Lead acid, LiFePO4, LTO, LI-95 batteries can be dangerous. Ensure no sparks or flames are present when working near batteries.
- Eye protection should always be used. Never short circuit the battery
- Given sufficient light solar panels always generate energy even when they are disconnected.
- Accidental 'shorting' of the terminals or wiring can result in sparks causing personal injury or a fire hazard. We recommend that you cover up the panel(s) with some sort of soft cloth so you can block all incoming light during the installation. This will ensure that no damage is caused to the Solar Panel or Battery if the wires are accidentally short circuited.
- Always install a battery fuse on each circuit including the solar controller
- Do not reverse connect the wires to the solar panel or battery

MOUNTING THE DEVICE

The Solar Controller has two mounting options.

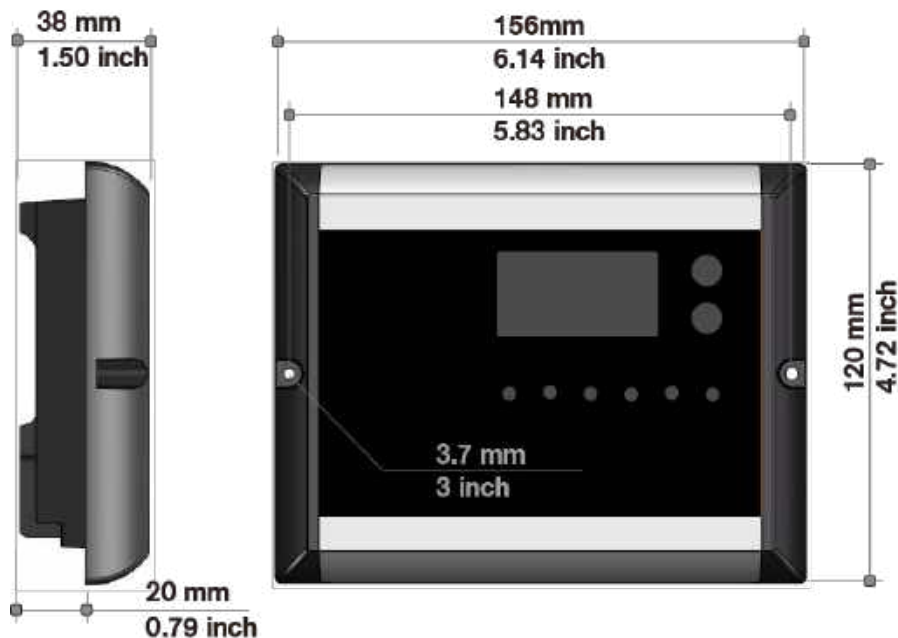
1. Surface mount:

The quickest and easiest way to mount the unit is to use the two plastic spacers and self tapping screws supplied and mount the unit to a flat surface,

2. Flush (panel) mount:

Before deciding to use this mounting method, please ensure there is sufficient depth behind the controller or in the cavity. (Refer to Diagram below)

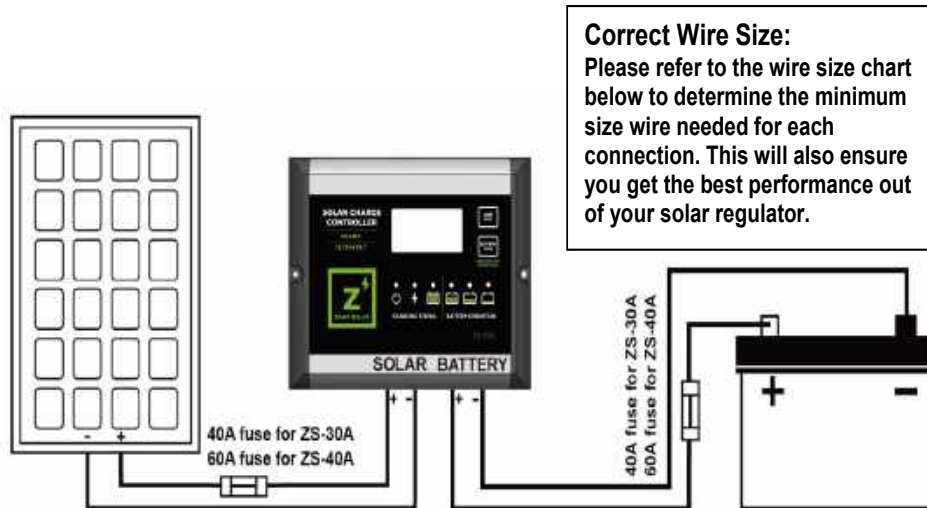
Using the dimensions shown in the following diagram, mark a 105mm x 130mm rectangle where you wish to mount the controller and cut-out the panel opening then use the two self- tapping screws supplied to secure the unit.





