



OLIVER
TRAVEL TRAILERS

2022



LEGACY ELITE & LEGACY ELITE II

**OPTIONAL
FEATURES**

COMPONENT MANUALS

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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@natureshead.com
Phone: 251-295-3043
Warranty: 5-Year



SureCall Fusion2Go 3.0 Cell Phone Amplifier

SureCall
48346 Milmont 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

ANDERSEN 
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

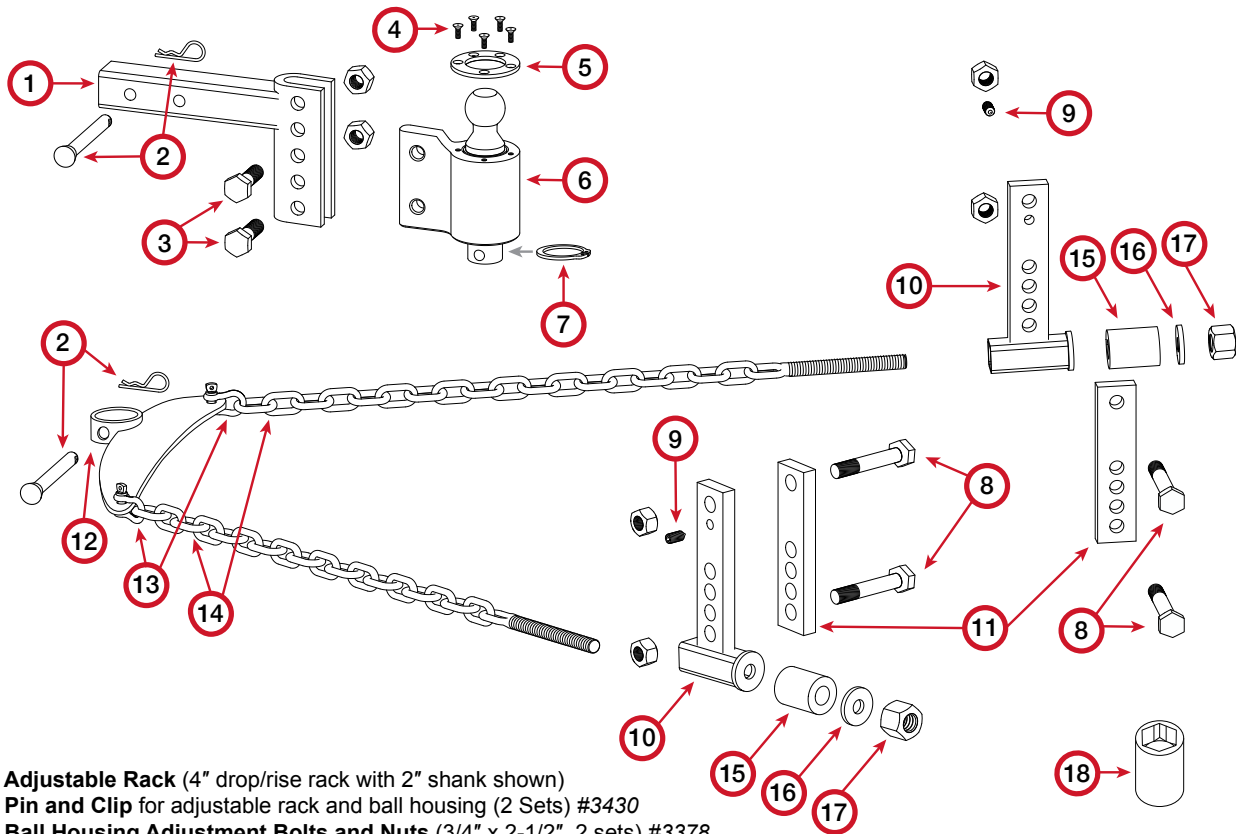
A NOTE ABOUT SUSPENSION

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

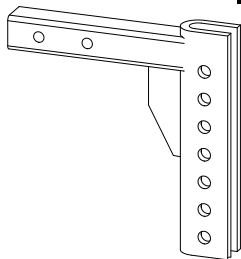


1. Adjustable Rack (4" drop/rise rack with 2" shank shown)
2. Pin and Clip for adjustable rack and ball housing (2 Sets) #3430
3. Ball Housing Adjustment Bolts and Nuts (3/4" x 2-1/2", 2 sets) #3378
4. Ball Housing Plate Screws (5 pcs, attached to ball housing)
5. Ball Housing Plate (attached to ball 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

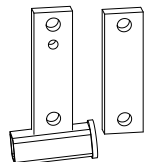
TOOLS NEEDED FOR INSTALLATION

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)

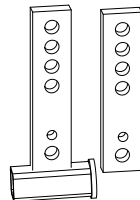
Possible Add-Ons (see page 14 for more info and products)



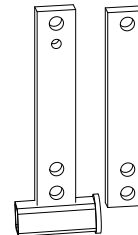
8" drop/rise
adjustable rack



4-3/8" Brackets



Raised 3/4"/5"/6"
Brackets



7"/8" Brackets



2" or 2-5/16" WD Ball
with Spring Clip

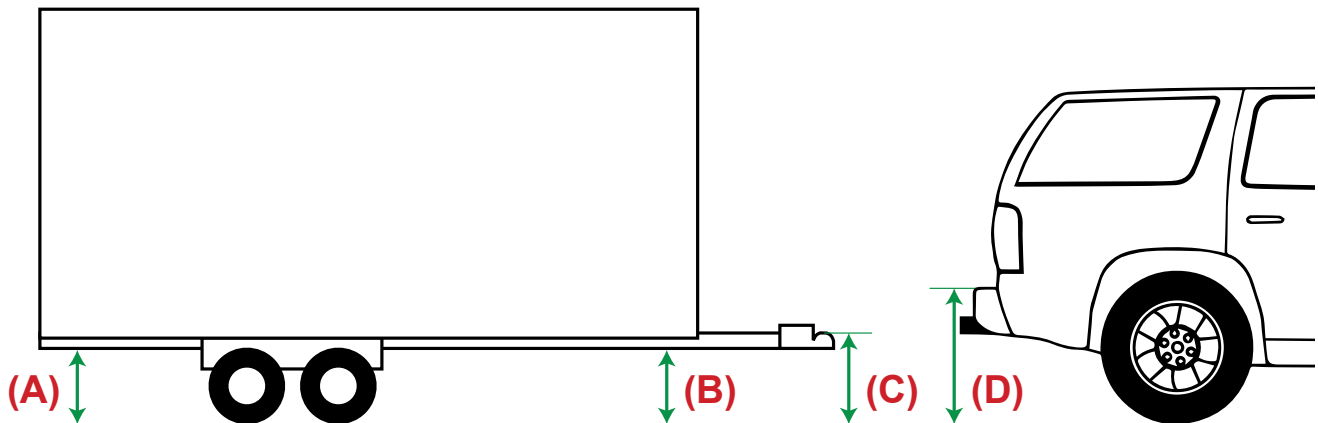


SECTION 1: PREPARATION

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.

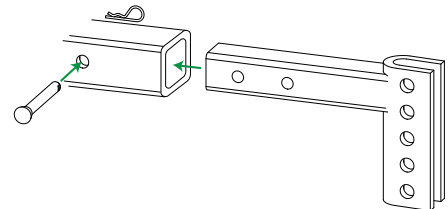
1-2. Ensure that the trailer is parallel to the ground by comparing measurements (A) and (B) — i.e. from the ground to the frame on both the front and back of the trailer.



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

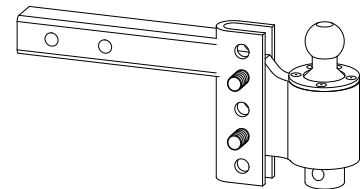
2-1. Once the trailer is level, place the adjustable rack into the hitch receiver on your towing vehicle. Secure it to the receiver using the standard pin and clip (provided) or your own locking pin.

(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.

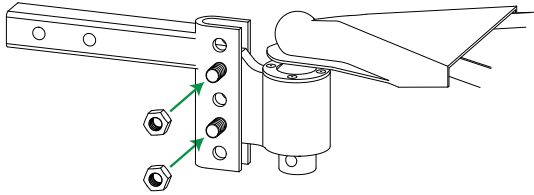
The front end of your trailer should now be about 1" to 1-1/2" lower than the back. If the front of the trailer is **MORE** than 1-1/2" lower than the back, you might need to raise the trailer coupler off of the Ball Housing and move the Ball Housing up a notch or two so that it is close to level (i.e.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

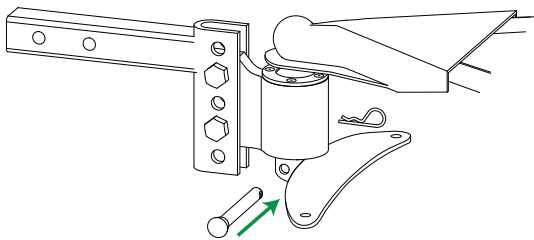


SECTION 3: ATTACHING THE TENSION PLATE AND CHAINS



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.

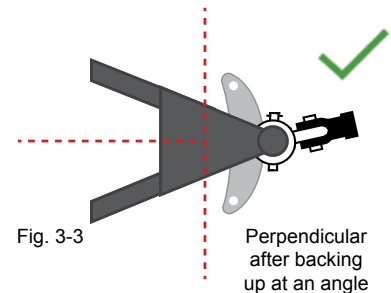
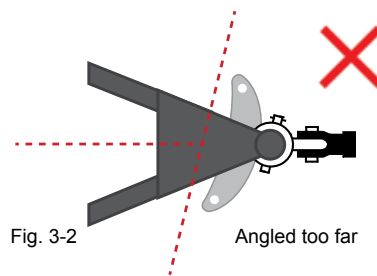
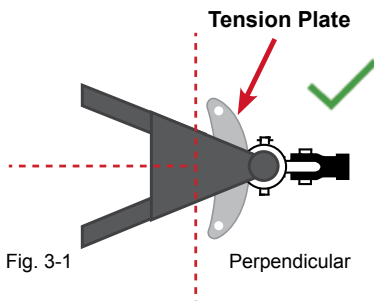
IMPORTANT! For this part of the installation, make sure there is **ALMOST NO WEIGHT** being placed on the ball when you lock the trailer coupler in place on the ball.



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.

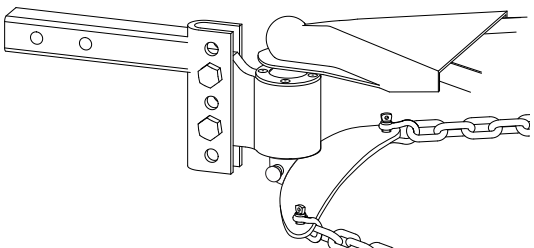
3-3. Look at a bird's-eye-view of the Tension Plate (see below) to make sure that the Tension Plate is close to perpendicular to the trailer frame (fig. 3-1). If not, raise the trailer jack off the ground and use the tow vehicle to move the Trailer forward or backward at an angle until the plate is close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



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.**



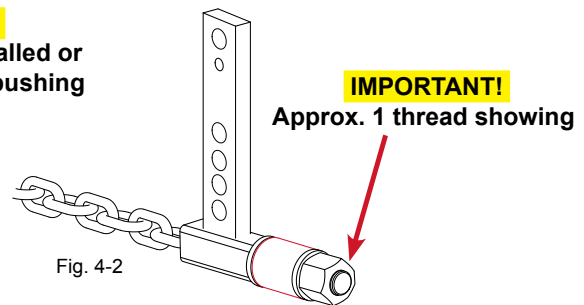
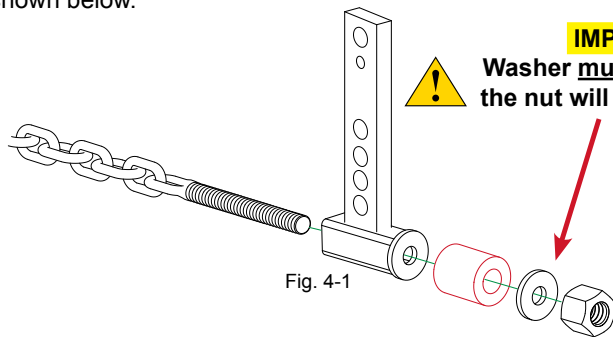
3-5. Attach the chain shackles to the Tension (Triangle) Plate by threading the shackle pin through the hole on the plate (everything should look like the diagram on the left).

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



SECTION 4: ATTACHING THE FRAME BRACKETS TO THE TRAILER

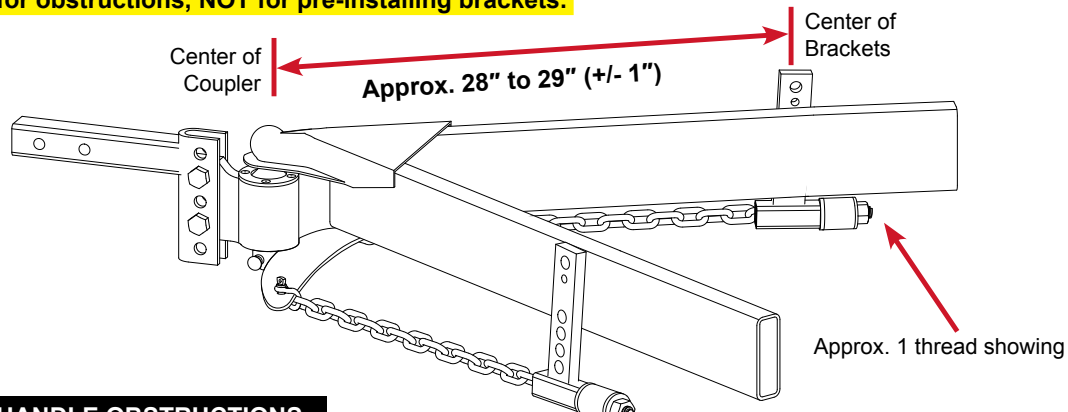
4-1. With the TRAILER STILL RAISED, attach both tension chains to the outside frame brackets using the hardware shown below.



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.

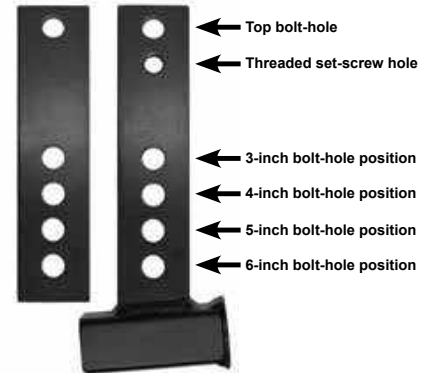


CAUTION! Double-check around the trailer frame to see if there are any brake lines, gas lines, or wiring that could be damaged by installation of the frame brackets. If so, find a way to reroute them before final installation.

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.

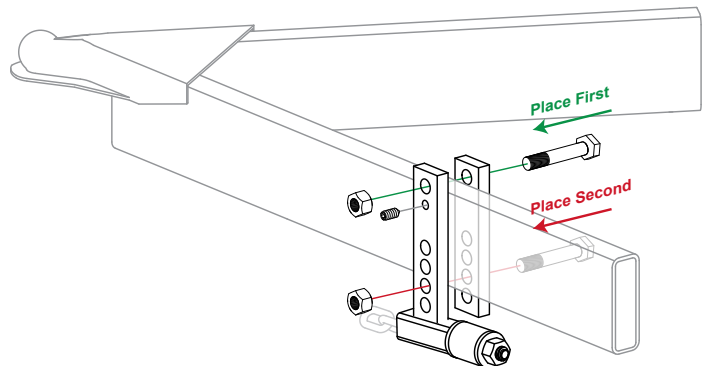
Correct Bolt Installation Order

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.**

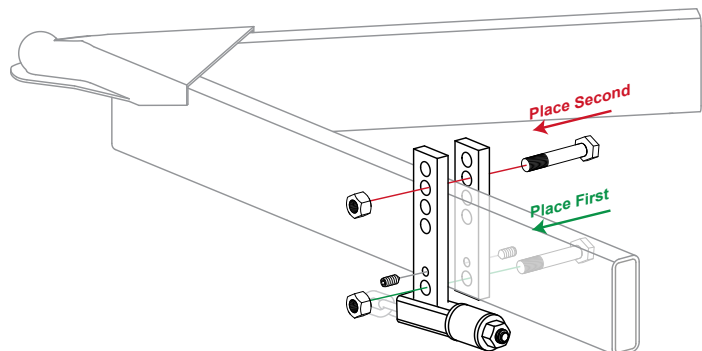
CORRECT INSTALLATION ORDER FOR:

- 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.

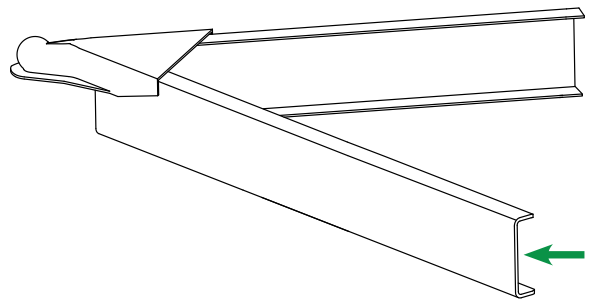


4-6. Using a 5/16" allen ratchet or allen wrench, screw in all set screws until they **barely touch** the trailer frame. Then, proceed to tighten them 1-1/2 to 2 more full rotations. If you find that your brackets tend to shift, you can use one of the following optional set screw installation methods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

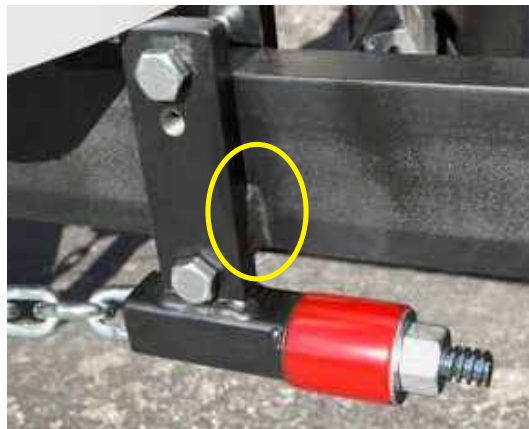


2. OPTIONAL FRAME BRACKET INSTALLATION - WELDING (for both Regular and C-Channel frames)

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.

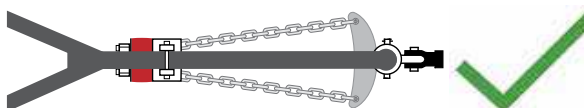
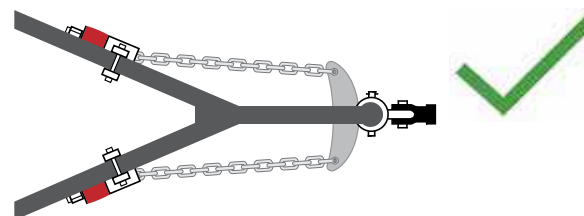
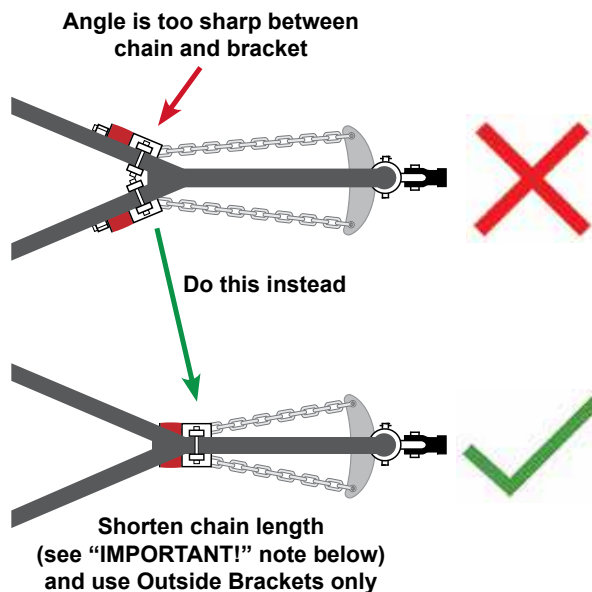
NOTE: You do not need to weld the inside frame brackets. Should you decide to sell your trailer later, the weld could be easily removed by prying the bracket away and grinding off the leftover weld.



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.



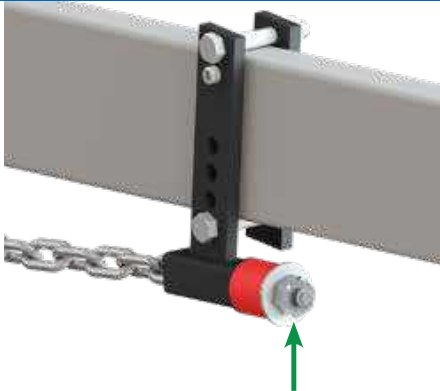
Use Outside Brackets Only

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.

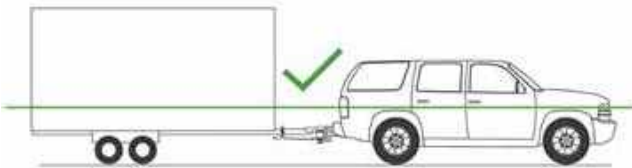
To fine-tune the weight distribution, you can tighten or loosen both Tension Nuts one thread at a time. Although it is not crucial, it is a good practice to tighten or loosen both of the Tension Nuts about the same amount.

See Section 6 for further checking and adjustment.

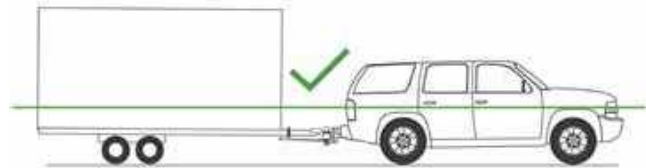
SECTION 6: CHECKING AND ADJUSTING THE TENSION

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.

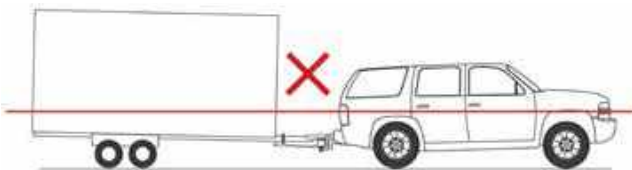
IMPORTANT Trying to get the Tow Vehicle perfectly level is **NOT** necessary — you just don't want to be too extreme in either direction (too much towards the tow vehicle's front axle or too much towards the rear axle). After hundreds of installations we have found that it is quite effective to basically "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:



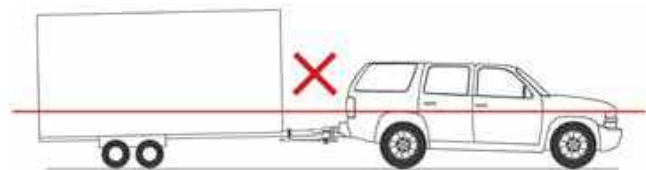
GOOD: Trailer and tow vehicle are level



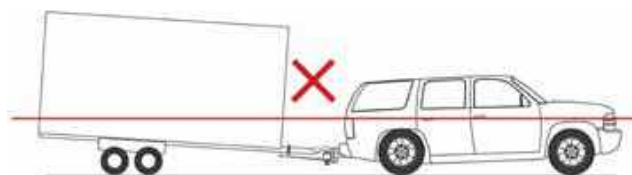
GOOD: Trailer is level, rear of tow vehicle is a little lower than front



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



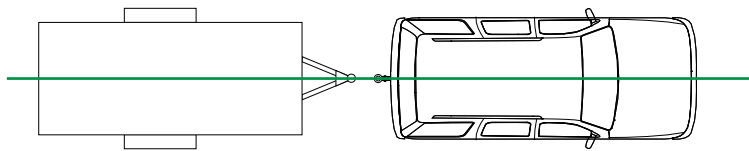
REMEMBER Any time your load changes in the towing vehicle or trailer, re-check to see how level you are and make adjustments as needed. Also, check the tightness of all nuts and bolts often and re-tighten as necessary.

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).

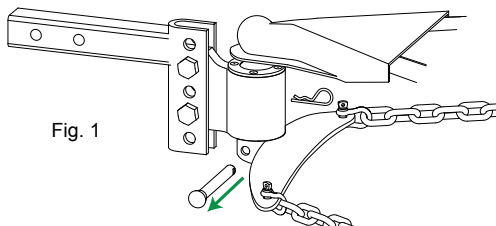


Fig. 1

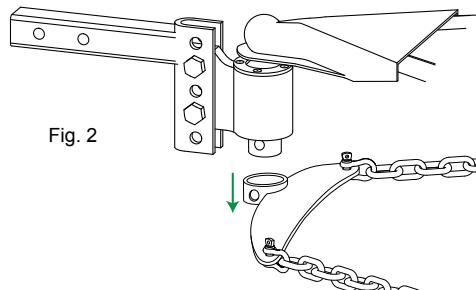


Fig. 2

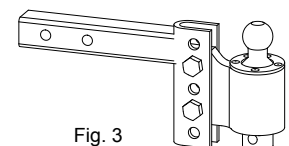


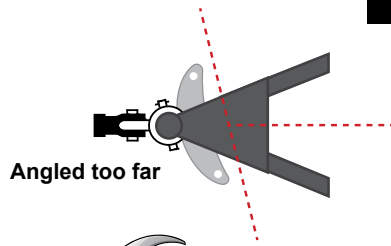
Fig. 3



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?

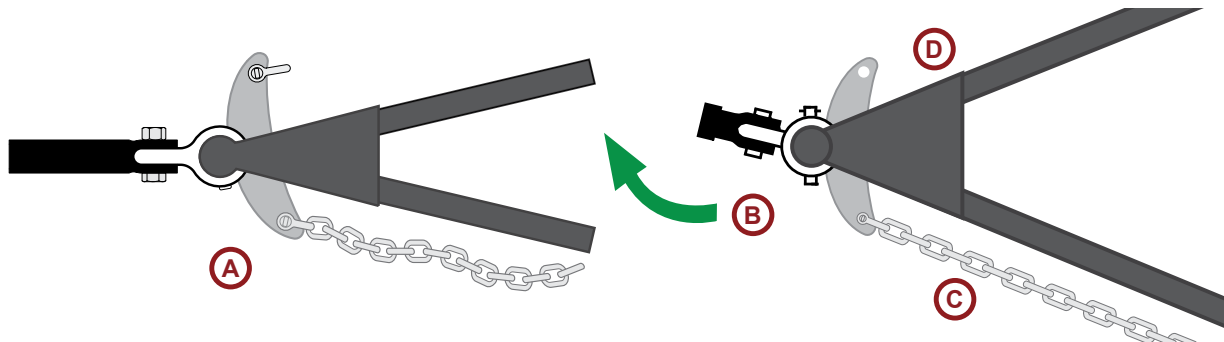


If you are unable to back up your tow vehicle to the same angle as when you unhooked your trailer or the tension (triangle) plate is no longer perpendicular to the trailer, then follow the procedure below to straighten out the tension plate.



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)



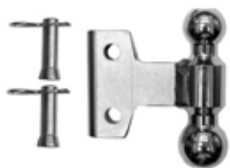
#3369
3"/" RAISED
Bracket Set
(low trailer frames only)



#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

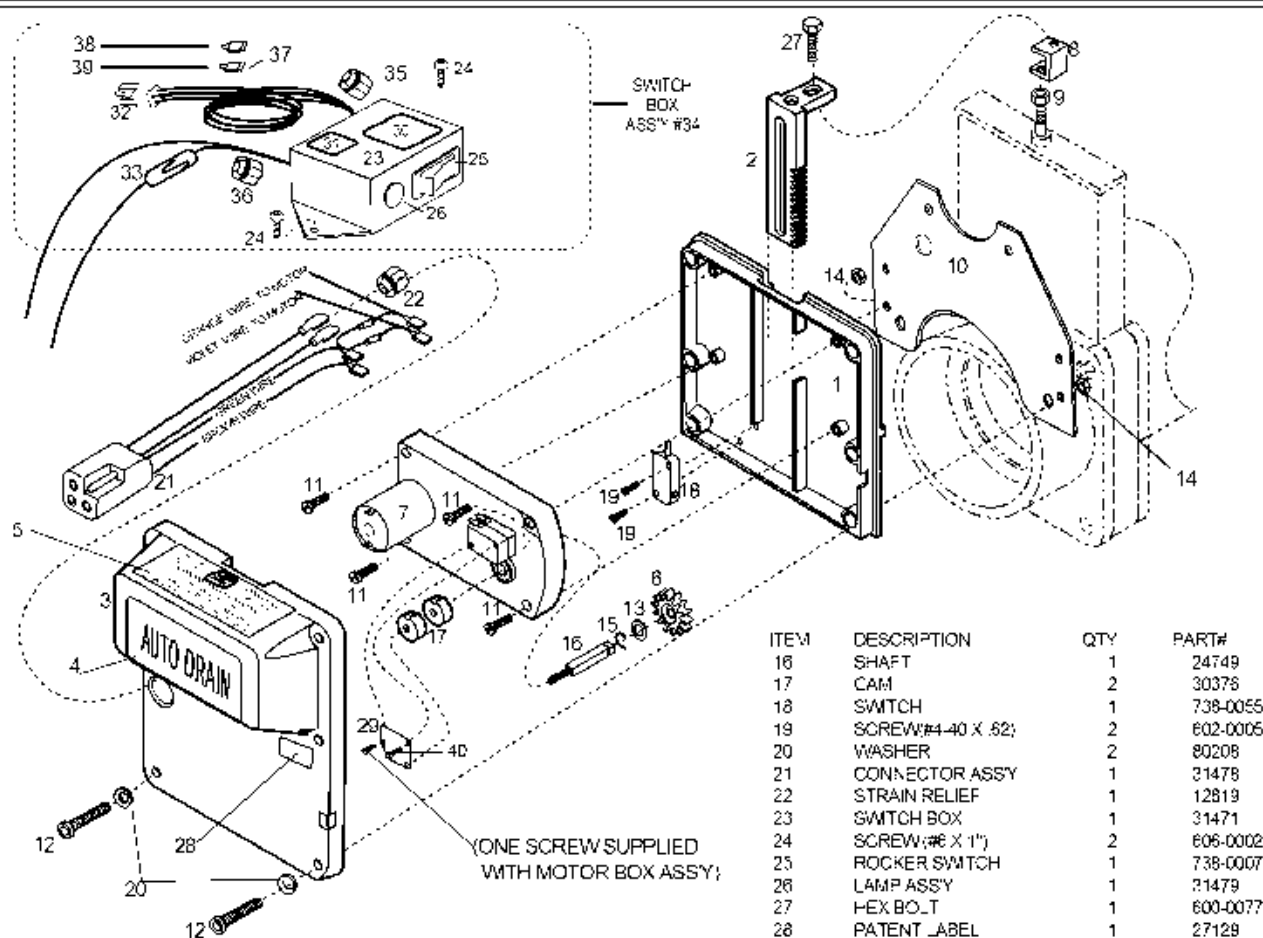
OPERATION:

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.**



PARTS LIST FOR 3" AUTO-DRAIN

ITEM	DESCRIPTION	QTY	PART#	ITEM	DESCRIPTION	QTY	PART#
1	BASE MACHINED	1	31473	16	SHAFT	1	24749
2	RACK GEAR	1	24131	17	CAM	2	30376
3	COVER, MACHINED	1	26876	18	SWITCH	1	738-0055
4	AUTO DRAIN LABEL	1	25012	19	SCREW(#4-40 X .52)	2	602-0005
5	WARNING/SERIAL LABEL	1	25386	20	WASHER	2	80208
6	DRIVE GEAR	1	24134	21	CONNECTOR ASSY	1	31478
7	MOTOR BOX ASSY	1	24122	22	STRAIN RELIEF	1	12819
8	SPACER	1	30992	23	SWITCH BOX	1	31471
9	HEX NUT .25-.20	1	610-0006	24	SCREW(#6 X 1")	2	606-0002
10	UNIVERSAL BRACKET	1	30893	25	ROCKER SWITCH	1	738-0007
11	SCREW(#4-24)	4	605-0007	26	LAMP ASSY	1	31479
12	SCREW(#10-32 X 1.12")	2	601-1006	27	HEX BOLT	1	600-0077
13	WASHER	1	80225	28	PATENT LABEL	1	27129
14	LOCKNUT(#10-32)	2	611-2100	29	PLATE SUPPORT	1	28429
15	"E" RING	1	634-1250	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	602-0036

(NOT SHOWN- COVER FOR SWITCH BOX- PN 24306)



H&H ENGINEERING

DIVISION OF BARKER, 1750 CO. 750 E. 14100 AVE. P.O. BOX 440, BATTLE CREEK, MI 49906-0440

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PAGE 2 of 3	DATE 9 JUN 09	FORM # 31476
REVISION LETTER F	CDW 14057	APPROVED



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.



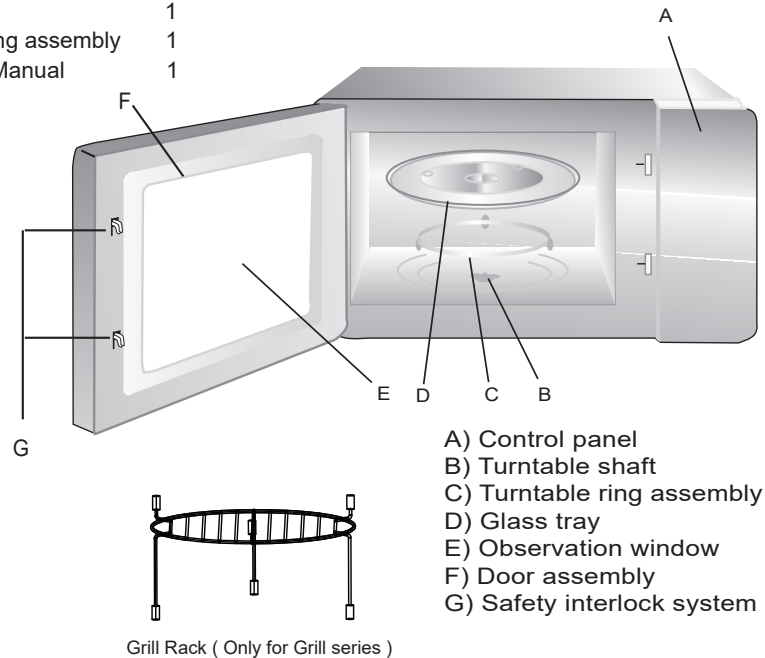
SETTING UP YOUR OVEN

Names of Oven Parts and Accessories

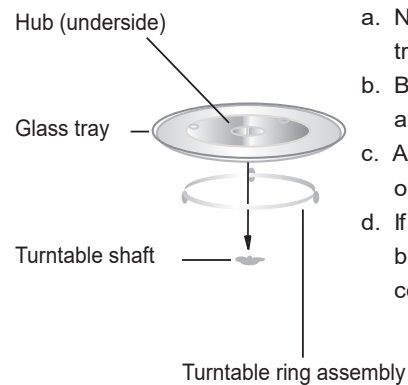
Remove the oven and all materials from the carton and oven cavity.

Your oven comes with the following accessories:

Glass tray	1
Turntable ring assembly	1
Instruction Manual	1



Turntable Installation

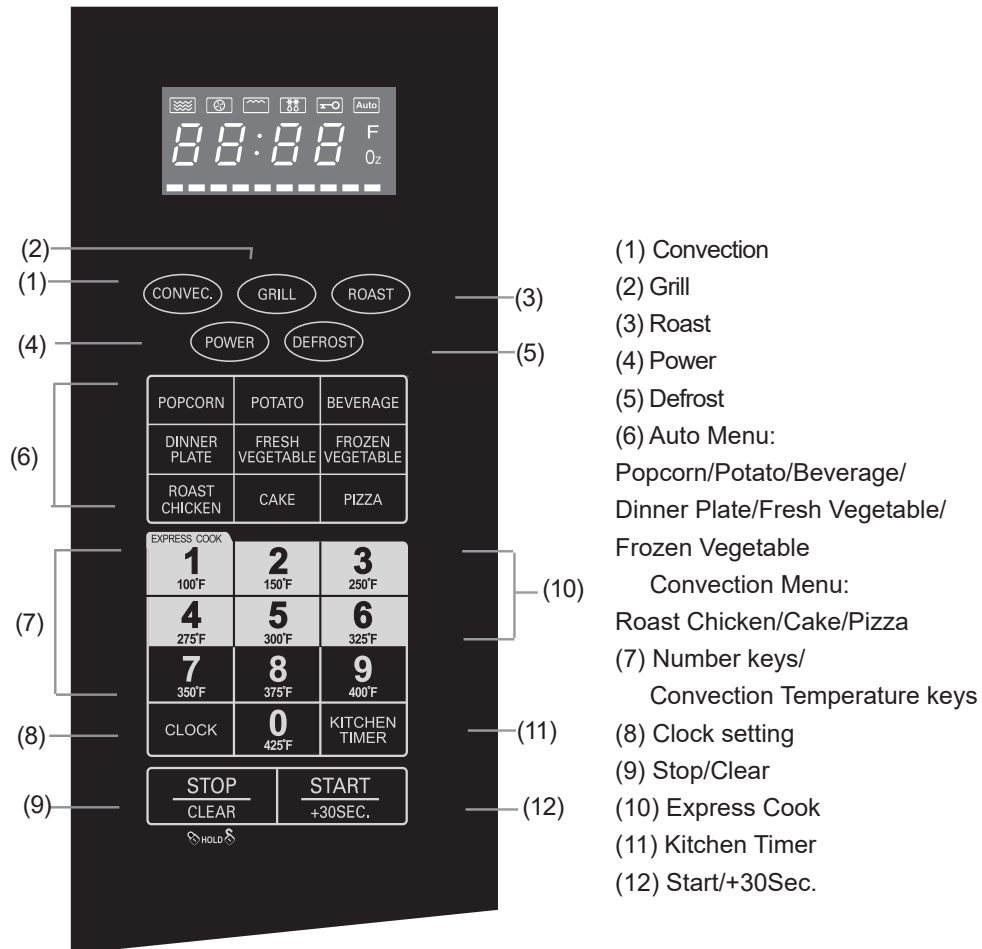


- Never place the glass tray upside down. The glass tray should never be restricted.
- Both glass tray and turntable ring assembly must always be used during cooking.
- All food and containers of food are always placed on the glass tray for cooking.
- If glass tray or turntable ring assembly cracks or 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.



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 defrost ing 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.



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	a. Electrical cord for oven is not plugged in. b. Door is open. c. Wrong operation is set.	a. Plug into the outlet. b. Close the door and try again. c. Check instructions.
Arcing or sparking	a. Materials to be avoided in microwave oven were used. b. The oven is operated when empty. c. Spilled food remains in the cavity.	a. Use microwave-safe cookware only. b. Do not operate with oven empty. c. Clean cavity with wet towel.
Unevenly cooked foods	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.	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	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.	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	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.	a. Use microwave-safe cookware only. b. Use correct cooking time, power level. c. Turn or stir food.

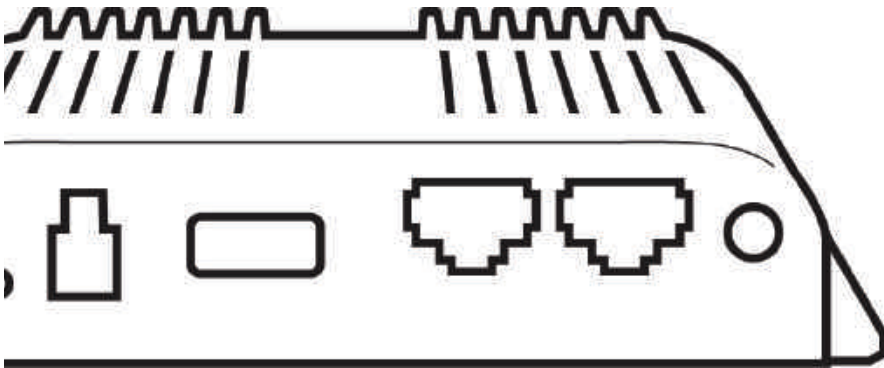
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COR Series Router

IBR900 / IBR950

User Manual



cradlepoint.com





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INTRODUCTION

WHAT'S IN THE BOX

- Ruggedized router with integrated business-class 3G/4G modem; includes integrated mounting plate
- Quick Start Guide with warranty information
- External 3G/4G mobile broadband modem antennas (2) (SMA), finger tighten only
- External WiFi antennas (2) reverse SMA*, < 5 dBi gain, finger tighten only
- 12 V / 2 A power supply w/ locking connector; DC GPIO/power cable available
- Extra SIM door screws (2)

NOTE: -NPS SKU comes with no antennas or power supply, and includes a 2-meter locking power and GPIO cable (direct wire).

*-IBR900 only

KEY FEATURES

WAN

- Dual-modem capable with optional COR Extensibility Dock
- LP6: LTE Advanced LTE/HSPA+ (SIM-based Auto-Carrier Selection for all North American and European carriers)
- WiFi as WAN¹, with WPA2 Enterprise Authentication for WiFi-as-WAN³
- Failover/Failback
- Load Balancing
- Advanced Modem Failure Check
- WAN Port Speed Control
- WAN/LAN Affinity
- IP Passthrough
- Standby

LAN

- VLAN 802.1Q
- DHCP Server, Client, Relay
- DNS and DNS Proxy
- DynDNS
- UPnP
- DMZ
- Multicast/Multicast Proxy
- QoS (DSCP and Priority Queuing)
- MAC Address Filtering

WiFi¹

- Dual-Band Dual-Concurrent
- 802.11 a/b/g/n/ac wave 2
 - MU-MIMO and 256 QAM support
- Up to 128 connected devices (64 per radio – 2.4 GHz and 5 GHz)
- Multiple SSIDs: 2 per radio (4 total)
- WPA2 Enterprise (WiFi)
- Hotspot/Captive Portal



- SSID-based Priority
- Client Mode for faster data offload

MANAGEMENT

- Cradlepoint Enterprise Cloud Manager²
- Web UI, API, CLI
- Active GPS support on all models
- Data Usage Alerts (router and per client)
- Advanced Troubleshooting (support)
- Device Alerts
- SNMP
- SMS control
- Serial Redirector
- Auto APN Recovery
- Syslog

VPN AND ROUTING

- IPsec Tunnel – up to five concurrent sessions
- L2TP³
- GRE Tunnel
- OSPF/BGP/RIP³
- Route Filters (Access Control Lists, Prefix Filters, Route Maps, Communities for BGP)
- Per-Interface Routing
- Routing Rules
- Policy-based Routing
- NAT-less Routing
- Virtual Server/Port Forwarding
- NEMO/DMNR³
- IPv6
- VRRP³
- STP³
- NHRP³
- VTI Tunnel support
- OpenVPN support
- CP Secure VPN compatible
- Serial PAD Mode

SECURITY

- RADIUS and TACACS+ support*
- 802.1x authentication for Ethernet
- Zscaler integration³
- Certificate support
- ALGs
- MAC Address Filtering
- Advanced Security Mode (local user management only)
- Per-Client Web Filtering
- IP Filtering
- Content Filtering (basic)
- Website Filtering
- Zone-Based Object Firewall with host address (IP or FQDN), port, and MAC address



*-Native support for authentication. Authorization and accounting support through hotspot/captive portal services.