WIRING CONNECTIONS

To protect the Battery and the Solar Panel, we strongly recommend that you place a 40A inline fuse for ZS-30A (60A fuse for ZS-40A) on the positive wire on both the “Solar” and “Battery” Circuits. (As close to the Battery /Panel as possible)
 The Solar Controller has 4 terminals which are clearly marked ‘Solar’ and ‘Battery’. There is a (12V) and earth (GND) terminal for each circuit.
 Refer to the wiring diagram below.



	Battery Connection		Solar Array Connection		
Length of Wire	5ft	10ft	10ft	15ft	20ft
Size (AWG)	10	8	10	8	8

1. Using the Terminals supplied, crimp the terminals on your Solar Array wires and connect to the Solar Panel like shown.
2. Using the Terminals supplied, crimp the terminals on your Battery wires and connect to the Battery like shown.

When the connections are completed, Solar Controller will start working automatically.

OPERATION - LCD DISPLAY

Please check your battery manufacturer’s specifications to select correct battery type. The unit provides 6 battery types for selections: LiFePO4, LTO, LI-95, Gel, AGM, WET (conventional lead acid).






ZAMP CHARGE CONTROLLER

Press **BATTERY TYPE** button and **hold** for 3 seconds access battery type selection mode, the battery type you select will be shown on the LCD meter, the default setting is AGM Battery; the controller will automatically retain your battery type setting.

Caution: Incorrect battery type setting may damage your battery.

When the controller powers on, the unit will run self-qualify mode and automatically show below items on LCD before going into charging process

 Self-test starts, digital meter segments test

 Software version test

 Rated voltage and current test

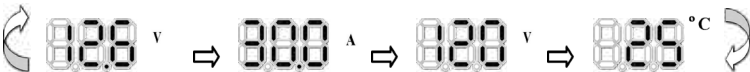
 External battery temperature sensor test (if connected)



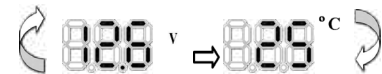
Indicates the solar panel connected.

After going into charging process, the LCD displays the charging statuses as below: Press **VOLT / AMP** button in sequence, the LCD will display in turn with Battery Voltage, Charging Current, Charged capacity (Amp-hour) and Battery Temperature (if external temperature sensor connected)

Display in the daytime



Display during the night-



The **VOLT / AMP** button can be changed at any time during the charging process.

You also can visually monitor your battery charging condition for each battery; there is a LCD bar to show the percentage of charge, indicating the battery is charged to 25%, 50%, 75% or 100%.

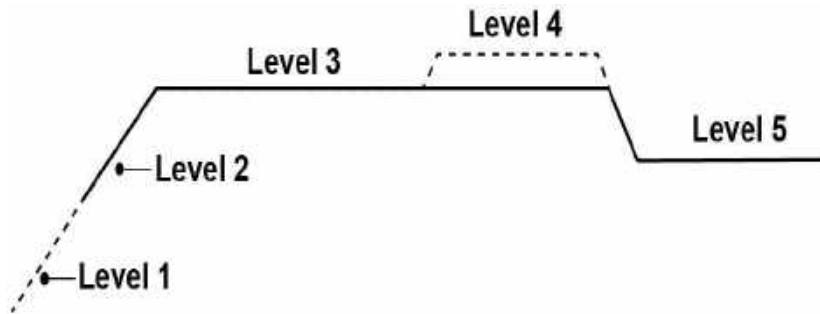


The LCD also can be treated as an independent voltage meter or thermometer. A voltage less than 11.5V Volts indicates that the battery is discharged and requires re-charging.