CLOUD OPTIMIZED IP COMMUNICATIONS

- Automated WAN Failover/Failback support
- WAN Affinity and QoS allow prioritization of VoIP services
- Advanced VPN connectivity options to HQ
- SIP ALG and NAT to allow VoIP and UC communications to traverse firewall
- MAC Address Filtering
- 802.1p/q for LAN QoS segmentation and treatment of VoIP on LAN
- Private Network support (wired and 4G WAN)
- Cloud-based management²

1 – WiFi-related functions are only supported on IBR900 models

2 – [Enterprise Cloud Manager](#) requires a subscription

3 – Requires an [Extended Enterprise License](#)

SPECIFICATIONS

WAN:

- Dual-modem capable with optional COR Extensibility Dock
- Integrated LP6 Category 6 LTE Advanced LTE modem (with DC-HSPA+ failover)
- Two LAN/WAN switchable 10/100/1000 Gigabit Ethernet ports – one default WAN (cable/DSL/T1/satellite/Metro Ethernet)
- WiFi as WAN, Metro WiFi; 2x2 MIMO “N” 2.4 GHz or 5 GHz; 802.11 a/b/g/n/ac wave 2 (IBR900 only)

LAN:

- Dual-band dual-concurrent WiFi; 802.11 a/b/g/n/ac wave 2 (IBR900 only)
- Two LAN/WAN switchable 10/100/1000 Gigabit Ethernet ports – one default LAN
- Serial console support for out-of-band management of a connected device

PORTS:

- Power
- 2-wire GPIO
- Add more GPIO ports with optional 9-wire GPIO cable or COR Extensibility Dock (see Accessories section below)
- USB 2.0
- Two Ethernet LAN/WAN
- Two cellular antenna connectors (SMA)
- One active GPS antenna connector (SMA)
- Two WiFi antenna connectors (R-SMA)
- 15-pin dock port for COR Extensibility Dock or 9-wire GPIO cable

TEMPERATURE:

- -30 °C to 70 °C (-22 °F to 158 °F) operating

HUMIDITY (non-condensing):

- 5% to 95% operating
- 5% to 95% storage

POWER:

- DC input steady state voltage range: 9–33 VDC (requires inline fuse for vehicle installations)
 - For 9–24 VDC installations, use a 3 A fuse



- For > 24 VDC installations, use a 2.5 A fuse
- Reverse polarity and transient voltage protection per ISO 7637-2
- Ignition sensing (automatic ON and time-delay OFF)
- Power consumption:
 - Idle: 4 W
 - WiFi Tx/Rx: 9 W
 - LTE Tx/Tx: 6.25 W
 - 12 VDC / 2 A adapter recommended

WIFI POWER:

- 2.4 GHz: 18 dBm conducted
- 5 GHz VHT20: 17.5 dBm conducted
- 5 GHz VHT40: 17 dBm conducted
- 5 GHz VHT80: 16.5 dBm conducted

SIZE: 4.6 × 4.5 × 1.2 in (118 × 113.5 × 29.3 mm)

WEIGHT: 14 oz (400 g)

CERTIFICATIONS:

- FCC, CE, IC
- AS, NZS, SGP (IMDA)
- WiFi Alliance (IBR900 only) – 802.11a/b/g/n/ac Wave 2 certified
- Safety: UL/CUL, CB Scheme, EN60950-1
- Shock/Vibration/Humidity: compliant with MIL STD 810G and SAEJ1455
- Ingress Protection: compliant with IP54 (includes protection from dust and splashing water)
- Materials: WEEE, RoHS, RoHS-2, California Prop 65
- Vehicle: E-Mark, compliant with ISO 7637-2
- Telecom: PTCRB/CTIA, GCF-CC
- Regulatory Models: S5A643A, S5A644A, S5A648A, S5A701A, S5A706A

GPS

- GPS Protocols: TAIP and NMEA 0183 V3.0
- Satellite channels: Maximum 40 channels, simultaneous tracking
- Concurrent standalone GPS, GLONASS, BeiDou and Galileo
- 1 Hz refresh rate
- Accuracy:
 - < 2 m: 50%
 - < 5 m: 90%
 - Horizontal: < 2 m (50%); < 5 m (90%)
 - Altitude: < 4 m (50%); < 8 m (90%)
 - Velocity: < 0.2 m/s
- Acquisition (measured with signal strength: -135 dBm):
 - Hot start: 1 second
 - Warm start: 29 seconds
 - Cold start: 32 seconds
- Sensitivity
 - Tracking: -160 dBm (tracking sensitivity is the lowest GNSS signal level for which the device can still detect an in-view satellite 50% of the time when in sequential tracking mode)
 - Acquisition (standalone): -145 dBm (acquisition sensitivity is the lowest GNSS signal level for which the device can still detect an in-view satellite 50% of the time)
- Operational limits: altitude <6000 m or velocity <100 m/s (either limit may be exceeded, but not both)



ACCESSORIES

Cradlepoint offers several accessory options for extensibility, power and antennas:

EXTENSIBILITY

- COR Extensibility Dock (Part # 170700-000)
- 9-wire power & GPIO cable (Part #170680-000)

POWER

Vehicle options

- Vehicle locking power adapter for COR (Part # 170635-000)
- Two meter locking power and GPIO cable (direct wire) (Part # 170585-000) – *included by default on IBR900LP6-NA-NPS only*

Power Supplies/Adapters

- North America COR IBR900/IBR950 power supply (Part # 170716-000)
- International power supply -- includes adapters for US, EU, UK, AU (Part # 170717-000)
- Barrel to 4-pin power adapter (Part # 170665-000)

ANTENNAS – 3G/4G Modem, WiFi, & GPS

- 700 MHz – 2700 MHz Wide Band Directional Antenna (Yagi/Log- Periodic) Part #: 170588-000
- 12" Mag-Mount Antenna with SMA Male Connector Part #: 170605-000
- 4" Mini Mag-Mount Antenna with SMA Male Connector Part #: 170606-000
- 2.4/5 GHz Dual-band Dual-concurrent WiFi Antenna Part #: 170628-000 (WiFi models only)
- Universal 3G/4G/LTE Modem Antenna Part #: 170649-000
- GPS Screw-Mount Antenna Part #: 170651-000
- GPS Mag-Mount Antenna Part #: 170652-000
- Multi-Band Omni-Directional Antenna Part #: 170668-000
- Indoor/Outdoor Panel Patch Part #: 170669-000
- Universal LTE/4G/3G / 2dBi/3dBi antenna with SMA connector for all AER, ARC, COR, and MC400 products (Part # 170704-001)

Vehicle Antennas

- 3-in-1 GPS & Modem Screw-Mount Part #: 170653-000
- 3-in-1 Adhesive-Mount Antenna Part #: 170653-001
- 5-in-1 GPS, Modem & WiFi Screw-mount Part #: 170654-000
- Low Profile 5-in-1 MIMO LTE, MIMO WiFi (2.4/5 GHz), & GPS Screw Mount Antenna with 5 m Cables Part #: 170654-001

See the Cradlepoint antenna accessories page for more information about antennas. Also see the Antenna Ordering and Installation Guide, available as a PDF in the Resources section of antenna and router product pages.

BUSINESS-GRADE MODEM SPECIFICATIONS

COR IBR900/IBR950 LP6 models include an integrated LTE Advanced Category 6 4G LTE modem. The LP6 modems support SIM-Based Auto-Carrier selection so there is only one model for all of North America. Simply insert the SIM and wait for the router to automatically detect the SIM and establish a connection.

The LTE bands certified for each carrier are listed below.

COR IBR900LP6-NA, COR IBR950LP6-NA, COR IBR900LP6-EU

- **Technology:** LTE Advanced, HSPA+
- **Downlink Rates:** LTE 300 Mbps, HSPA+ 42.2 Mbps





- **Uplink Rates:** LTE 50 Mbps, HSPA+ 5.76 Mbps
- **Frequency Bands:**
 - **LTE** Bands 1-5, 7, 8, 12, 13, 17, 20, 25, 26, 29, 30, 41
 - **Verizon:** 2, 4, 5, 13 (XLTE support w/carrier aggregation)
 - **AT&T:** 2, 4, 5, 12/17, 29, 30
 - **Sprint:** 25, 26, 41 (LTE Plus Support)
 - **T-Mobile:** 2, 4, 12 (T-Mobile Wideband LTE Support)
- **Carrier Aggregation:**
 - 1+ 8
 - 2+ 2/5/12 (17 w/MFBI)/13/29
 - 3+ 7/20
 - 4+ 4/5/12 (17 w/MFBI)/13/29
 - 5+ 2/4/30
 - 7+ 3/7/20
 - 8+ 1
 - 12 (17 w/MFBI) + 2/4/30
 - 13+ 2/4
 - 20+ 3/7
 - 30+ 5/12 (17 w/MFBI)
 - 41+ 41
- **Fallback:** WCDMA/DC-HSPA+ (42/5.76 Mbps): Bands 1, 2, 3, 4, 5, 8
- **Power:** LTE: 23 dBm \pm 1; HSPA+: 23 dBm \pm 1
- **Antennas:** two SMA male (plug), finger tighten only (maximum torque spec is 7 kgf/cm²)
- **GPS:** active GPS support
- **SMS:** SMS support
- **Industry Standards & Certs:** CE, FCC, GCF-CC, IC, PTCRB, AT&T, Sprint, Verizon

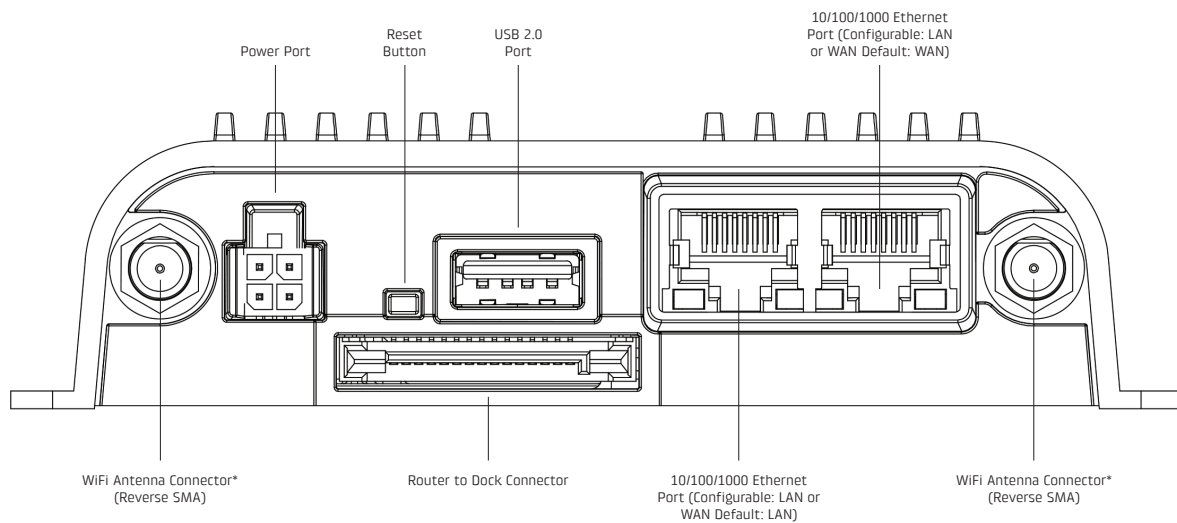
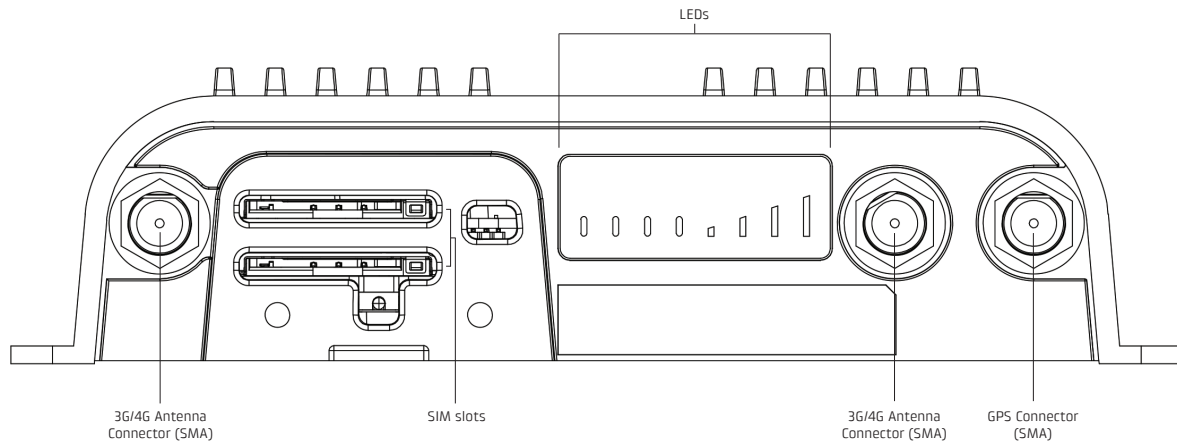
COR IBR900/IBR950LP5 models include an integrated LTE Advanced Category 6 4G LTE modem, and support Asia Pacific. The LP5 modems support SIM-Based Auto-Carrier selection. Simply insert the SIM and wait for the router to automatically detect the SIM and establish a connection.

COR IBR900LP5-AP, COR IBR950LP5-AP

- **Technology:** FDD/TDD (Category 6) LTE Advanced, DC-HSPA+
- **Downlink Rates:** LTE 300 Mbps, DC-HSPA+ 42.2 Mbps
- **Uplink Rates:** LTE 50 Mbps, DC-HSPA+ 5.76 Mbps
- **Frequency Bands:**
 - **LTE** Bands: 1, 3, 5, 7, 8, 11, 18, 19, 21, 28, 38, 39, 40, 41
 - **TD-SCDMA** 39
- **Carrier Aggregation:**
 - 1+ (8, 18, 19, 21)
 - 3+ (5, 7, 19, 28)
 - 7+ (5, 7, 28)
 - 19+ 21
 - 38+ 38
 - 39+ 39
 - 40+ 40
 - 41+ 41
- **Fallback:** WCDMA/DC-HSPA+ (42/5.76 Mbps): Bands 1, 5, 6, 8, 9, 19
- **Power:** LTE: 23 dBm \pm 1; DC-HSPA+: 23 dBm \pm 1
- **Antennas:** two SMA male (plug), finger tighten only (maximum torque spec is 7 kgf/cm²)
- **GPS:** active GPS support
- **SMS:** SMS support
- **Industry Standards & Certs:** CE, GCF-CC, RC Australia, others pending



HARDWARE



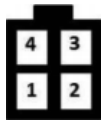
* - only on IBR900



POWER/GPIO CONNECTOR

This connector has four pin slots: power, ground, input, and output.

Connector pinout – view into router (rear view of cable connector):

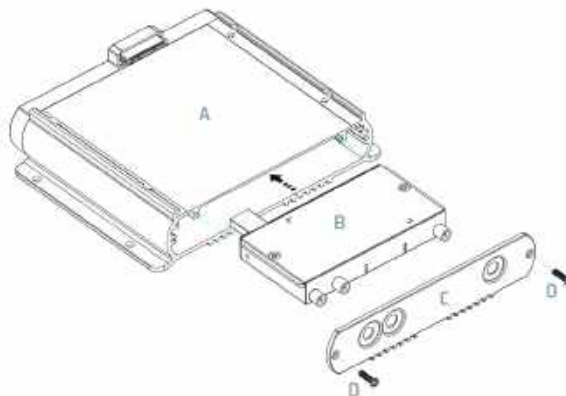


Pin	Definition	Details	Wire Color
1	Ground	-	Black
2	Power	9-33 V DC	Red
3	Input	3 V input high threshold (36 V tolerant)	Orange
4	Output	capable of sinking 250 mA	Blue

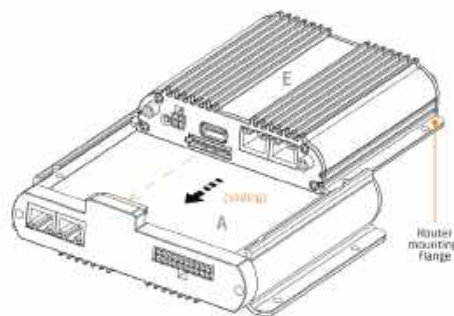


EXTENSIBILITY DOCK INSTALLATION INSTRUCTIONS

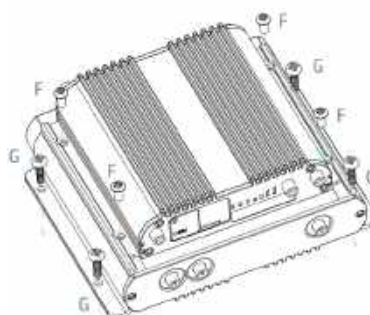
1. Remove modem door (C) from dock (A).
2. Insert activated SIM(s) into MC400 modem (B).
3. Slide MC400 modem (B) into modem dock (A).
4. Attach modem door (C) using M3 screws (D).



5. Remove dock port protective cover. With the dock port of the router facing the dock, slide the mounting flange(s) of the router (E) into the guide rails of the dock (A).
6. Fully seat the dock connectors and align the router/dock holes.



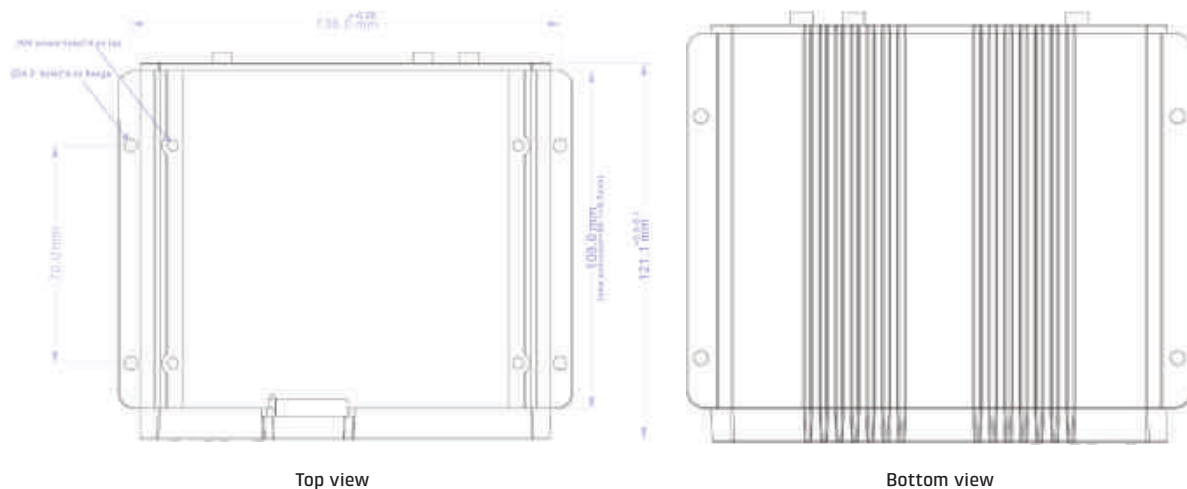
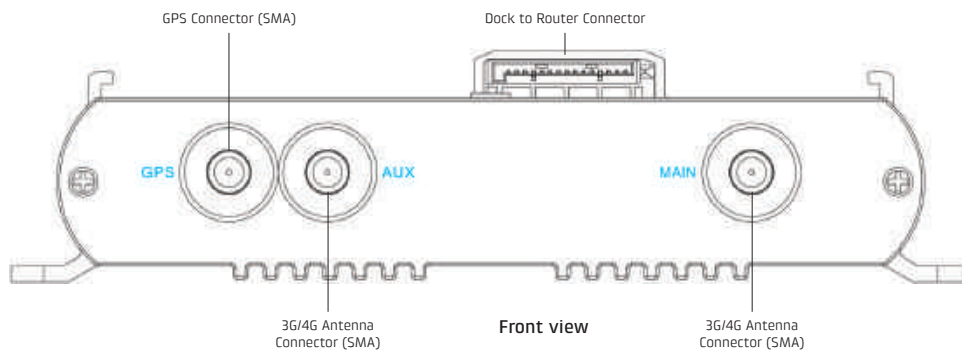
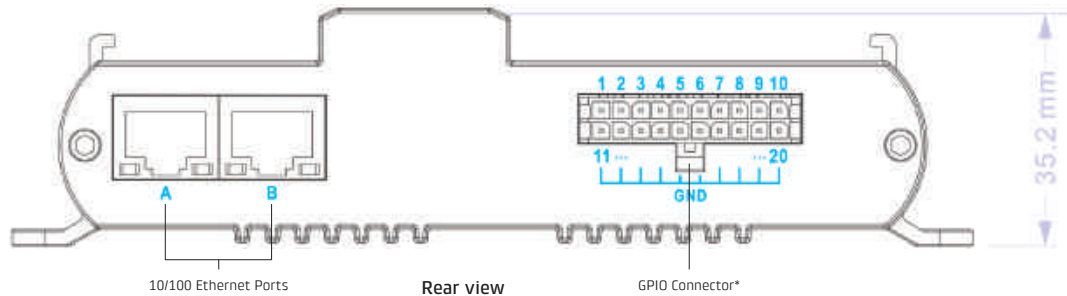
7. Secure router to dock using four M5x8 screws (F), then secure dock to mounting surface using four mounting screws (G) (not supplied). For high-vibration environments, Cradlepoint recommends using thread locker.



NOTE: Do not place router antennas and MC400 antennas immediately adjacent. Cradlepoint recommends remotely attaching one or both sets of antennas.



EXTENSIBILITY DOCK HARDWARE AND DIMENSIONS



* - See Appendix A for Pinout information



LEDS



POWER The Cradlepoint IBR900/IBR950 must be powered using an approved 9-33 VDC power source.

- Green = Powered ON.
- No Light = Not receiving power. Check the power switch and the power source connection.
- Yellow = Attention. Open the administration pages and check the router status.



WiFi BROADCAST Indicates WiFi activity.

- Green = On and operating normally.
- Yellow = Attention.



GPS Indicates the status of GPS connection.

- Blue = GPS locked.
- Blinking Blue = Obtaining lock.
- No Light = Off/no lock.



INTEGRATED MODEM Indicates information about the integrated modem.

- Green = Modem has established active WAN connection.
- Blinking Green = Modem is connecting.
- Yellow = Modem not active.
- Blinking Yellow = Data connection error.
- Blinking Red = In process of resetting.
- No Light = Modem not connected.



SIGNAL STRENGTH Blue LED bars indicate the active modem's signal strength.

- 4 Solid Bars = Strongest signal.
- 1 Blinking Bar = Weakest signal. (A blinking bar indicates half of a bar.)

ADDITIONAL LED INDICATIONS

- Several different LEDs flash when the factory reset button is detected.
- Two of the modem LEDs blink red in unison for 10 seconds when there is an error during firmware upgrade.

SUPPORT AND WARRANTY

CradleCare Support available in the US and Canada with technical support, software upgrades, and advanced hardware exchange: 1-, 3-, and 5-year options.

Three-year limited hardware warranty available world-wide on IBR900/IBR950 series products when purchased from an approved Cradlepoint Partner or Distributor — extend warranty to 5 years.





QUICK START

BASIC SETUP

1. Insert an activated SIM

A wireless broadband data plan must be added to your Cradlepoint IBR900. Wireless broadband data plans are available from wireless carriers such as Verizon, AT&T, Sprint, EE, and Vodafone. The SIM must be provisioned with the carrier. Contact your carrier for details about selecting a data plan and about the process for provisioning your SIM.

Once you have an activated SIM, insert it into the integrated modem. Insert the SIM card into the slot marked **SIM 1** (use the other slot, **SIM 2**, for a secondary/backup SIM).

To insert or remove SIM card:

1. Remove dual SIM cover.
2. Insert SIM card notch-end first with metal contacts down.
3. Replace dual SIM cover.

Note: Device will not power on without cover in place.

2. Attach the WiFi and modem antennas

Attach the three WiFi antennas (included) and two modem antennas to the connectors. Antennas are joined, which enables you to position them for optimal signal. To attach, hold the antenna straight and twist the base of the antenna to connect, folding the joint if needed. **NOTE: Ensure that the router antennas are not near metal or other RF reflective surfaces.**

3. Connect to power source

Wire power cable to 9-33 V power source. (AC power supply sold separately.)

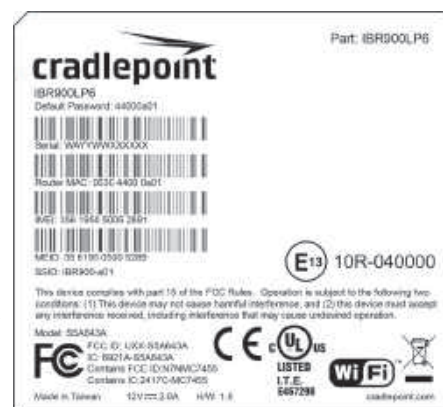
ACCESSING THE ADMINISTRATION PAGES

Once you are connected, open the Cradlepoint IBR900's GUI-based administration pages to make configuration changes to your router.

1. Open a browser window and type "**cp/**" or "**192.168.0.1**" in the address bar. Press **ENTER/RETURN**.
2. When prompted for your password, type the eight character **DEFAULT PASSWORD** found on the product label.

NOTE: The product label shown is an example only: your **DEFAULT PASSWORD** and **SSID** will be unique.

It's possible – and more efficient – to do all your configuration changes through Cradlepoint **Enterprise Cloud Manager** (ECM) without logging into the local administration pages. Set up a group of routers and set the configuration for all of them at once. See **below** for more information about ECM.





FIRST TIME SETUP WIZARD

When you log in for the first time, you will be automatically directed to the **FIRST TIME SETUP WIZARD**, which will walk you through the steps to customize your Cradlepoint IBR900. You have the ability to configure any of the following:

- Administrator Password
- Time Zone
- WiFi Network Name
- Security Mode
- Access Point Name (APN) for SIM-based modems
- Modem Authentication
- Failure Check

If you are currently using the router's WiFi network, you will need to reconnect your devices to the network using the newly established wireless network name and password.

*NOTE: To return to the First Time Setup Wizard after your initial login, select **SYSTEM** from the navigation bar, expand **Setup Wizard**, and select **First Time Setup**.*

USING ENTERPRISE CLOUD MANAGER

Rapidly deploy and dynamically manage networks at geographically distributed stores and branch locations with **Enterprise Cloud Manager**, Cradlepoint's next generation management and application platform. Enterprise Cloud Manager (ECM) integrates cloud management with your Cradlepoint devices to improve productivity, increase reliability, reduce costs, and enhance the intelligence of your network and business operations.

Click [here](#) to sign up for a free 30-day ECM trial.

Depending on your ordering process, your devices may have already been bulk-loaded into ECM. If so, simply log in at cradlepointecm.com using your ECM credentials and begin managing your devices seamlessly from the cloud.

If your device has not yet been loaded into your ECM account, you need to register. Log into the device administration pages and select **Enterprise Cloud Manager** from the **SYSTEM** menu. Enter your ECM username and password, and click on "Register".

Once you have registered your device, go to cradlepointecm.com and log in using your ECM credentials.

For more information about how to use Cradlepoint Enterprise Cloud Manager, see the following:

- [Getting Started](#)
- [ECM on the Knowledge Base](#)



ADMINISTRATION PAGES

Quick Links

Dashboard

Connection Manager

Status

Networking

Security

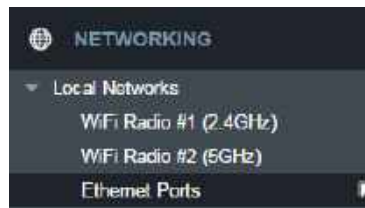
System

QUICK LINKS

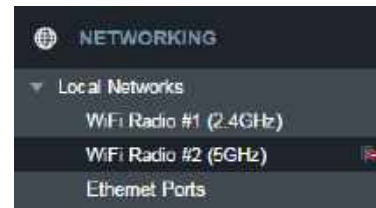
Quick Links allows you to bookmark your most commonly-used settings. Simply click on the bookmark icon (🔖) to add an item to your Quick Links menu. To remove an item from your Quick Links menu, select the item and click on the remove bookmark icon (🔖).



Quick Links Menu



Add Quick Link



Delete Quick Link

DASHBOARD



The **Dashboard** is a centralized location for basic information about the status of your router. The areas include:

- Device Information
- Ethernet WAN*
- Modems*
- WWAN*
- Ethernet LAN*
- WiFi LAN*

*-To quickly edit settings for any of these areas, click on the pencil icon (✎) in the top-right of the desired dialog box.

You may return to the Dashboard at any time by clicking on **DASHBOARD** from the left menu or by clicking on the Cradlepoint logo at the top-left of the screen.



CONNECTION MANAGER

The router can establish an uplink via Ethernet, WiFi as WAN, or 3G/4G modems (removable or external USB). If the primary WAN connection fails, the router will automatically attempt to bring up a new link on another device: this feature is called **failover**. If Load Balance is enabled, multiple WAN devices may establish a link concurrently.

WAN INTERFACE PROFILES & PRIORITY

This is a list of the available interfaces used to access the Internet. You can enable, stop, or start devices from this section. Drag the priority icon (☰) up or down to set the interface the router uses by default and the order that it allows failover.

WAN Interface Profiles & Priority									
➕ Add ✎ Edit ✖ Delete 🔧 Control									
	Profile Name	Conditions	Availability						
			☑	🌙	⚖	⏮	⏭	⏪	📊
☰	Ethernet	type is Ethernet	☑	☐	☐	⚙	⚙	🟢	⚙
☰	Ethernet WAN (VID: 1)	(Connected)	☑	☐	☐	⚙	⚙	🟢	⚙
☰	LTE-only Modems	type is Modem + tech is LTE	☑	☐	☐	⚙	⚙	🟢	⚙
☰	LTE/3G Multi-mode Modems	type is Modem + tech is LTE/3G	☑	☐	☐	⚙	⚙	🟢	⚙
☰	Internal LP6 (SIM1 - Verizon)	(Available)	☑	☐	☐	⚙	⚙	🟢	⚙
☰	Internal LP6 (SIM2 - NO SIM)	(SIM error, NOSIM)	☑	☐	☐	⚙	⚙	🟢	⚙
☰	WiFi as WAN	type is WWAN	☑	☐	☐	⚙	⚙	🟢	⚙
☰	3G-only Modems	type is Modem + tech is 3G	☑	☐	☐	⚙	⚙	🟢	⚙

Availability Key

☑ Enable	⚖ Load Balance	⏭ WAN Verify	📊 Data Usage
🌙 Standby	⏮ On Demand	⏪ Failback	

STANDBY

Standby is used to decrease failover time from one WAN interface to another. When Standby is enabled for a WAN profile or interface, the relevant interfaces are kept in a connected-but-idle (minimal, non-routed traffic) state. When the current WAN connection is disrupted, the traffic will failover to the next priority WAN. If that interface is on Standby, the connection is already established and failover will take much less time.

Note that the current connected interface(s) is/are indicated by a green connection state. For interfaces on Standby, the interface is indicated by a yellow connection state. If the interface is indicated in red, the interface is not currently connected or in Standby.

Standby is used to enable faster failover times only. If you want to manage traffic to a specific WAN interface, you will need to use WAN Affinity. If WAN Affinity is enabled for a particular profile or interface, do not enable Standby for that profile or interface as the failover results may vary and be unexpected.



LOAD BALANCE

To enable Load Balancing, select the check box for each desired device. If this is enabled, the router will use multiple WAN interfaces to increase the data transfer throughput by using any connected WAN interface consecutively. Selecting Load Balance will automatically start the WAN interface and add it to the pool of WAN interfaces to use for data transfer. Turning off Load Balance for an active WAN interface may require the user to restart any current browsing session.

From **WAN Management**, select the **Load Balance Algorithm** from the following dropdown options:

- **Round-Robin:** Evenly distribute each session to the available WAN connections.
- **Rate:** Distribute load based on the current upload and download rates. A WAN device's upload and download bandwidth values can be set in **CONNECTION MANAGER**.
- **Spillover:** This was the default algorithm in older (version 3) firmware. Load is always given to devices with the most available bandwidth. The estimated bandwidth rate is based on a combination of the upload and download configuration values and the observed capabilities of the device.
- **Data Usage:** This mode works in concert with the Client Data Usage feature.

The router will make a best effort to keep data usage between interfaces at a similar percentage of the assigned data cap in the data usage rule for each interface, rather than distributing sessions based solely on bandwidth. For proper functioning you need to create data usage rules for each WAN device you will be load balancing. Make certain to select the "Use with Load Balancing" checkbox in the data usage rule editor.

ON DEMAND

Typically, modem connections are not always on. When the On Demand mode is selected a connection to the Internet is made as needed. When On Demand is not selected a connection to the Internet is always maintained.

WAN VERIFY

If this is enabled, the router will check that the highest priority active WAN interface can get to the Internet even if the WAN connection is not actively being used. If the interface goes down, the router will switch to the next highest priority interface available. If this is not selected, the router will still failover to the next highest priority interface but only after the user has attempted to get out to the Internet and failed.

Idle Check Interval: The amount of time between each check. (Default: 30 seconds. Range: 10-3600 seconds.)

Monitor while connected: (Default: Off) Select from the



following dropdown options:

- **Passive DNS** (modem only): The router will take no action until data is detected that is destined for the WAN. When this data is detected, the data will be sent and the router will check for received data for two seconds. If no data is received the router behaves as described below under **Active DNS**.
- **Active DNS** (modem only): A DNS request will be sent to the DNS servers. If no data is received, the DNS request will be retried four times at five-second intervals. (The first two requests will be directed at the Primary DNS server and the second two requests will be directed at the Secondary DNS server.) If still no data is received, the device will be disconnected and failover will occur.
- **Active Ping**: A ping request will be sent to the Ping Target. If no data is received, the ping request will be retried four times at five-second intervals. If still no data is received, the device will be disconnected and failover will occur. When "Active Ping" is selected, the next line gives an estimate of data usage in this form: "Active Ping could use as much as **9.3 MB** of data per month." This amount depends on the **Idle Check Interval**.
- **Off**: Once the link is established the router takes no action to verify that it is still up.

FAILBACK

This is used to configure failback, which is the ability to go back to a higher priority WAN interface if it regains connection to its network.

Select the **Failback Mode** from the following options:

- Usage
- Time
- Disabled

Usage Threshold: Fail back based on the amount of data passed over time. This is a good setting for when you have a dual-mode EVDO/WiMAX modem and you are going in and out of WiMAX coverage. If the router has failed over to EVDO it will wait until you have low data usage before bringing down the EVDO connection to check if a WiMAX connection can be made.

- High (Rate: 80 KB/s. Time Period: 30 seconds.)
- Normal (Rate: 20 KB/s. Time Period: 90 seconds.)
- Low (Rate: 10 KB/s. Time Period: 240 seconds.)
- Custom (Rate range: 1-100 KB/s. Time Period range: 10-300 seconds.)

Time: Fail back only after a set period of time. (Default: 90 seconds. Range: 10-300 seconds.) This is a good setting if you have a primary wired WAN connection and only use a modem for failover when your wired connection goes down. This ensures that the higher priority interface has remained online for a set period of time before it becomes active (in case the connection is dropping in and out, for example).

Disabled: Deactivate failback mode.

Immediate Mode: Fail back immediately whenever a higher priority interface is plugged in or when there is a priority change. Immediate failback returns you to the use of your preferred Internet source more quickly which may have advantages such as reducing the cost of a failover data plan, but it may cause more interruptions in your network than Usage or Time modes.



DATA USAGE

Data Usage displays upload and download traffic for each LAN client. Check **Monitor Monthly** (or Weekly or Daily) **Usage** to begin tracking this information. This data is not retained between router reboots.

For **Monthly** and **Weekly** you are able to specify the day to start each cycle (e.g. the 1st or Tuesday, respectively).

Usage Cap: Enter a Cap amount in Megabytes. 1024 Megabyte is equal to 1 Gigabyte.

Use with Load Balancing: When checked, the Load Balancing feature is allowed to use the thresholds and metrics of this rule when making balance decisions. This causes Load Balancing to spread the data usage between interfaces according to the assigned usage rather than bandwidth. This is a best effort to keep all interfaces with these rules at a similar percentage utilization of data (e.g. 10%, 50%, 90%) as the cycle progresses, rather than quickly using 100% of a fast 1GB capped interface while using only a fraction of a slow 10GB capped interface, thus leaving the rest of the cycle with only the slow interface. The Data Usage algorithm on the WAN Affinity/Load Balancing page must be selected or this checkbox has no effect.

Shutdown on Cap: When checked, the WAN device will shutdown when the assigned usage is reached. A cycle reset or a rule deletion will re-enable the device.

Alert on Cap: An email alert will be generated and sent when the assigned data cap is reached. **NOTE:** The SMTP mail server must be configured in **System > Device Alerts**.

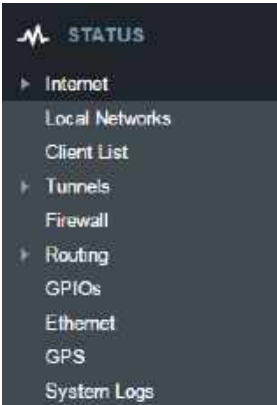
Custom Alerts: Check to enable custom alerts at specified percentage of usage cap.

Custom Alert Percentages: Example: "50,80,90,110" (values can exceed 100%) (Triggers alerts when 50, 80, 90, 110% of usage cap is used)

NOTE: To enable data usage, check **Data Usage Enabled** from WAN Management.

STATUS

- Internet
- Local Networks
- Client List
- Tunnels
- Firewall
- Routing
- Ethernet
- GPS
- System Logs

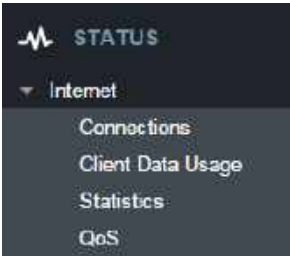


INTERNET

CONNECTIONS

Select your device to reveal detailed information about the following device properties:

- Summary
- Modem
- Cellular Network
- General Information
- Statistics



Device List

Device
<input checked="" type="checkbox"/> Ethernet WAN (VID: 1)
<input type="checkbox"/> Internal LP6 (SIM1 - Verizon)
<input type="checkbox"/> Internal LP6 (SIM2 - NO SIM)

Device Information: Internal LP6 (SIM1)

Property	Value
Summary	
Modem	
Cellular Network	
General Information	
Statistics	



Property	Value
Summary	
State	available
Manufacturer	Cradlepoint Inc.
Model	Internal LP6 (SIM1)
Modem Firmware Version	SWI9X30C_02.05.07.0
Registered Carrier	Verizon Wireless
Home Carrier	Verizon
Roaming Status	Home
Signal Strength	100 %
RSSI	-73 dBm
SINR	7.6 dB
RSRP	-97 dB
RSRQ	-11 dB
Mobile Directory Number	
MEID	
IMEI	
Current APN	VZWINTERNET

Property	Value
Summary	
Modem	
Manufacturer	Cradlepoint Inc.
Product	Internal LP6 (SIM1)
Model	Internal LP6 (SIM1)
Supported Technologies	lte/3g
Firmware Version	SWI9X30C_02.05.07.00 r5154 CARM
Package Version	02.05.07.00_VERIZON_002.008_002
Mobile Directory Number	
ESN/IMEI	
MEID	
IMEI	
ICCID	
Mobile Subscriber Identifi...	
IMSI	311480206582221
PRI ID	9905117
PRI Version	000.006
PIN Status	READY
SIM Card Lock	FALSE
Chipset	9X30C
Hardware Version	1.0
Temperature	36 C



Property	Value
Summary	
Modem	
Cellular Network	
Home Carrier	Verizon
Roaming Status	Home
Carrier Status	UP
Connection State	Active
Service Display	LTE
Signal Strength	100 %
RSSI	-53 dBm
SINR	19.4 dB
RSRP	-10 dB
RSRQ	-12 dB
Profile 1:	vzwims
Profile 2:	vzwadmn
Profile 3:	VZWINTERNET
Profile 4:	vzwapp
Profile 5:	vzw600
Profile 6:	vzwadmn
Profile 9:	vzwims
Profile 10:	vzwadmn
Profile 11:	VZWINTERNET
Profile 12:	vzwapp
Profile 13:	
Cell ID	2366526 (0x2d4016)
Operating Mode	Online
System Mode	LTE
IMS Registration State	In Progress
PS State	Attached
PRIL Version	15414
RF Band	Band 4
Bandwidth	10 MHz
RX Channel	2000
TX Channel	20000
LTE Tx Power	-3.0 dBm
RX Frequency Band	2110-2155 MHz
TX Frequency Band	1710-1755 MHz
EMM State	Registered
EMM Sub State	Normal Service
EMM Connection State	RRC Connected
Network Address Identifier (NAI)	
Profile	0 Enabled
Home Address	0.0.0.0
Primary Home Agent	255.255.255.255
Secondary Home Agent	255.255.255.255
MN-AAA SPI	2
MN-HA SPI	300
MN-AAA SS	Set
MN-HA SS	Set
Reverse Tunneling	1
EVDIO AAA Auth Status	Not Requested
Home PLMN ID	311480
Tracking Area Code	2617

Property	Value
Summary	
Modem	
Cellular Network	
General Information	
Unique Identifier	c760b5b7
Port	int1
Type	mdm
Model	Internal LP6 (SIM1)
Interface	pmip1
MTU	1428

Property	Value
Summary	
Modem	
Cellular Network	
General Information	
Statistics	
Outgoing Bytes	288098
Incoming Bytes	144940
Connection Uptime	0:08:00



CLIENT DATA USAGE

Displays the following client information:

- Name
- IP Address
- MAC Address
- Data Uploaded
- Data Downloaded
- Last Traffic

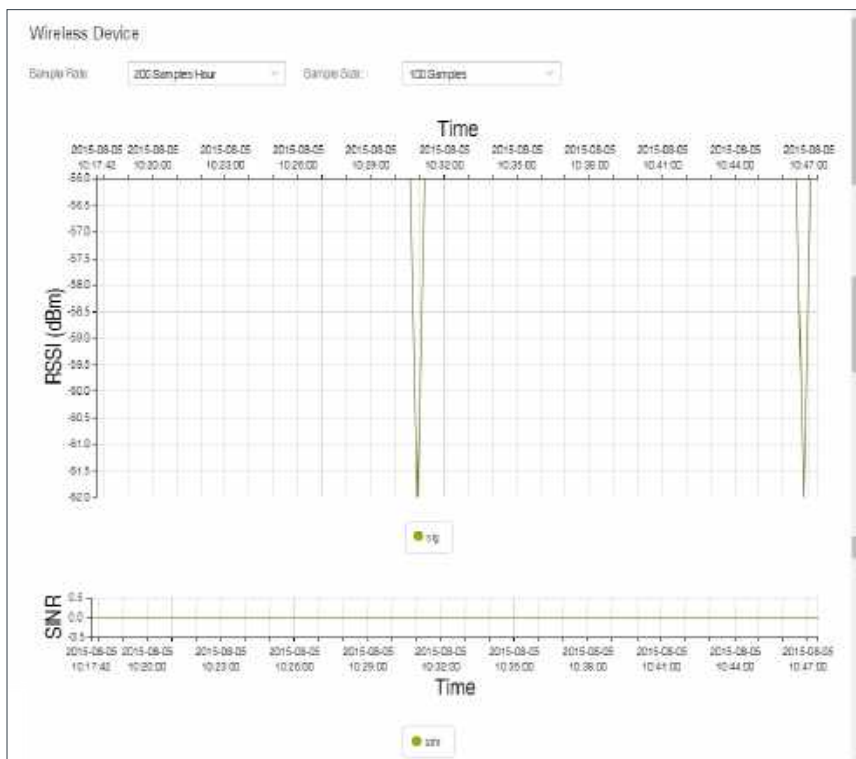
Client Data Usage					
Reset Statistics					
Name	IP	MAC	Uploaded	Downloaded	Last Traffic
ptbunroughs	192.168.0.132	34:a6:d7:43:5d:df	0.18 MB	0.20 MB	8/3 12:14