CHARGING STAGES

The unit has a 5-stage charging algorithm.

Soft Charge (Level 1) –Bulk Charge (Level 2)-Absorption charge (Level 3) – Equalizing Charge* (Level 4) - Float Mode (Level 5)



Soft Charge- When batteries suffer an over-discharge, the controller will softly ramp the battery voltage up to 10V.

Bulk Charge-Maximum current charging until batteries rise to Absorption level

Absorption Charge-Constant voltage charging and battery is over 80%

Equalization Charge*-Only for WET battery type, when the WET battery is deeply drained below 10V, it will automatically run this stage to bring the internal cells as an equal state and fully complement the loss of capacity. (other battery types do not run Equalization charge)

Float Charge-Battery is fully charged and maintained at a safe level.
A fully charged Lead acid battery (GEL, AGM, WET battery) has a voltage of more than 13.6 Volts; A fully charged LiFePO4, LTO or LI-95 battery has a voltage level of 13.4V.

Remarks: Voltage setting for 12V mode, x 2 for 24V mode.






OPERATION - L.E.D. INDICATION













The 6 LED's indicate the charging status and the battery condition						
	Red	Blue	Green	Green	Yellow	Red
Solar Power Present-No battery connected	ON	OFF	OFF	OFF	OFF	Flash
Soft charging	ON	Flash	OFF	OFF	OFF	ON
Bulk charging	ON	ON	OFF	Subject to battery voltage		
Absorption charging	ON	ON	OFF	ON	OFF	OFF
Equalization charging	ON	ON	OFF	ON	OFF	OFF
Float charging	ON	OFF	ON	ON	OFF	OFF
Solar panel weak	Flash	OFF	OFF	Subject to battery voltage		
At night, no charge	OFF	OFF	OFF	Subject to battery voltage		
Battery Voltage below 11.5V (+/-0.2V)	ON	ON	OFF	OFF	OFF	ON
Battery Voltage between 11.5V - 12.5V(+/-0.2V)	ON	ON	OFF	OFF	ON	OFF
Battery Voltage above 12.5V (+/-0.2V)	ON	ON	OFF	ON	OFF	OFF




ZAMP CHARGE CONTROLLER

ABNORMAL OPERATION MODE

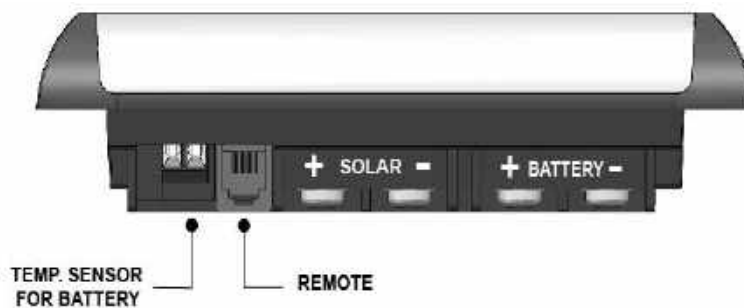
Solar panel abnormal mode	LCD display	LED indication	LCD backlight
Solar panel weak		 Flash	ON
Solar panel reverse connection		 Flash	Flash
Solar panel over voltage (> 26.5V)		 Flash	Flash

Battery abnormal mode	LCD display	LED indication	LCD backlight
Battery disconnected or less than 3.0V		 Flash  Flash  Flash	Flash
Battery reverse connection		 Flash	Flash
Battery over voltage than > 17.5V		 Flash	Flash
Battery temperature over 65°C		 Flash  Flash  Flash	Flash

The solar controller abnormal mode	LCD display	LED indication	LCD backlight
The controller over temperature protection			Flash

OPTIONAL EXTERNAL DEVICE

The controller provides two optional devices (excludes in the packaging box).