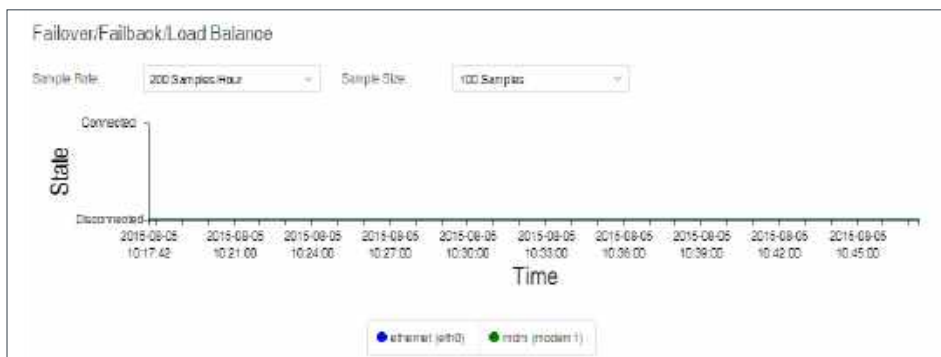
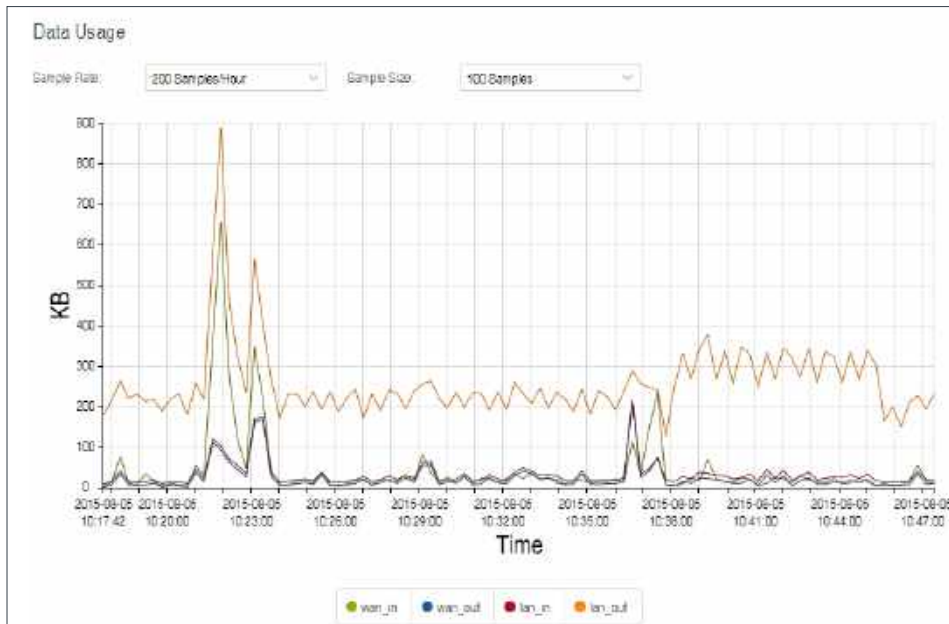
To reset information, click **Reset Statistics**.

STATISTICS

Statistics can be gathered at variable Sample Rate and Sample Size for the following areas:

- Wireless Device
- Data Usage
- Failover/Failback/Load Balance





QoS

Displays packets and bytes transmitted and received by your Quality of Service (QoS) queues. To enable and configure QoS, go to **NETWORKING** > **QoS**.

QoS

Queue	Transmit (packets/bytes)	Receive (packets/bytes)
Default	1455 / 213.70 KB	834 / 231.41 KB
test	29 / 4.30 KB	26 / 11.95 KB



LOCAL NETWORKS

Displays information about your local networks. To configure local networks, go to **NETWORKING > Local Networks**.

Local Networks			
	Network	Hostname	Type
⊞	Guest LAN: 192.168.10.1 / 255.255.255.0	cp	lan
⊞	Primary LAN: 192.168.0.1 / 255.255.255.0	cp	lan

Local Networks			
	Network	Hostname	Type
⊞	Guest LAN: 192.168.10.1 / 255.255.255.0	cp	lan
⊞	Primary LAN: 192.168.0.1 / 255.255.255.0	cp	lan
	<div>IPv4 Addresses: 192.168.0.1/24</div> <div>Broadcast: 192.168.0.255</div> <div>VRRP State: Disabled</div>	<div>WiFi (2.4 GHz): IBR900-pb</div> <div>Type: Wlan</div> <div>Interface: ath00</div> <div>Link Arp Type: ether</div> <div>State: Forwarding</div>	<div>State:</div> <div>Link State: unknown</div> <div>Link Flags: broadcast, multicast</div> <div>up, running, lowerup</div> <div>Incoming Stats:</div> <div>Total: 0.00 B</div> <div>Drops: 0.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 0.00 B</div> <div>Outgoing Stats:</div> <div>Total: 0.00 B</div> <div>Drops: 0.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 0.00 B</div>
		<div>WiFi (5 GHz): IBR900-ac0-5g</div> <div>Type: Wlan</div> <div>Interface: ath10</div> <div>Link Arp Type: ether</div> <div>State: Forwarding</div>	<div>State:</div> <div>Link State: unknown</div> <div>Link Flags: broadcast, multicast</div> <div>up, running, lowerup</div> <div>Incoming Stats:</div> <div>Total: 0.00 B</div> <div>Drops: 0.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 0.00 B</div> <div>Outgoing Stats:</div> <div>Total: 0.00 B</div> <div>Drops: 0.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 0.00 B</div>
		<div>VLAN: 2-lan: Port(s): 1U, 2U</div> <div>Type: Ethernet</div> <div>Interface: eth0.2</div> <div>Link Arp Type: ether</div> <div>Link Type: vlan</div> <div>State: Forwarding</div>	<div>State:</div> <div>Link State: up</div> <div>Link Flags: broadcast, multicast</div> <div>up, running, lowerup</div> <div>Incoming Stats:</div> <div>Total: 3.90 MB</div> <div>Drops: 4.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 22.41 KB</div> <div>Outgoing Stats:</div> <div>Total: 28.07 MB</div> <div>Drops: 0.00 B</div> <div>Errors: 0.00 B</div> <div>Packets: 20.33 KB</div>



CLIENT LIST

Displays information about your Wireless, Wired, and Hotspot Clients, and allows you to Kick Wireless Clients, block MAC addresses of both Wireless and Wired Clients, and Revoke Hotspot Clients.

Wireless Clients

Hostname	IP	MAC	Connection	Time Online	Kick	Block
			802.11n, 20 MHz, 63 Mbps, 2.4...	0:02:10	Kick	Block MAC

Wired Clients

Hostname	IP	MAC	Block?
plumoughs			Block M...
plumoughs			Block M...

Hotspot Clients

Hostname	IP	MAC	Data Usage	Time Online	Revoke?
No HotSpot Clients					



TUNNELS

NETCLOUD ENGINE

Displays status of configured NetCloud Engine tunnels. To add and configure CP Secure VPN Tunnels, go to **NETWORKING > Tunnels > CP Secure VPN**.

CP SECURE VPN

Displays status of your CP Secure VPN Tunnels. To add and configure CP Secure VPN Tunnels, go to **NETWORKING > Tunnels > CP Secure VPN**.

IPSEC VPN

Displays status of your IPSec VPN Tunnels. To add and configure IPSec VPN Tunnels, go to **NETWORKING > Tunnels > IPSec VPN**.

IPSec VPN Tunnels						
Disable VPN						
Name	Connections	Status	Protocols	Transferred	Direction	Time Online
mytunnel	0	Idle				



OPEN VPN

Displays status of your OpenVPN Tunnels. To add and configure OpenVPN Tunnels, go to **NETWORKING > Tunnels > OpenVPN**.

OpenVPN Tunnels						
Tunnel Name	Connected/Updated Since	Remote Address	Local Address	Bytes Out	Bytes In ↑	State
mytunnel	Thu Sep 3 12:25:24 2015	1.2.3.4	0.0.0.0	148.15M	0.00B	idle/down

GRE

Displays status of your GRE Tunnels. To add and configure GRE Tunnels, go to **NETWORKING > Tunnels > GRE**.

GRE Tunnels				
Name	Status	Transmit (packets/bytes)	Receive (packets/bytes)	MTU
mytunnel	Tunnel Not Alive	5 / 120.00 bytes	0 / 0.00 bytes	1476

FIREWALL

Displays information about your Firewall Connection Tracking States. To configure your firewall, select **SECURITY** from the left navigation.

Connection Tracking States										
<input type="checkbox"/> Auto Update <input type="button" value="Update"/> <input type="button" value="Details"/> <input type="button" value="Flush"/>										
	Proto	Timeout	TCP State	Status	Orig Src	Orig Dst	Orig Dst ...	Reply Src	Reply Dst	Reply Dst ...
1	TCP	431971	ESTABL...	seen_reply...	192.168.0...	216.115.1...	443	216.115.1...	172.19.0.216	59827
2	UDP	10		confirmed...	172.19.0.101	255.255.2...	67	255.255.2...	172.19.0.101	68
3	TCP	431950	ESTABL...	seen_reply...	192.168.0...	65.54.225...	443	65.54.225...	172.19.0.216	59882
4	UDP	6		confirmed...	172.19.0.118	255.255.2...	67	255.255.2...	172.19.0.118	68
5	UDP	14		confirmed...	172.19.0.148	255.255.2...	67	255.255.2...	172.19.0.148	68
6	UDP	27		confirmed...	172.19.0.111	255.255.2...	67	255.255.2...	172.19.0.111	68
7	UDP	1		confirmed...	172.19.0.119	255.255.2...	67	255.255.2...	172.19.0.119	68
8	UDP	0		confirmed...	172.19.0.94	255.255.2...	67	255.255.2...	172.19.0.94	68



ROUTING

Displays information about your System, protocol, BGP, OSPF, RIP, and RIPng Routes. To configure these routes, go to **NETWORKING > Tunnels**.

System Routes					
IP Address	Gateway	Netmask	Interface	Metric	Routing Protocol
1.2.3.0		24	*ifac0.tun0	0	
100.107.201.144		30	9cd858ae	0	
192.168.0.0		24	primarylan	0	
192.168.10.0		24	guestlan	0	
fe80::		64	primarylan	256	

GPIO

Displays information about your GPIOs. To configure GPIOs, go to **SYSTEM > GPIO Configuration**.

System GPIO Status			
GPIO	I/O Direction	Status	Last Modified
1 on power cable	out	GPIO 1 on power cable is low.	1969-12-31 17:00:16
2 on power cable	in	Disabled	
1 on expander	in	Disabled	
2 on expander	in	Disabled	
3 on expander	in	Disabled	
4 on expander	in	Disabled	
5 on expander	in	Disabled	

ETHERNET

Displays information about your Ethernet ports. To configure Ethernet ports, go to **NETWORKING > Local Networks > Ethernet Ports**.

Ethernet		
Port	Link Status	Link Speed
0	down	none
1	up	100FD
2	down	none



GPS

Displays GPS location and status. To enable and configure GPS, go to **SYSTEM > Administration > GPS**.

SYSTEM LOGS

Displays System Log information. To configure System Logging, go to **SYSTEM > Administration > System Logging**.

System Logs

Auto Update: ☐

Update Once

Clear Log

Save Log

Time	Source	Level	Message
Type to filter	Type to filter	Type to filter	Type to filter
Thu Sep 3rd 12:29:19 2015	openvpn[919]	INFO	UDPv4 link remote: [AF_INET]1.2.3.4:1194
Thu Sep 3rd 12:29:19 2015	openvpn[919]	INFO	UDPv4 link local (bound): [undef]
Thu Sep 3rd 12:29:19 2015	openvpn[919]	INFO	Preserving previous TUN/TAP instance: tun0
Thu Sep 3rd 12:29:19 2015	openvpn[919]	INFO	Re-using pre-shared static key
Thu Sep 3rd 12:29:19 2015	openvpn[919]	WARNING	NOTE: the current --script-security setting may allow this configuration ...
Thu Sep 3rd 12:29:17 2015	openvpn[919]	INFO	SIGUSR1[soft,ping-restart] received, process restarting



NETWORKING

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LOCAL NETWORKS

WIFI RADIO #1 (2.4GHZ)

WIFI RADIO #2 (5GHZ)

To edit your wireless network, select its name and click **Edit**.



WiFi Name (SSID): When users browse for available wireless networks, this is the name that they will see. This name is referred to as the SSID (service set identifier). For security purposes, Cradlepoint highly recommends that you change this from the pre-configured name.

Hidden: This shows whether the router broadcasts its SSID. It is somewhat harder for hackers to find and attack a router that is not broadcasting its SSID, which adds to the wireless security, but it is also more difficult for friendly users to attach to a WiFi network with a hidden SSID.

Isolate: Select this to isolate all wireless clients so they cannot directly communicate with each other on the wireless network.

Edit SSID: IBR900-pb

WiFi Name (SSID): IBR900-pb

Hidden: ☐

Isolate: ☐

WMM: ☒

Enabled: ☒

Security Mode: WPA2 Personal

WPA Settings

WPA Option: AES

WPA Password: ***** [Unmask Password](#)

Re-key Interval: 3600

Protected Management Frames: Disabled



WMM: WiFi Multimedia. This is a basic traffic shaping, or QoS (quality of service), system for the network. WMM works behind the scenes to set priorities for different types of traffic on your network. For example, video streams are given higher priority than print jobs, since video streams need consistent throughput.

Enabled: Whether the network is available.

Security Mode: You have several options for selecting a security mode. The mode you choose depends on the security features your wireless adapters support.

- WPA2 Personal
- WPA / WPA2 Personal
- WPA Personal
- WPA2 Enterprise
- WPA / WPA2 Enterprise
- WPA Enterprise
- WEP Auto
- Open

Select "Open" to create a hotspot; otherwise select the best security that your devices will support (Cradlepoint recommends **WPA2**).

Depending on which Security Mode you select, there are different setup options.

- "**Personal**" security modes require passwords.
- "**Enterprise**" security modes are linked to a RADIUS server and require RADIUS authentication: **IP**, **Port**, and **Shared Key** (Secondary IP and NAS ID optional).
- "**WPA2**" (Personal or Enterprise) forces AES as the WPA Cipher.
- "**WPA/WPA2**" and "**WPA**" (Personal or Enterprise) allow AES, TKIP/AES, and TKIP.
- "**WEP Auto**" requires a WEP Key.
- "**Open**" has no password or other security measures.

NOTE: If you don't know whether you should choose Personal or Enterprise, assume Personal since you need to know RADIUS authentication for Enterprise.

In order to protect your network from hackers and unauthorized users, Cradlepoint highly recommends **WPA2/AES** for security if your attached devices can support it. WEP and WPA/TKIP are obsolete and have been replaced by WPA/AES. Using those security settings will cause the WiFi to limit to 802.11g modes.

NOTE: If you select one of the security modes and are unable to connect to the router afterwards, you can use the reset buttons to reset the router to its factory default state and try a different security mode instead.

When you select either **WiFi Radio #1 (2.4GHz)** or **WiFi Radio #2 (5GHz)** from **Local Networks**, you have several additional options for configuring your wireless LANs under the **WiFi Settings** heading.

Channel Selection Method: This controls how a WiFi channel is selected.

- **User Selection** – Manually set the channel
- **Random Selection** – The router randomly sets the channel
- **Smart Selection** (Default) – Scans to determine the lowest interference WiFi channel

Channel Selection Schedule: When using the "Smart" channel selection, this controls whether the router will periodically rescan for a better channel and change to it. Select from "Once," "Daily," "Weekly," or "Monthly." Note that there may be a momentary WiFi disconnection while the channel changes.

Channel: (Shows if **User Selection** is selected.) The WiFi channel* corresponds to a frequency the router uses to communicate with other devices. For 2.4 GHz, the range is 1 to 11, and 1, 6, and 11 do not overlap each other. Select a channel from the dropdown list:

- 1 (2412 MHz)
- 2 (2417 MHz)



- 3 (2422 MHz)
- 4 (2427 MHz)
- 5 (2432 MHz)
- 6 (2437 MHz)
- 7 (2442 MHz)
- 8 (2447 MHz)
- 9 (2452 MHz)
- 10 (2457 MHz)
- 11 (2462 MHz)

For 5.0 GHz, the ranges are 36 to 64 and 149 to 165.

- 36 (5180 MHz)
- 40 (5200 MHz)
- 44 (5220 MHz)
- 48 (5240 MHz)
- 149 (5745 MHz)
- 153 (5765 MHz)
- 157 (5785 MHz)
- 161 (5805 MHz)
- 165 (5825 MHz)

* - Channels listed above represent US/FCC settings. EU users will see different settings.

The image shows a 'WiFi Settings' configuration window. The settings are as follows:

- Channel Selection Method: Smart Selection
- Channel Selection Schedule: Once
- Client Timeout: 300
- TX Power: 100 %
- RTS Threshold: 2347 bytes
- Fragmentation Threshold: 2346 bytes
- DTIM: 1
- Beacon: 100 ms
- Short Slot: ☒
- Wireless Mode: 802.11 b/g/n
- Protection: Auto
- Airtime Fairness: ☐
- Channel Width: 20 MHz
- Extended Channel: Above
- MCS: Auto
- Short GI: ☒
- RADIUS Timeout: 3600
- RADIUS Retry: 60

Client Timeout: If the access point is not able to communicate with the client it will disconnect it after this timeout (in seconds).

TX Power: Normally the wireless transmitter operates at 100% power. In some circumstances, however, there might be a need to isolate specific frequencies to a smaller area. By reducing the power of the radio, you can prevent transmissions from reaching beyond your corporate/home office or designated wireless area.

RTS Threshold: When an excessive number of wireless packet collisions are occurring, wireless performance can be improved by using the RTS/CTS (Request to Send/Clear to Send) handshake protocol. The wireless transmitter will begin to send RTS frames (and wait for CTS) when data frame size in bytes is greater than the RTS Threshold. This setting should remain at its default value.

Fragmentation Threshold: Wireless frames can be divided into smaller units (fragments) to improve performance in the presence of RF interference and at the limits of RF coverage. Fragmentation will occur when frame size in bytes is greater than the Fragmentation Threshold. This setting should remain at its default value. Setting the Fragmentation value too low may result in poor performance.

DTIM: A DTIM is a countdown informing clients of the next window for listening to broadcast and multicast messages. When the wireless router has buffered broadcast or multicast messages for associated clients, it sends the next DTIM with a DTIM Interval value. Wireless clients detect the beacons and awaken to receive the broadcast and multicast messages. The default value is 1. Valid settings are between 1 and 255.

Beacon: Beacons are packets sent by a wireless router to synchronize wireless devices. Specify a Beacon Period value between 20 and 1000 milliseconds.

Short Slot: Slot Time is the period wireless clients use in determining if the channel is free for transmission. Enabling this value allows clients that can utilize a shorter time to do so. Disabling this option forces all clients to use a longer backoff check and thus may reduce network throughput while reducing the number of transmission collisions.



Wireless Mode: Select the WiFi clients with which the router will be compatible. Greater compatibility is a tradeoff with better performance. For greatest compatibility with all WiFi devices, select 802.11 a/b/g/n or 802.11 a/b/g/n/ac.

2.4 GHz options

- 802.11 b
- 802.11 b/g
- 802.11 a/b/g/n
- 802.11 b/g/n
- 802.11 n

5 GHz options

- 802.11 a/b/g/n/ac
- 802.11 g/n/ac
- 802.11 n/ac
- 802.11 ac
- 802.11 n
- 802.11 g
- 802.11 b

Protection: In Auto mode the device will use protection to improve performance in mixed mode networks. Turn protection off to maximize throughput with 802.11n clients.

Airtime Fairness: Airtime Fairness will attempt to balance air time between faster and slower wireless clients to more fairly distribute bandwidth.

Channel Width: Selects whether the router uses a single 20 MHz channel to send/receive, or uses two adjacent 20 MHz channels to create a 40 MHz channel. Higher performance is possible with the 40 MHz channel. Selecting Auto is generally best. Enabling WiFi as WAN will force 20 MHz only mode.

Extended Channel: When operating in 40 MHz mode the access point will use an extended channel either below or above the current channel. Optimal selection will depend on the channels of other networks in the area.

MCS: 802.11n uses multiple Modulation Coding Schemes to enable higher throughput in various environments. Since clients can dynamically change rates depending on environment, selecting **Auto** is generally best.

Short GI: Short GI is an optimization for shortening the interval between transmissions. May be incompatible with older clients.

RADIUS Timeout: (Default: 3600 seconds) When using an Enterprise security mode clients will be forced to re-authenticate with the RADIUS server at this interval in seconds. This allows administrators to revoke access so when an attached client's authentication expires, the client must re-authenticate.

RADIUS Retry: (Default: 60 seconds) When using an Enterprise security mode, if a RADIUS query fails to receive a response from the server it will delay by this interval (in seconds) before attempting another query. This helps protect the network from floods of authentication requests if the RADIUS server is temporarily unreachable.

ETHERNET PORTS

Ethernet Port Configuration provides controls for your router's Ethernet ports. There are three total ports: by default, one WAN port and two numbered LAN ports. While default settings will be sufficient in most circumstances, you have the ability to control: **Mode** (WAN or LAN) and **Link Speed**. Additional controls for WAN ports are available in **CONNECTION MANAGER**.

Mode: WAN or LAN. By default there are two LAN (Local Area Network) ports and one WAN (Wide Area Network) port.

- **Internet (WAN)** is used as a possible source of Internet for the router
- **Local Network (LAN)** is for connecting a computer or similar device directly to the router with an Ethernet cable.



Link Speed: Default setting is Auto. The Auto setting is preferred in most cases.

- Auto
- 10Mbps - Half Duplex
- 10Mbps - Full Duplex
- 100Mbps - Half Duplex
- 100Mbps - Full Duplex
- 1000Mbps - Full Duplex

HOTSPOT SERVICES

Any of your networks can be enabled as a hotspot. To enable a hotspot, you need to select a network and set it as a hotspot in **NETWORKING > Hotspot Services**.

NOTE: Although any network can be a hotspot, the router allows only one hotspot.

Hotspot Mode: Choose from the following dropdown options:

- **Simple:** Allows “Terms of Use” page and timeout settings controlled within the router
- **RADIUS/UAM:** Allows you to set up external authentication servers

Local IP Network: A single LAN Group – including both WiFi and Ethernet – can be configured as your hotspot. If you do not already have a LAN Group configured as a hotspot, click **Configure** and set the **IPv4 Routing Mode** to “Hotspot” for the LAN Group you want to use.

NOTE: Routing Mode is in the Primary LAN Editor under the IPv4 Settings tab. Select a network in **NETWORKING > Local IP Networks** and click **Edit** to open the Primary LAN Editor.

Allow Service on 3G/4G Modems: Allows you to enable or disable hotspot access to the Internet over a modem. This is often used if the router has a main wired link and a secondary modem for failover (typically with a more expensive/limited data plan). Select this option if you want the router to allow data traffic over the modem if the wired connection goes down.

Disable Service if Ethernet Threshold is met: This will block hotspot use of the WAN when the threshold is met. This can be used if the router is being used as a backup failover connection to another router with a wired connection. If that other router’s wired connection goes down and it starts using this router for its primary connection, then disable hotspot use of the WAN connection. Set the limiting **Rate (KB/s)** and **Time Period (seconds)**.

Redirect HTTPS Requests: This allows initial requests to HTTPS websites to be redirected appropriately.

Hotspot/UAM Authentication Port: Default: 8000. Type in a different port number, or use the slider to change the port.

Simple Mode Settings

Display: This section allows you to choose if a “Terms of Use” page will be given to the user connecting to the hotspot.

- **Internal Terms of Use.** Fill in your own terms of use.



- **External Terms of Use.** Specify a URL that has the Terms of Use page. Users will automatically be directed to this page.
- **No Terms of Use. Redirect Only.**

Redirection on Successful Authentication: Depending on your choice for the "Terms of Use" page, you have further options for where the user will be directed. After the user accepts the terms, you can either let him/her continue to the URL they were trying to reach or you can force the user to go to a specified URL once before continuing on.

- To the URL the user intended to visit
- To an administrator-defined URL

Redirect URL: If you have chosen to send users to an administrator-defined URL, you will need to specify the address.

Session Timeout: (Default: 60 minutes.) The amount of time the user may use the router before being forced to authenticate again.

Idle Timeout: (Default: 15 minutes.) If the user is idle for this amount of time, make them re-authenticate.

Bandwidth (upload): (Default: 512 Kbits/sec.) The data rate limit for users uploading data through the hotspot.

Bandwidth (download): (Default: 1024 Kbits/sec.) The data rate limit for users downloading data through the hotspot.

The screenshot shows the 'Simple Mode Settings' interface. At the top, there's a 'Display' dropdown set to 'Internal Terms of Use'. Below it is a 'Terms of Use Text' area with a placeholder 'Please enter your terms of use'. Further down, there's a 'Redirect on Successful Authentication' section with a dropdown set to 'To the URL the user intended to visit'. Below this are four settings: 'Session Timeout' (60 mins), 'Idle Timeout' (15 mins), 'Bandwidth (upload)' (512 Kbits/sec), and 'Bandwidth (download)' (1024 Kbits/sec). At the bottom are 'Reset', 'Save', and 'Load Default Profile' buttons.

Allowed Hosts/Domains Prior to Authentication

Adding hostnames to this list will allow access from your network to any external domain or website prior to being authenticated. For example, a hotel might allow access to its own website prior to authentication.

Click **Add** to enter new hostnames you wish to allow.

Enter the hostname or domain name of the website you wish to **allow**, e.g. www.company.com or company.com. To allow all domain and sub-domain options, use a wildcard, e.g. *.company.com.

Click **Update** to save your additions.

The screenshot shows the 'Allowed Hosts/Domains Prior to Authentication' interface. It has 'Add', 'Edit', and 'Remove' buttons. Below is a table with a header 'Host Name' and a single entry '*.company.com' with a checkbox to its left.

Authorized MAC Addresses

Add the MAC addresses of trusted machines. This gives them automatic access through the hotspot portal.

Click **Add** to enter new MAC Addresses you wish to allow.

Click **Update** to save your additions.

The screenshot shows the 'Authorized MAC Addresses' interface. It has 'Add', 'Edit', and 'Remove' buttons. Below is a table with a header 'MAC Address' and a single entry 'aa:bb:cc:dd:ee:ff' with a checkbox to its left.



DHCP SERVER

DHCP stands for Dynamic Host Configuration Protocol. The built-in DHCP server automatically assigns IP addresses to the computers and other devices on each local area network (LAN). In this section you can view a list of assigned IP addresses and reserve IP addresses for particular devices.

Active Leases: A list of devices that have been provided DHCP leases. The DHCP server automatically assigns these leases. This list will not include any devices that have static IP addresses on the network. Select a device and click **Reserve** to add the device and its IP address to the list of **Reservations**.

Active Leases				
Hostname	IP Addr	Hardware Addr	Expiration	Reserve
pbunbough	192.168.0.132	34:e6:d7:43:56:df	12 hours: 0 mins	Reserve

Reservations				
Add Edit Remove				
Hostname	IP Addr	IPv6 Addr	Hardware Addr	Enable
<input type="checkbox"/> host		ABC:567:0:0:8008:0099:1111:0	aa:bb:cc:dd:ee:ff	True

Reservations: This is a list of devices with reserved IP addresses. This reservation is almost the same as when a device has a static IP address except that the device must still request an IP address from the router. The router will provide the device the same IP address every time. DHCP reservations are helpful for server computers on the local network that are hosting applications such as Web and FTP. Servers on your network should either use a static IP address or a reservation.

While you have the option to manually input the information to reserve an IP address (Hostname, Hardware Addr, IP Addr), it is much simpler to select a device under the **Active Leases** section and click "Reserve." The selected device's information will automatically be added under **Reservations**.

LOCAL IP NETWORKS

Local IP Networks displays the following information for each network:

- **Network Name**, **IP address/Netmask**, and **Enabled/Disabled** (along the top bar)
- **Multicast Proxy** (Enabled/Disabled)
- **DHCP Server** (Enabled/Disabled)
- **DHCP Relay** (Enabled/Disabled)
- **Schedule** (Enabled/Disabled – See the Schedule tab in the Local Network Editor)
- **VRRP Failover State** (Disabled, Backup, or Master)
- **IPv4 Routing Mode** (NAT, Standard, IP Passthrough, Hotspot, Disabled)
- **IPv6 Addressing Mode** (SLAAC Only, SLAAC with DHCP, Disable SLAAC and DHCP)
- **Access Control** (Admin Access, UPnP Gateway, LAN Isolation)
- **Attached Interfaces** (Ethernet ports, WiFi, VLAN)

Local IP Networks				
Add	Edit	Remove		
<input checked="" type="checkbox"/> Primary LAN	192.168.0.1	255.255.255.0	ENABLED	
Multicast Proxy:	DISABLED	Subnet for Multicast:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
DHCP Server:	DISABLED	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
DHCP Relay:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
Schedule:	DISABLED	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
VRRP Failover State:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
IPv4 Routing Mode:	NAT	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
IPv6 Addressing Mode:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
Access Control:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
<input type="checkbox"/> Guest LAN	192.168.1.1	255.255.255.0	DISABLED	
Multicast Proxy:	DISABLED	Subnet for Multicast:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
DHCP Server:	DISABLED	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
DHCP Relay:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
Schedule:	DISABLED	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
VRRP Failover State:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
IPv4 Routing Mode:	NAT	• IPv4 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
IPv6 Addressing Mode:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	
Access Control:	DISABLED	• IPv6 Access Point:	VLAN: 5 (VLAN: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	

Click **Add** to configure a new network, **Remove** to delete a network, or select an existing network and click **Edit** to view configuration options.

General Settings

Enabled: The network can be manually disabled or in some specific situations may be automatically disabled to work with certain types of modems.



Name: The “name” property primarily helps to identify this network during other administration tasks.

Hostname: The hostname is the DNS name associated with the router’s local area network IP address.

IPv4 Settings

IP Address: This is the address used by the router for local area network communication. Changes to this parameter may require a restart to computers on this network.

Netmask: The netmask controls how many IP addresses can be used in this network. The default value is usually acceptable for most situations.

IPv4 Routing Mode: Each network can use a unique routing mode to connect to the Internet. The default of NAT is desirable in most configurations.

- **NAT:** Network Address Translation hides private IP addresses behind the router’s IP address.
- **Standard:** Without NAT exposes the subnet addresses which requires them to be externally routable.
- **IP Passthrough:** IP Passthrough passes the IP address given by the modem WAN through the router. Hotspot, VPN, and GRE must be disabled. Any Wireless interfaces must be removed from this network in order to enable IP Passthrough.
- **Hotspot:** Provide Hotspot Services on this Network, requiring Terms of Service or RADIUS/UAM authentication before WAN access will occur on both Wireless and Wired LAN connections.

IPv6 Settings

IPv6 Address Source: The Address source has three settings. The default of **Delegated** is desirable in most configurations.

- **Delegated:** The address is provided by a router connected to this router’s WAN.
- **Static:** The address is provided by the router admin.
- **None:** No use of an IPv6 WAN address, IPv6 is disabled on the WAN.

IPv6 Address: An IPv6 Address is a unique numerical label for a computer or device using the Internet Protocol (IP). IPv6 addresses are typically in the format composed of 8 sets of 4 hexadecimal numbers. Leading zeros can be ignored and the longest set of continuous zeros can be replaced with ::. For example, the IPv6 address of 0001:0000:0234:5678:0000:0000:9abc:0def can be expressed as 1:0:234:5678::9abc:def.

Interfaces

Select the network interfaces which will be attached to this network by either dragging desired interface or clicking left or right arrows to move them between **Available Interfaces** and **Selected Interfaces**.

Access Control

UPnP Gateway: Select the UPnP (Universal Plug and Play) option if you want to enable the UPnP Gateway service for computers on this network.

Admin Access: When enabled users may access these admin pages from this network.



IPv4 DHCP

DHCP Server

- **Enable DHCP Server:** When the DHCP server is enabled, users of your network will be able to automatically connect to the Internet without any special configuration. It is recommended that you leave this enabled. Advanced DHCP server configuration is available at **NETWORKING > Local Networks > DHCP Server**.
- **Range Start:** The starting IP address in the DHCP Server range is the beginning of the reserved pool of IP addresses which will be given to any DHCP enabled computers on your network. The default value is almost always sufficient.
- **Range End:** The ending IP address in the DHCP Server range is the end of the reserved pool of IP addresses which will be given to any DHCP enabled computers on your network. The default value is almost always sufficient.
- **Lease Time:** The lease time specifies how long DHCP enabled computers will wait before requesting a new DHCP lease. Smaller values are better suited to busy environments.
- **Custom Options:** Send optional extra options to DHCP clients of this network. This can be used to, for example, set the boot TFTP server of a network for disk-less clients.

Optionally provide custom DHCP settings:

DHCP Server

Enable DHCP Server: ☒

Range Start:

Range End:

Lease Time: mins

Custom Options: ☐

DHCP Relay

Enable DHCP Relay: ☐

DHCP Relay

- **Enable DHCP Relay:** DHCP Relay communicates with a DHCP server and acts as a proxy for DHCP broadcast messages that must be routed to remote segments. This is accomplished by converting broadcast DHCP messages to unicast messages to communicate between clients and servers.

Multicast Proxy

Multicast Proxy: Enables IGMP proxying to allow Multicast Streams to flow across this network.

Quick Leave Mode: Disable quick leave mode if it's vital that the daemon should act exactly as a real multicast client on the upstream interface. However, disabling this function increases the risk of bandwidth saturation.

Altnet: If multicast traffic originates outside the upstream subnet, add address(es) to the "altnet" to define legal multicast sources.

IPv6 Addressing

Address Configuration Mode: SLAAC stands for Stateless address autoconfiguration. A network can be configured to use SLAAC only, or it can be configured to also use DHCPv6 to provide ip addresses to clients.

DHCP Range Start: The DHCP Range Start is the beginning of the range that will be used for IPV6 DHCP addresses. The IPV6 range will always start at 1.

DHCP Range End: The ending IP address in the DHCP Server range is the end of the reserved pool of IP addresses which will be given to any DHCP enabled computers on your network.

IPv6 DHCP Lease Time: Specifies how long DHCP enabled computers will wait before requesting a new DHCP lease.

Schedule

Enable Schedule Service: Enable the interface scheduler. A schedule allows an interface to be enabled or disabled during specific hours of a day.

VRRP

Enable VRRP: Enable or disable VRRP.



Virtual Router IP: IP Address of the Virtual Router.

Virtual Router ID: Identifier of the Virtual Router.

Router Priority: Failover priority of this router. The highest priority router will take ownership of the Virtual IP.

WAN Fault Priority: This optional value sets the failover priority of this router when no WAN connection is available. If the value matches the normal router priority, WAN connection state will not be considered. If the value is empty (the default), the router will always give up the Virtual IP and let a new master take over when no WAN connection is available.

Advertisement Interval: Sets the amount of time (in seconds) between sending VRRP advertisements.

Initial Value Router State: This controls the initial failover state of the VRRP instance when it first comes up.

Authentication: VRRP Authentication Method. Note that VRRP Authentication has been deprecated as of RFC 3768.

Password: VRRP Group Password.

Provide Virtual IP in DHCP leases: Select this to automatically set the DHCP default gateway address and DNS server address to the Virtual IP in DHCP leases provided on this network.

STP

Enable STP: Enable **Spanning Tree Protocol** loop detection.

Bridge Priority: Set the priority of the bridge. When determining the root bridge of the spanning tree topology, the bridge priority is compared first. The bridge with the lowest priority will win. If you want this router to be the root bridge, then set it to a value less than the default of 32768. A valid priority value is between 0 and 65535.

Wired 802.1X

Enable 802.1X: Require IEEE 802.1X Authorization.

Reauthentication Period: EAP reauthentication period in seconds.

Auth Server IP Address: IP address of the connected RADIUS server.

Auth Server MAC Address: Hardware address of the connected RADIUS server's interface. *NOTE: If you don't know the MAC address for the RADIUS server, enter 00:00:00:00:00:00, and the service will try to find the MAC address from the given IP address.*

Port

Password

Acct Server IP Address: IP address of the connected RADIUS server.

Acct Server MAC Address: This is the Hardware address of the connected RADIUS server's interface. *NOTE: If you don't know the MAC address for the RADIUS server, enter 00:00:00:00:00:00, and the service will try to find the MAC address from the given IP address.*

Port

Password



MAC FILTER & LOGGING

A MAC (Media Access Control) address is a unique identifier for a computer or other device. This page allows you to manage clients by MAC address. You can filter clients by MAC addresses and/or keep a log of devices connected to your router.

Filter Configuration

The MAC Filter allows you to create a list of devices that have either exclusive access (whitelist) or no access (blacklist) to your local network.

Enabled: Click to allow MAC Filter options.

Whitelist: Select either "Whitelist" or "Blacklist" from a dropdown menu. In "Whitelist" mode, the router will restrict LAN access to all computers except those contained in the "MAC Filter List" panel. In "Blacklist" mode, listed devices are completely blocked from local network access.

MAC Filter List (Whitelist or Blacklist)

Add devices to either your whitelist or blacklist simply by inputting each device's MAC address.

NOTE: Use caution when using the MAC Filter to avoid accidentally blocking yourself from accessing the router.

MAC Logging Configuration

Enable MAC Logging: Enabling MAC Logging will cause the router to log MAC addresses that are connected to the router. MAC addresses that you do not want to have logged (addresses that you expect to be connected) should be added to the "Ignored MAC Addresses" list.

You can configure the router to send an alert if a connected device has a MAC address that the router doesn't recognize. Go to **SYSTEM > Device Alerts** to set up these email alerts.

Ignored MAC Addresses

This is the list of MAC addresses that will not produce an alert or a log entry when they are connected to the router. These should be MAC addresses that you expect to be connected to the router. To add MAC addresses to this list, simply select devices shown in the MAC Address Log and click "Ignore." You can also add addresses manually.

MAC Address Log

This shows the last 64 MAC addresses that have connected to the router, as well as which interface was used to connect. The time/date that is logged is the time of the first connection. The page may need to be refreshed to show the most recent log entries.

Double-clicking on entries from this list will add them to the **Ignored MAC Addresses** list.



VLAN INTERFACES

A virtual local area network, or VLAN, functions as any other physical LAN, but it enables computers and other devices to be grouped together even if they are not physically attached to the same network switch.

To enable a VLAN, select a VID (virtual LAN ID) and a group of Ethernet ports through which users can access the VLAN. Then go back up to the **Local Network Editor** to attach your new VLAN to a network. To use a VLAN, the VID must be shared with another router or similar device so that multiple physical networks have access to the one virtual network.

Click **Add** to create a new VLAN interface. To edit an interface, select the check box next to the desired interface.

VLAN Interfaces				
<div>Add Edit Remove</div>				
<input type="checkbox"/>	UID	VID	Mode	Ports
<input type="checkbox"/>	wan	1	WAN	0/0
<input type="checkbox"/>	lan	2	LAN	1/0 2/0 3/0 4/0 5/0 6/0 7/0 8/0 9/0 10/0 11/0 12/0

Edit wan

VID: 1

Name (UID): wan

Mode: WAN

Configured Ports

Add Edit Remove

<input type="checkbox"/>	Port	Mode
<input type="checkbox"/>	Ethernet WAN	Untagged



TUNNELS

CP SECURE VPN

Configured, deployed, and managed from the cloud, CP Secure VPN delivers a virtual private data network that minimizes both cost and complexity. Unlike traditional bulky head-end concentrator hardware solutions, CP Secure VPN allows IT managers to secure their expanding Edge Networks using architectures that scale quickly and are easy to maintain. For more information, visit cradlepoint.com.

Click **Add** to configure a new CP Secure VPN tunnel; click **Edit** to make changes to an existing tunnel.

Add/Edit Tunnel – General

Name: Give the tunnel a name that uniquely identifies it.

Activation Username: Account username.

Activation Password: Account password.



Remote Gateway: US and European gateways associated with activation username and password.

Port: Remote Secure port.

Certificate Name: Select the certificate used for authentication. Certificates are managed in **SECURITY/Certificate Management**.

Tunnel Enabled: Enabled or Disabled.

NOTE: CP Secure VPN requires an ECM Prime subscription. For more information, visit cradlepoint.com.

IPSEC VPN

VPN (virtual private network) tunnels are used to establish a secure connection to a remote network over a public network. For example, VPN tunnels can be used across the Internet by an individual to connect to an office network while traveling, or by two office networks to function as one network.

The two networks set up a secure connection across the (normally) unsecure Internet by assigning VPN encryption protocols.

Cradlepoint VPN tunnels use **IPsec** (Internet Protocol security) to authenticate and encrypt packets exchanged across the tunnels. To set up a VPN tunnel with a Cradlepoint router on one end, there must be another device (usually a router) that also supports IPsec on the other end.

IKE (Internet Key Exchange) is the security protocol in IPsec. IKE has two phases, phase 1 and phase 2. The router has several different security protocol options for each phase, but the default selections will be sufficient for most users.

The VPN tunnel status page allows you to view the state of the VPN tunnels. If a tunnel fails to connect to the remote site, check the System Logs for more information. You may double click on a cell to directly edit that information.

Click **Add** to configure a new VPN tunnel; click **Edit** to make changes to an existing tunnel.

Add/Edit Tunnel – General

Tunnel Name: Give the tunnel a name that uniquely identifies it.

Anonymous Mode: Select to allow remote connections from any IP address.

Responder Mode: When enabled, the router will not initiate negotiation with peers.

Local Identity: Specifies the identifier sent to the remote host during phase 1 negotiation. If left blank it will default to the IP address of the WAN connection.

IPSec VPN Tunnels				
Add Edit Remove				
Name	Local Networks	Remote Networks	IKE Phase 1	IKE Phase 2



Currently we only support identifiers in the form of an IP address, a user-fully qualified domain name (user@mydomain.com) or just a fully qualified domain name (www.mydomain.com). If the remote side of the tunnel is configured to expect an identifier, then both must match in order for the negotiation to succeed. If NAT-T is being used, a single word (instead of an address) can be used if a DynDNS connection is not being used.

Remote Identity: Specifies the identifier we expect to receive from the remote host during phase 1 negotiation. If no identifier is defined then no verification of the remote peer's identification will be done. Currently we only support identifiers in the form of an IP address, a user-fully qualified domain name (user@mydomain.com) or just a fully qualified domain name (www.mydomain.com). If left blank we will default to the IP address of the WAN connection. If NAT-T is being used, a single word (instead of an address) can be used if a DynDNS connection is not being used.

Authentication Mode: Select from **Pre-Shared Key** and **Certificate**. **Pre-Shared Key** is used when there is a single key common to both ends of the VPN. **Certificate** requires the creation of a set of certificates and a private key that can be uploaded to the router. Select **Enable Certificate Support** in the **Global VPN Settings** section to upload a single set of certificates for the router to use.