Optional external Battery temperature sensor:

As an option, the unit provides a port to connect the external battery temperature sensor; if the external battery temperature sensor is connected, the unit will optimize the charging performance subjected to the battery temperature detected and also provide the battery over temperature protection, in some cases, if battery over temperature occurs, the controller will automatically stop charging.

Optional external Remote display meter:

As an option, the unit also provides a port to connect the external Remote display meter for some special location needed. The display content on the Remote meter is same as the display on the controller.



SPECIFICATIONS

1	Electrical Parameters			
1-1	Rated solar panel amps ZS-30A /ZS-40A	30 / 40	Max.	AMP
1-2	Normal input Solar cell array voltage	15-22		VDC
1-3	Max. solar cell array voltage (output has no load)	25	Max.	VDC
1-4	The controller lowest operating voltage (solar or battery side)	8V	Min	VDC
1-5	Maximum voltage drop-Solar panel to battery	0.25	Max.	VDC
2	Charging characteristics			
2-1	Minimum battery start charging voltage	3	Min	VDC
2-2	Soft start charging voltage	3-10	+/-0.2	VDC
2-3	Soft start charging current ZS-30A / ZS-40A	Up to 15 / 20		AMP
2-4	Bulk charge voltage	10-14.0	+/-0.2	VDC
2-5	Absorption charging voltage at 25°C			
	--LI-95 type battery (i)	13.7	+/-0.2	VDC
	--LTO type battery	14.0	+/-0.2	VDC
	--LiFePO4 type battery	14.4	+/-0.2	VDC
	--GEL battery	14.1	+/-0.2	VDC
	--AGM type battery (default setting)	14.4	+/-0.2	VDC
	--WET type battery	14.7	+/-0.2	VDC
2-6	Absorption transits to Equalizing or Float condition:			
	--Charging current drops to	1.0	+/0.1	AMP
	-- or Absorption charging timer timed out	4		Hour
2-7	Equalization charging active			
	--Only for WET battery			
	--Battery voltage discharged to less than	10	+/-0.2	VDC
	--Automatic equalizing charging periodical	28		Day
2-8	Equalization charging voltage at 25°C	15.5	+/-0.2	VDC
2-9	Equalization charging timer timed out	2		Hour
2-10	Float charging voltage at 25°C			
	-- For LI-95, LTO and LiFePO4 battery	13.4	+/-0.2	VDC
	-- For Gel, AGM, WET battery	13.6	+/-0.2	VDC
2-11	Voltage control accuracy	+/- 1%		
2-12	Battery temperature compensation coefficient	-24		mV/°C
2-13	Temperature compensation (exclude Lithium battery)	-20~+50		°C
3	Protection			
3-1	Against reverse polarity or short circuit			
3-2	No reverse current from battery to solar at night			
3-3	Over temperature protection during charging	65		°C
3-4	Transient over voltage protection with TVS or varistor			
4	Electrical parts			
4-1	Input output terminal	M5 terminals		
4-2	Remote port	RJ-11 (6 pins)		
5	Physical Parameters			
5-1	Controller material	Plastic, Standard ABS		
5-2	Power terminal maximum stranded wire size	#6 AWG stranded -16 mm ²		
5-3	Power terminal torque	Up to 17 in-lb (0.2n-m)		
5-4	Mounting	Vertical wall mounting		
5-5	IP grade	IP22,		
5-6	Net weight	Approx. 0.3kg / 0.66lb		
6	Environmental characteristics			
6-1	Operating temperature	-25 ~ 50°C / -13~122 °F		
6-2	Storage temperature	-40 ~ 85°C / -40~185 °F		
6-3	Operating Humidity range	100% no condensation		

Remarks: Voltage setting for 12V mode, x 2 for 24V mode.

(i) The LI-95 battery profile keeps your LiFePO4 battery charged at 95%. Evidence suggests that charging your Lithium battery to less than 100% can increase longevity of your battery.



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