Pre-Shared Key: Create a password or key. The routers on both sides of the tunnel must use this same key.

Mode: Select from **Tunnel**, **Transport** or **VTI-Tunnel**. **Tunnel Mode** is used for protecting traffic between different networks, when traffic must pass through an intermediate, untrusted network. **Transport Mode** is used for end-to-end communications (for example, for communications between a client and a server). **VTI Tunnel** creates a virtual tunnel interface with a specified virtual IP address. This interface can then be added to the zone firewall.

Initiation Mode: **Always On** or **On Demand**. **Always On** is used if you want the tunnel to initiate the tunnel connection whenever the WAN becomes available. Select **On Demand** if you want the tunnel to initiate a connection if and only if there is data traffic bound for the remote side of the tunnel.

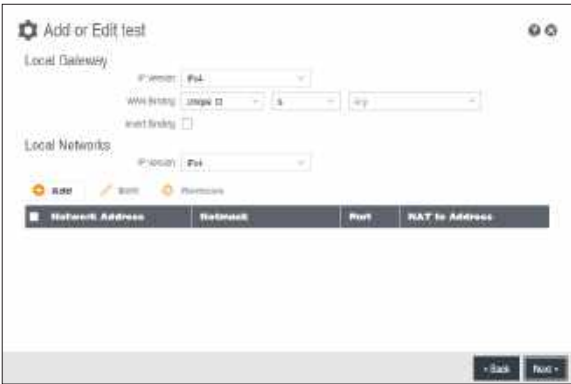
Tunnel Enabled: Enabled or Disabled.

Add/Edit Tunnel – Local Gateway

IP Version: Select **IPv4** or **IPv6**.

WAN Binding: WAN Binding is an optional parameter used to configure the VPN tunnel to ONLY operate when the specified WAN device(s) are available and connected. An example use case is when there is a router with both a primary and failover WAN device and the tunnel should only be used when the system has failed over to the backup connection.

Make a selection for “When,” “Condition,” and “Value” to create a WAN Binding. The condition will be in the form of these examples:



When	Condition	Value
Port	Is	USB Port 1
Type	Is not	WiMax

- **When:**
 - **Port** – Select by the physical port on the router that you are plugging the modem into (e.g., “USB Port 2”).
 - **Manufacturer** – Select by the modem manufacturer (e.g., “Cradlepoint Inc.”).



- **Model** – Set your rule according to the specific model of modem.
- **Type** – Select by type of Internet source (Ethernet, LTE, Modem, Wireless as WAN, WiMAX).
- **Serial Number** – Select a 3G or LTE modem by the serial number.
- **MAC Address** – Select a WiMAX modem by MAC Address.
- **Unique ID** – Select by ID. This is generated by the router and displayed when the device is connected to the router.
- **Condition:** Select “is,” “is not,” “starts with,” “contains,” or “ends with” to create your condition’s statement.
- **Value:** If the correct values are available, select from the dropdown list. You may need to manually input the value.

Invert Binding: Advanced option that inverts the meaning of WAN Binding to only establish this tunnel when the specified WAN Binding device(s) are *NOT* connected.

Add/Edit Tunnel – Local Networks

IP Version: Select IPv4 or IPv6.

The **Network Address** and the **Netmask** define what local devices have access to or can be accessed from the VPN tunnel.

NOTE: the local network IP address **MUST** be different from the remote network IP address.

Optionally: A **Port** can be defined that will limit the traffic going through the VPN tunnel to only that port. If the field is left blank, any port will be accepted by the tunnel.

Add/Edit Tunnel – Remote Gateway

Gateway: This value can be any of the following: an IPv4 address, an IPv6 address, or a fully qualified name in the form of “host.domain.com” (DNS names are case-insensitive, so only lower case letters are allowed). It is recommended that you use a dynamic DNS hostname instead of the static IP address – by using the dynamic DNS hostname, updates of the remote WAN IP are compensated for while connecting to a VPN tunnel.

Add/Edit Tunnel – Remote Networks

The **Network Address** and the **Netmask** define the remote network address range that local devices will have access to via the VPN tunnel.

NOTE: the remote network IP address **MUST** be different from the local network IP address.

Optionally: A **Port** can be defined that will limit the traffic going through the VPN tunnel to only that port. If the field is left blank, any port will be accepted by the tunnel.

Add/Edit Tunnel – IKE Phase 1

IKE security has two phases, phase 1 and phase 2. You have the ability to distinctly configure each phase, but the default settings will be sufficient for most users.

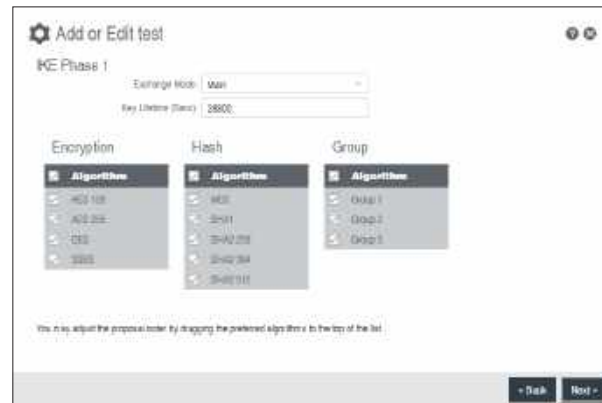
To set up a tunnel with a remote site, you need to match your tunnel’s IKE negotiation parameters with the remote site. By selecting several encryption, hash, and DH group options, you improve your chances



for a successful tunnel negotiation. For greatest compatibility, select all options; for greatest security, select only the most secure options that your devices support.

Exchange Mode: The IKE protocol has two modes of negotiating phase 1 – **Main** (also called Identity Protection) and **Aggressive**.

- In **Main** mode, IKE separates the key information from the identities, allowing for the identities of peers to be secure at the expense of extra packet exchanges.
- In **Aggressive** mode, IKE tries to combine as much information into fewer packets while maintaining security. Aggressive mode is slightly faster but less secure.



Because it has better security, **Main** mode is recommended for most users.

Key Lifetime: The lifetime of the generated keys of phase 1 of the IPsec negotiation from IKE. After the time has expired, IKE will renegotiate a new set of phase 1 keys.

Encryption, Hash, and DH Groups

Each IKE exchange uses one encryption algorithm, one hash function, and one DH group to make a secure exchange.

Encryption: Used to encrypt messages sent and received by IPsec.

- AES 128
- AES 256
- DES
- 3DES

Hash: Used to compare, authenticate, and validate that data across the VPN arrives in its intended form and to derive keys used by IPsec.

- MD5
- SHA1
- SHA2 256
- SHA2 384
- SHA2 512

Note that some Encryption/Hash combinations (e.g., 3DES with SHA2 384/512) are computationally expensive, impacting WAN performance. AES is as strong an encryption and performs much better than 3DES.

DH Groups: The DH (Diffie-Hellman) Group is a property of IKE and is used to determine the length of prime numbers associated with key generation. The strength of the key generated is partially determined by the strength of the DH Group. Group 5, for instance, has greater strength than Group 2.

- Group 1: 768-bit key
- Group 2: 1024-bit key
- Group 5: 1536-bit key

In IKE Phase 1 you can only select one DH group if you are using **Aggressive** exchange mode.



By default, all the algorithms (encryption, hash, and DH groups) supported by the device are checked, which means they are allowed for any given exchange. Deselect these options to limit which algorithms will be accepted. Be sure to check that the router (or similar device) at the other end of the tunnel has matching algorithms.

The algorithms are listed in order by priority. You can reorder this priority list by clicking and dragging algorithms up or down. Any selected algorithm may be used for IKE exchange, but the algorithms on the top of the list are more likely to be used more often.

Add/Edit Tunnel – IKE Phase 2

Perfect Forward Secrecy (PFS): Enabling this feature will require IKE to generate a new set of keys in phase 2 rather than using the same key generated in phase 1. Additionally, with this option enabled the new keys generated in phase 2 are exchanged in an encrypted session. Enabling this feature affords the policy greater security.

Key Lifetime: The lifetime of the generated keys of phase 2 of the IPsec negotiation from IKE. After the time has expired, IKE will renegotiate a new set of phase 2 keys.

Phase 2 has the same selection of **Encryption** and **DH Groups** as phase 1, but you are restricted to only one DH Group. Phase 2 and phase 1 selections do not have to match. For the **Hash** selection an added value of SHA 256_128 (128-bit truncation) is available. The original specification and the Cradlepoint default is 96-bit truncation, but RFC4868 requires 128-bit. A VPN to newer Cisco or Juniper devices will typically require 128-bit.

Add/Edit Tunnel – Dead Peer Detection

Dead Peer Detection (DPD) defines how the router will detect when one end of the IPsec session loses connection while a policy is in use.

Connection Idle Time: Configure how long the router will allow an IPsec session to be idle before beginning to send Dead Peer Detection (DPD) packets to the peer machine. (Default: 30 seconds. Range: 10 – 3600 seconds.)

Request Frequency allows you to adjust the delay between these DPD packets. (Default: 15 seconds. Range: 2 – 30 seconds.)

Maximum Requests: Specify how many requests to send at the selected time interval before the tunnel is considered dead. (Default: 5. Range: 2 – 10.)

Failback Retry Period: If you have VPN tunnel failover/failback enabled (see below), set the time period between each check on the primary network after failover. (Default: 10 seconds. Range: 5 – 60 seconds.)

Failover Tunnel and **Failback Tunnel:** Use these settings to create two tunnels – one as the primary tunnel and one as the backup tunnel. To configure tunnel failover/failback, complete the following steps:

1. Create two tunnels: one for primary and one for backup. Make sure that both tunnels have the same **Remote Network** and that both have **Dead Peer Detection** enabled.
2. Choose one to be the primary tunnel. Open the editor for this tunnel and make sure **Tunnel Enabled** is selected. Then go to the **Dead Peer Detection** page. Under **Failover Tunnel** select the other tunnel you have created.
3. Open the editor for the failover tunnel. Make sure **Tunnel Enabled** is *not* selected. On the **Dead Peer Detection** page, set the **Failback Tunnel** to your primary tunnel.



Global VPN Settings

These settings apply to all configured VPN tunnels.

Enable VPN Service: Enabling VPN Service will allow you to load a certificate for VPN to the router.

Certificate Name: Select the Certificate Name.

IKE / ISAKMP Port: Internet Key Exchange / Internet Security Association and Key Management Protocol port. (Default: 500. This is a standard VPN port that usually does not need to be changed.)

IKE / ISAKMP NAT-T Port: Internet Key Exchange / Internet Security Association and Key Management Protocol network address translation traversal port. (Default: 4500. This is a standard VPN NAT-T port that usually does not need to be changed.)

NAT-T KeepAlive Interval: Number of seconds between sending NAT-T packets to keep the tunnel alive if no other traffic is being sent. (Default: 20 seconds. Range: 0-3600 seconds. 20 seconds will be sufficient in almost all cases.)

Tunnel Connect Retry: Number of seconds between connection attempts. (Default: 30 seconds. Range: 10-255 seconds. 30 seconds will be sufficient in almost all cases.)

OPEN VPN

OpenVPN is an open source software application that implements virtual private network (VPN) techniques for creating secure point-to-point or site-to-site connections in routed or bridged configurations and remote access facilities.

NOTE: OpenVPN requires a feature license not included with ECM Prime. Go to **SYSTEM > Administration > Feature Licenses** to enable this feature.

Once you have a valid feature license, click **Add** to create a new OpenVPN tunnel. Click **Edit** to make changes to an existing tunnel.

Add/Edit Tunnel – General

- **Tunnel Name** – Enter a name to uniquely identify this tunnel
- **Tunnel Mode** – Select which mode this tunnel endpoint is required to be. Choose from the following:
 - Client
 - Server
- **Device Type** – Select between Routed (TUN) or Bridged (TAP) virtual device.
 - **Routed** creates an interface that can be used in the Zone Firewall and is fully routable.



- **Bridged** creates a network interface that can be assigned to a LAN under the Local Networks configuration. This interface is managed through the assigned LAN device.
- **Local Endpoint** – Enter the IP Address of the LNS (tunnel server) peer
- **Local Netmask** – Enter the Netmask of the LNS (tunnel server) peer
- **Remote Endpoint** – Enter the IP Address of the LNS (tunnel server) peer
- **Remote Netmask** – Enter the Netmask of the LNS (tunnel server) peer
- **Support IPv6 Tunnels** – Allow IPv6 traffic to be forwarded over this tunnel. If you select this option, also input an **IPv6 Tunnel Address** and **Tunnel Prefix Length** for IPv6
- **Tunnel Protocol** – Choose UDP or TCP
- **Port** – Specify the port if desired
- **Ping** – (Displays if the **Configuration Mode** is **Advanced**) If no packets have been sent in the amount of time entered, a ping is sent to the remote endpoint
- **Ping Restart** – (Displays if the **Configuration Mode** is **Advanced**) If no pings have been received in the amount of time entered, OpenVPN restarts the tunnel
- **Tunnel Enabled** – Click to enable/disable this tunnel

Add/Edit Tunnel – Security

- **Cipher** – Encrypt packets with the selected algorithm. The default is BF-CBC, an abbreviation for Blowfish in Cipher Block Chaining mode. Blowfish has the advantages of being fast, very secure, and allowing key sizes of up to 448 bits. Blowfish is designed to be used in situations where keys are changed infrequently. OpenVPN supports the CBC, CFB, and OFB cipher modes, however CBC is recommended and CFB and OFB should be considered advanced modes.
- **Auth Algorithm** – Authenticate packets with HMAC using message digest algorithm alg. (The default is SHA1). HMAC is a commonly used message authentication algorithm (MAC) that uses a data string, a secure hash algorithm, and a key, to produce a digital signature.
- **Verify peer certificate** – Verifies that peer certificate was signed with RFC3280 TLS rules set in key usage and extended key usage. This helps to prevent specific man-in-the-middle attacks.
- **TLS-Authentication** – In client/server mode: adds an additional layer of HMAC authentication on top of the tls control channel to protect against DoS attacks. In point-to-point mode: encrypts the communication using a static key. These keys must match on each endpoint.

Add/Edit Tunnel – Remote Servers

Create a list of remote server connections to connect to. OpenVPN will try to connect to each host in the list. If a disconnect occurs from a given server, the next server will be tried in a round-robin fashion.

- **Host** – IP address of the remote server
- **Port** – Specify the port if desired
- **Protocol** – Select UDP or TCP

Add/Edit Tunnel – Routes

Add or remove the routes that will be used to direct packets through the tunnel.



- **Network Address**
- **Netmask**

Generate Client Configuration

The Generate Client Configuration button can be used to generate client configurations for OpenVPN tunnels configured in Server mode. An .ovpn file will be created that can be imported to a variety of OpenVPN client devices (Android, iOS, Windows). If the private key for the server's certificate authority is known, a client certificate can be generated; otherwise one can be selected.

GRE

Generic Routing Encapsulation (GRE) tunnels can be used to create a connection between two private networks. Most Cradlepoint routers are enabled for both GRE and VPN tunnels. GRE tunnels are simpler to configure and more flexible for different kinds of packet exchanges, but VPN tunnels are much more secure.

In order to set up a tunnel you must configure the following:

- **Local Network** and **Remote Network** addresses for the “**Glue Network**,” the network that is created by the administrator that serves as the “glue” between the networks of the tunnel. Each address must be a different IP address from the same private network, and these addresses together form the endpoints of the tunnel.
- **Remote Gateway**, the public facing WAN IP address that the local gateway is going to connect to.
- **Routes** that allow you to configure what network traffic from local host(s) will be allowed through the tunnel.

Optionally, you might also want to enable the tunnel **Keep Alive** feature to monitor the status of a tunnel and more accurately determine if the tunnel is alive or not.

Click **Add** to configure a new GRE tunnel; click **Edit** to make changes to an existing tunnel.

Add/Edit Tunnel – General

Tunnel Name: Give the tunnel a name that uniquely identifies it.

Tunnel Key: Enables an ID key for a GRE tunnel, which can be used as an identifier for mGRE (Multipoint GRE).

Local Network: This is the local side of the “Glue Network,” a network created by the administrator to form the tunnel. The user creates the IP address inputted here. It must be different from the IP addresses of the networks it is gluing together. Choose any private IP address from the following three ranges that doesn't match either network:

- 10.0.0.0 - 10.255.255.255
- 172.16.0.0 - 172.31.255.255
- 192.168.0.0 - 192.168.255.255

Remote Network: This is the remote side of the “Glue Network.” Again, the user must create an IP address that is distinct from the IP addresses of the networks that are being glued together.

The screenshot shows the 'Add/Edit Tunnel' configuration interface. It includes the following fields and options:

- Tunnel Name: [Text input field]
- Tunnel Key: [Text input field]
- Local Endpoint: [Text input field, value: 0.0.0.0]
- Remote Endpoint: [Text input field, value: 0.0.0.0]
- Subnet Mask: [Text input field, value: 255.255.255.252]
- Remote Gateway: [Text input field, value: 0.0.0.0]
- TTL: [Text input field, value: 64]
- MTU: [Text input field]
- WAN Binding: [Dropdown menu, value: Unique ID]
- Invert Binding: [Radio button, unchecked]
- DHCP Enabled: [Checkbox, unchecked]
- Multicast Enabled: [Checkbox, unchecked]
- Enable Tunnel: [Checkbox, checked]
- Navigation: [Back] [Next]



The Remote Network and Local Network values will be flipped when inputted for the other side of the tunnel configuration.

Subnet Mask: This is the subnet mask for the Glue Network. The Local and Remote Network addresses must fit with this mask. 255.255.255.0 is a logical choice for most users.

Remote Gateway: This is the public facing, WAN-side IP address of the network to which the local gateway is going to connect.

TTL: Set the Time to Live (**TTL**), or *hop limit*, for the GRE tunnel.

MTU: Set the maximum transmission unit (**MTU**) for the GRE tunnel.

WAN Binding: WAN Binding is an optional parameter used to configure the GRE tunnel to *ONLY* operate when the specified WAN device(s) are available and connected. An example use case is when there is a router with both a primary and failover WAN device and the tunnel should only be used when the system has failed over to the backup connection.

Make a selection for “When,” “Condition,” and “Value” to create a WAN Binding. The condition will be in the form of these examples:

When	Condition	Value
Port	Is	USB Port 1
Type	Is not	WiMax

- **When:**
 - **Port** – Select by the physical port on the router into which you are plugging the modem (e.g., “USB Port 2”).
 - **Manufacturer** – Select by the modem manufacturer (e.g., “Cradlepoint Inc.”)
 - **Model** – Set your rule according to the specific model of modem
 - **Type** – Select by type of Internet source (Ethernet, LTE, Modem, Wireless as WAN, WiMAX)
 - **Serial Number** – Select a 3G or LTE modem by the serial number
 - **MAC Address** – Select a WiMAX modem by MAC Address
 - **Unique ID** – Select by ID. This is generated by the router and displayed when the device is connected to the router.
- **Condition:** Select “is,” “is not,” “starts with,” “contains,” or “ends with” to create your condition’s statement.
- **Value:** If the correct values are available, select from the dropdown list. You may need to manually input the value.

Invert WAN Binding: Advanced option that inverts the meaning of WAN Binding to only establish this tunnel when the specified WAN Binding device(s) are *NOT* connected.

Tunnel Enabled: Select to activate the tunnel.

Add/Edit Tunnel – Routes

Adding routes allows you to configure what types of network traffic from the local host or hosts will be allowed through the tunnel.

Click **Add Route** to configure a new route. You will need to input the following information, defined by the remote network:

- **Network Address** – This is the network address that is the destination of the route. This should be set to the network address at the remote side of the tunnel.



- **Netmask** – This is the corresponding subnet mask of the network being defined (Default: 255.255.255.0).

You can set the tunnel to connect to a range of IP addresses or to a single IP address. For example, you could input **192.168.0.0** and **255.255.255.0** to connect your tunnel to all the addresses of the remote network in the **192.168.0.x** range. Alternatively, you could select a single address by inputting that address along with a Netmask of **255.255.255.255**.

Add/Edit Tunnel – Keep Alive

GRE keep-alive packets can be enabled to be sent through the tunnel in order to monitor the status of the tunnel and more accurately determine if the tunnel is alive or not.

GRE keep-alive packets may be sent from both sides of a tunnel, or from just one side.

Enabled: Select to enable GRE Keep Alive to continually send keep-alive packets to the remote peer.

Rate: Choose the length of time in seconds for each check (Default: 10 seconds. Range: 2 – 3600 seconds).

Retry: Select the number of attempts before the GRE tunnel is considered down or up (Default: 3. Range: 1 – 255).

Failover Tunnel and Failback Tunnel: Use these settings to create two tunnels – one as the primary tunnel and one as the backup tunnel. To configure tunnel failover/failback, complete the following steps:

1. Create two tunnels: one for primary and one for backup. Make sure both tunnels have **Keep Alive** enabled.
2. Choose one to be the primary tunnel. Open the editor for this tunnel and make sure **Tunnel Enabled** is selected. Then go to the **Keep Alive** page. Under **Failover Tunnel** select the other tunnel you have created.
3. Open the editor for the failover tunnel. Make sure **Tunnel Enabled** is *not* selected. On the **Keep Alive** page, set the **Failback Tunnel** to your primary tunnel.

NEMO

Network Mobility (NEMO) is an Internet standards track protocol defined in RFC 5177. The protocol allows session continuity for every node in a mobile network as the network moves.

NOTE: NEMO requires a feature license not included with ECM Prime. Go to **SYSTEM > Administration > Feature Licenses** to enable this feature.

NEMO requires a service provider, e.g. Verizon Wireless Private Network with DMNR (Dynamic Mobile Network Routing). Your NEMO service provider will define many of the settings for your NEMO configuration.

Once you have a NEMO service provider and a valid feature license, add networks to the **Networks Routed by NEMO** section by first clicking **Add**. In the popup window, input:

- **Network Address** – This is the network address that is the destination of the route. This should be set to the network address at the remote side of the tunnel.
- **Netmask** – This is the corresponding subnet mask of the network being defined (Default: 255.255.255.0).

The Network Address and Netmask, or subnet mask, together define a range of IP addresses that comprise the local network you want associated with the NEMO settings.



Network Mobility (NEMO) Settings

Enable: Enable NEMO.

WAN: Select the WAN(s) to use for the NEMO connection. An expression such as "Unique ID is (any)" will allow NEMO to operate on any WAN, whereas "Type is LTE" will limit NEMO operation to the WAN(s) provided by any connected LTE device(s).

With WAN: Register the NEMO connection simultaneous with its specified WAN connection becoming available. If not checked, will only register the NEMO connection when needed.

Home IP Address and Home Netmask – These may be provided by your NEMO service provider. The IP address is a placeholder, "dummy" address; any IP address can be used (1.2.3.4 is common).

Home Agent IP Address, Home Agent Password, and Home Agent SPI – Your home agent will be defined by your NEMO service provider.

Renew Registration – The NEMO network regularly re-registers with the home agent (e.g., every 30 seconds). Specify the number of seconds between each check-in.

MTU – Override the maximum transmission unit (**MTU**) of the NEMO tunnel. The TCP **MSS** (maximum segment size) is automatically derived from the MTU. Leave blank to rely on **Path MTU Discovery**.

L2TP

Layer 2 Tunneling Protocol (**L2TP**) tunnels can be used to create a connection between two private networks.

NOTE: L2TP Tunnels require a feature license not included with ECM Prime. Go to **SYSTEM > Administration > Feature Licenses** to enable this feature.

Once you have a valid feature license, click ****Add**** to create a new L2TP tunnel. Click ****Edit**** to make changes to an existing tunnel.

Add/Edit Tunnel – General

- **Tunnel Name** – Enter a name to uniquely identify this tunnel
- **LNS address** – Enter the IP Address of the LNS (tunnel server) peer
- **MTU** – Set the maximum transmission unit (**MTU**) for the L2TP tunnel
- **MRU** – Set the maximum receive unit (MRU) to request from the tunnel peer. The MRU is very similar to the MTU: MTU is for packets sent and MRU is for packets received
- **Tunnel Enabled** – Click to enable/disable this tunnel. Default: Enabled.



Authentication

More authentication options and overrides are available in the next section.

- **Username** – Username for user-specific authorization. Leave blank to disable.
- **Password** – Shared secret (or password) used to authenticate the associated Local and Remote names.

Redial

- **Enabled** – When this is selected, the tunnel will attempt to reconnect if disconnected.

Add/Edit Tunnel – Authentication

- **Remote Name** – Authorization name specified by and to the remote system as its identity, sometimes a username or hostname. Leave blank to match any.
- **Local Name** – Authorization name specified by and to the remote system as the local system identity; sometimes a username or hostname. Leave blank to match any.
- **Secret** – Shared secret (or password) used to authenticate the associated Local and Remote names.

Overrides

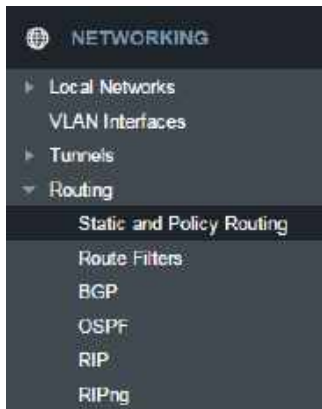
Override Authentication methods/parameters. With methods set to Allow the two ends of the tunnel can negotiate a common scheme. Sometimes this negotiation fails, or the implementation on one end is incompatible with the other. To solve those authentication issues, enable the overrides as needed.

- **Authentication** – Username for user-specific authorization. Leave blank to disable.
- **CHAP** – Choose from Allowed, Refused, or Required.
- **PAP** – Choose from Allowed, Refused, or Required.
- **Name** – Override names used to authenticate the router. Leave empty to use the default.

Add/Edit Tunnel – Routes

Typically specific routes are unnecessary, but they can be added in this section if needed. You can add or remove routes to be used to funnel packets through the tunnel.

- **Network Address** – This is the network address that is the destination of the route. This should be set to the network address at the remote side of the tunnel.
- **Netmask** – This is the corresponding subnet mask of the network being defined.



ROUTING

STATIC AND POLICY ROUTING

The Main route policy sends all traffic that reaches it to the Main route table. It cannot be edited or removed. Typical destination-based static routes should be added to the Main route table.

Policy routing allows for the addition of routes which are only evaluated when a certain set of conditions match. Match conditions are specified in a route policy. Evaluation occurs in the order in which the route policies are listed and continues until a route is matched. The order of evaluation can be changed via drag/drop. A route policy (including Main) will be overridden by policies that precede it in the list.

To avoid unexpected routing problems, newly created route policies are placed below the Main policy where they will have no effect.

Route Policies: Route Policies map a policy to a route table. Any traffic matched by the policy will be routed according to the specified route table. If no policy or no route is matched, the lookup will continue with the next policy in the list.

Route Policies					
<div> + Add ✎ Edit ✖ Remove </div>					
	IP Version	Source IP/Network Address	Destination IP/Network Address	Incoming Device	Table
<input type="checkbox"/>	Any	Any	Any	Any	Main

Main Route Policy: A special route policy that maps to the Main route table. It cannot be edited or removed. Click **Add** to create a new route policy. Click **Edit** to edit an existing route policy.

Match on

- **IP Version:** Select IPv4 or IPv6. Depending on your selection, you have different options for defining the address range.
- **Source IP/Network Address:** Select the source IP network upon which this policy will match. Leave blank to match on any.
- **Destination IP/Network Address:** Select the destination IP network upon which this policy will match. Leave blank to match on any.
- **Incoming Device:** Select the incoming device upon which this policy will match. Leave blank to match on any.

'lo' is a special device that matches all local (router-originated) traffic, including NTP, Syslog, TACACS, ECM, and updates. 'lo:ecm' matches just the subset of local traffic for ECM. 'lo:updates' matches just the subset of local traffic for updates downloaded directly from CDNs such as modem and router firmware.

Route Policy Editor

Match on:

IP Version:

Source IP/Network Address:

Destination IP/Network Address:

Incoming Device:

Reference:

Table:



To route local traffic differently than either subset, policy for the subset(s) should be configured with a higher priority than the more general local source.

Reference

Table: Select the route table to use for routing when this policy is matched. Only user-created route tables may be selected (Main is reserved for the Main policy).

Route Tables: Static route tables to be used in policy route lookups. In order for route tables defined here to take effect, a corresponding Route Policy must be created. Note that route tables defined here are not available for use in dynamic routing protocols.

Main Route Table: A special route table that contains the main system routes. It cannot be removed and cannot be referenced by a user-defined policy. The Main route table is available for use in dynamic routing protocols.

Click **Add** to open the Route Table Editor. Click **Add** to create a new route table or **Edit** to edit an existing route table.

- **Destination IP/Network Address:** Enter the network address in the following forms:
 - IPv4: 1.2.3.4/32
 - IPv6: 0123:4567::CDEF/128

The optional gateway must match the IP version entered here.

- **Gateway:** Enter the gateway in the following forms:
 - IPv4: 1.2.3.4/32
 - IPv6: 0123:4567::CDEF/128

The form must match the ip network address. If Gateway is blank, a device interface must be selected. Both Gateway and Device may also be specified.

- **Device:** Select the device interface. Selecting **null0** will install a black hole route. If Device is blank, a gateway must be entered. Both Gateway and Device may also be specified.
- **Metric:** The static route is added to the kernel with the specified Metric, in the range 1–16777215.
- **Allow Network Access:** Some static routes will need an IP Filter Rule added to allow packets to route without being blocked by the firewall. Checking the box opens the firewall for all traffic to and from the specified network. Adding custom rules to the appropriate filtering policy may be more secure than checking this box.

The 'Route Tables' screen displays a table with one entry, 'Main'. Above the table are buttons for '+ Add', 'Edit', and 'Remove'.

The 'Route Table Editor' screen has a 'Name' field, a 'Routes' section with '+ Add', 'Edit', and 'Remove' buttons, and a table with columns 'IP/Network Address', 'Gateway', and 'Device'.

The 'Static Route Editor' screen contains fields for 'Destination IP/Network Address', 'Gateway', 'Device', and 'Metric', along with an 'Allow Network Access' checkbox.

ROUTE FILTERS

Common route filters may be used by any of the routing protocols. When shown in selection UI, filter names are prepended with a label to identify the type, i.e. al:AccessListName, pl:PrefixListName, and rm:RouteMapName. Filter names must be unique across all filters, common and protocol-specific.



Route filter entries are processed in the order in which they appear in the grid. A match will apply the action (permit or deny) specified for the entry and processing will stop. If a filter is referenced and no match is found, the route is denied.

Access List: Allows packet filtering by IP address.

Prefix List: Works the same as an access list with the addition of filtering by prefix length. If the IP Network matches, the filter will match if the prefix length is less than or equal to the 'le' value, or greater than or equal to the 'ge' value. 'le' and 'ge' are optional, if both are omitted the prefix list acts as an access list.

Route Map: Provides a richer set of match conditions for packet filtering than access or prefix lists, and allows policy to be applied to a route via set actions.

- **Description:** Displayed to help identify the route map.
- **Permit:** Checking Permit will carry out the Set Actions if the Match Conditions are met, and permit the route. Clearing Permit will deny the route if the Match Conditions are met.
- **Match Conditions:** A set of conditions that define a match.
- **Set Actions:** A set of actions that are triggered by a match.

Certain match conditions and set actions are protocol-specific. Referencing a protocol-specific route map from an incompatible protocol will cause errors during operation that prevent the routing protocol from starting.

- **OSPF-specific:** metric-type.
- **BGP-specific:** as-path, weight, comm-list, local-preference, community, ext community.

A community is identified by a 32-bit value (e.g. 1234567890) usually expressed as two 16-bit values separated by a colon (e.g. 18838:722). A received or well-known community can be referenced by its number (or number pair), while defining a community list allows naming and referring to it by name.

Note certain well-known communities can be used by name without definition: **no-advertise** (never advertise these routes), **no-export** (don't advertise beyond confederation boundary), **local-AS** (don't advertise to external peers), **internet** (advertise to everyone), and **none** (used to clear any community associated with a route).

BGP route filters are only used by the BGP protocol. Access lists are prepended with 'fl:' when shown in selection UI. Community lists are prepended with 'cl:'. Filter names must be unique across all filters, common and protocol-specific.

The Prefix List Editor interface shows a 'Name' field at the top. Below it is a table titled 'Entries' with columns: Action, IP Network, LE, and GE. One entry is visible with Action 'deny' and IP Network '192.168.0.0'. At the bottom are 'Cancel' and 'Save' buttons.

The Entry Editor - Match Conditions interface shows a 'Description' field and a 'Permit' checkbox. Below are tabs for 'Match Conditions' and 'Set Actions'. Under 'Match Conditions', there are 'Add', 'Edit', and 'Remove' buttons. A dropdown menu is open showing options: as-path (BGP), metric, community (BGP), extcommunity (BGP), ip address, ipv6 address, ip next-hop, and ipv6 next-hop. A 'Cancel' and 'Save' button are at the bottom right.

The Entry Editor - Set Actions interface shows a 'Description' field and a 'Permit' checkbox. Below are tabs for 'Match Conditions' and 'Set Actions'. Under 'Set Actions', there are 'Add', 'Edit', and 'Remove' buttons. A dropdown menu is open showing options: as-path prepend (BGP), metric, metric-type (OSPF), weight (BGP), community (BGP), extcommunity (BGP), comm-list (BGP), local preference (BGP), ip next-hop, and ipv6 next-hop. A 'Cancel' and 'Save' button are at the bottom right.



Route filter entries are processed in the order in which they appear in the grid. A match will apply the action (permit or deny) specified for the entry and processing will stop. If a filter is referenced and no match is found, the route is denied.

Access List: The ip as-path access-list allows filtering by BGP as-path. The as-path value can be specified as a regular expression (regex).

Community List: Allows filtering by community. In essence a community is a label which is attached to routes learned from that community. Then that community or label can be used to select which policy(s) should be applied to those routes.

BGP

The latest version of BGP (Border Gateway Protocol) is version 4. BGP-4 is one of the Exterior Gateway Protocols and de facto standard of Inter Domain routing protocol. BGP-4 is described in RFC1771, A Border Gateway Protocol 4 (BGP-4). BGP is a distance vector routing protocol, and the AS-Path framework provides distance vector metric and loop detection to BGP RFC1930.

BGP Editor

- **Enabled:** Click to enable/disable the policy. (Default: enabled).
- **Name:** Unique name of the policy.
- **Router-ID:** This sets the router-ID of the BGP process. The router-ID may be an IP address of the router, but need not be – it can be any arbitrary 32-



bit number. However it ***MUST*** be unique within the entire BGP domain to the BGP speaker: bad things will happen if multiple BGP speakers are configured with the same router-ID.

- **Cluster ID:** Specify the cluster ID, used if the BGP cluster has more than one route reflector.
- **ASN:** The AS (Autonomous System) number is one of the essential elements of BGP.
- **View Name:** Specify a view to exchange BGP routing information without adding to the kernel routing table.
- **Distance:** The Administrative Distance can be specified for each of External (EBGP), Internal (IBGP) and Local routes, respectively. Defaults of 20, 200 and 200 will apply for any unspecified distance if any distance is specified.
- **Maximum Paths:** Maximum Paths can be set greater than 1 to allow multipath routing. This setting limits the number of paths; resources will be allocated to the limit specified whether or not all paths are used. The first field sets a limit for both EBGP and IBGP. If desired, a different limit can be applied just to IBGP using the second field.
- **Multipath Relax:** Select "relax" to allow multi-path routing to different ASNs.
- **Timers Keepalive/Hold:** Keepalive interval is the time between keepalive messages sent to peers. Hold time is the timeout after the last keepalive message until the peer is declared dead. The Keepalive interval must be set in order to set the Hold time. All times are in seconds from 1 to 65535. Set to 0 or empty to disable (default).

Networks Associated with ASN or IPv6 Networks

Associated with ASN: To configure a BGP router, you need an AS number. An AS number is an identification of autonomous system. BGP protocol uses the AS number for detecting whether the BGP connection is internal one or external one. Use the IPv4 address and netmask or IPv6 address with a **CIDR notation** prefix length to define the address range.

Neighbor Options or IPv6 Neighbor Options: Creates a new neighbor identified by remote ASN and IP address.

- **Peer Group:** Optionally specify a peer group for this neighbor. You can **Bind** to an existing peer group or **Define** a new one. A neighbor will inherit the properties from the peer group to which it is bound. Properties specified in a neighbor will override inherited properties.
- **IP Address:** The IP address of the neighbor. Not specified if this is a peer group definition.
- **Port:** Specify port.
- **Remote ASN:** Enter the ASN of the remote AS. The AS (Autonomous System) number is one of the essential elements of BGP. BGP is a distance vector routing protocol, and the AS-Path framework provides distance vector metric and loop detection to BGP. RFC1930.
- **Weight:** Assign a weight to a neighbor connection.
- **Maximum Prefix:** Specify the maximum number of prefixes that a BGP routing process will accept from the specified peer.



- **Password:** Enable message digest5 (MD5) authentication on a TCP connection between BGP peers. The same password must be used on both peers.
- **Update Source:** Specify the IPv4 source address or interface name to use for the BGP session to this neighbor.
- **Default Originate:** Allow the local router to send the default route (0.0.0.0) to a neighbor for use as a default route. Optionally, a route map can be specified to conditionally inject the default route.
- **Don't Send Community:** Unless this option is selected, any defined communities attributes will be sent to the BGP neighbor.
- **eBGP Multihop:** Accept and attempt BGP connections to external peers residing on networks that are not directly connected. Mutually exclusive with TTL Security. Optionally specify Time To Live from 1 to 255 hops.
- **TTL Security:** Specify the number of hops to reach eBGP neighbors. Mutually exclusive with eBGP Multihop.
- **Next Hop Self:** Configure the router as the next hop for a BGP-speaking neighbor or peer group if it is learned via eBGP. Select **All** to also apply this setting to routes learned via iBGP.
- **Local AS Number:** Enter the AS Number used locally as this neighbor's prefix. It is prepended to the received AS_PATH when receiving routing updates from the peer, and prepended to the outgoing AS_PATH when transmitting local routes to the peer. Check **No Prepend** to not prepend the local AS Number to either the received or outgoing AS_PATH. Check **Replace AS** to prepend the local AS Number to just the outgoing AS_PATH.
- **Distribute-list In/Out:** Specify a distribute-list for the peer in either or both directions. Lists are chosen from the collection of access lists and prefix lists defined in Route Filters, Common tab. Access list and prefix list names are prepended with 'al' and 'pl', respectively.
- **Filter-list In/Out:** Filter this neighbor's incoming and/or outgoing advertisements according to the specified as-path access list(s). Lists are chosen from the collection of as-path access lists defined in Route Filters, BGP tab.
- **Prefix-list In/Out:** Filter this neighbor's incoming and/or outgoing advertisements according to the specified prefix list(s). Lists are chosen from the collection of prefix lists defined in Route Filters, Common tab.
- **Route Map In/Out:** Apply a route map to incoming and/or outgoing routes. Maps are chosen from the collection of route maps defined in Route Filters, Common tab.
- **Route Reflector Client:** Configures the router as a BGP route reflector and configures the neighbor as its client.
- **Capability Negotiation:** Configure capability negotiation with the remote peer. Select **Strict** to completely match capabilities. Select **Disable** to suppress sending a negotiation message to peers that are not configured as IPv4 unicast. Select **Override** to ignore the remote peer's capability value and use the local value instead.
- **Soft Reconfiguration:** Configure the router to store updates.
- **Advertisement Interval:** Configure the interval for BGP routing updates, in seconds from 0 to 600.
- **Timers Keepalive/Hold:** **Keepalive interval** is the time between keepalive messages sent to peers. **Hold time** is the timeout after the last keepalive message until the peer is declared dead. The **Keepalive interval** must be set in order to set the **Hold time**. All times are in seconds from 1 to 65535. Set to 0 or empty to disable (default).

Redistribute Routes: Redistribute routes of the specified protocol or kind into BGP, with the metric type and metric set if specified, filtering the routes using the given route map if specified. Redistributed routes may also be filtered with distribute lists.

- **Type:** The type is the source of the route. Select from: Main, Connected, Static, RIP, and OSPF.
- **Metric:** Numerical priority of the route.
- **Route Map:** Route maps provide a means to filter and/or apply actions to routes, allowing policies to be applied to routes.



OSPF

OSPF (Open Shortest Path First) version 2 is a routing protocol described in RFC2328, OSPF Version 2. OSPF is an IGP (Interior Gateway Protocol). Compared with RIP, OSPF can provide more scalable network support and faster convergence times. OSPF is widely used in large networks such as ISP (Internet Service Provider) backbone and enterprise networks. Click **Add** to add an OSPF router.

General

- **Enable:** Enable and disable the routing protocol policy.
- **Router ID:** OSPF routers are identified by a unique ID which must be a dotted quad (like an IP address). This ID MUST be unique within the entire OSPF domain – errors will happen if multiple OSPF speakers are configured with the same router-ID.
- **ABR Type:** The OSPF standard does not allow an ABR to consider routes through connected non-backbone areas. **Relaxed** (default) relaxes this restriction and will consider routes through non-backbone areas if the backbone area is down. **Standard** respects the OSPF standard regardless if the backbone area is down. **Shortcut** will always route through the best path even if it does not go through the backbone area. When this is set, shortcut can be enabled/disabled on a per area basis.
- **Flags:** RFC 1583 Compatibility uses the predecessor standard RFC 1583 path preference algorithm. This typically is NOT set. Opaque capability enables forwarding Opaque LSA extensions described in RFC 5250.
- **Max Metric:** Set this router to broadcast max (infinite-distance) metric. Essentially broadcasting that this router is unreachable.
- **Passive Interface Default:** By default, any interface that controls a defined OSPF network will send link-state advertisements. Set Passive Interface Default to allow only interfaces configured under Interfaces to send link-state advertisements.
- **Refresh Timer:** Sets the OSPF LSA refresh timer. Default is 10 seconds.
- **Reference Bandwidth (Mb/s):** Sets the reference bandwidth for cost calculations. Link cost will automatically scale in reference to this bandwidth unless explicitly overridden. The default is 100 Mb/s equal to cost of 1. Note: this setting MUST be consistent across routers in the OSPF domain.
- **SPF Timers:** Sets the shortest path first algorithm adaptive timers in milliseconds. Modifying these values allows you to manage CPU usage when calculating SPF. Delay sets the initial delay. SPF calculations will always be performed at least this many milliseconds apart. Consecutive SPF calculations will always be separated by at least the Hold Time up to the Max Hold Time increasing by Max Hold Time for each consecutive calculation.

Interfaces

- **Device:** Select device interface.
- **Options:** Set interface options. **Passive** means no Hellos will be transmitted out this interface. **MTU Ignore** disables MTU mismatch detection.
- **Network Type:** Set the network type for this interface.
- **Authentication:** Set OSPF interface authentication. **Key** sets the OSPF authentication key to a simple password. After setting authentication key, all OSPF packets are authenticated. The authentication key has a maximum length of eight characters if using plain text authentication and sixteen characters if using message-digest authentication. **Key ID** enables message-digest authentication. Leave this blank to enable plain text authentication. The Key ID identifies the secret key used to create the message digest. This ID is



part of the protocol and must be consistent across routers on a link.

- **Cost:** OSPF metric for this interface.
- **Transmit Delay:** Link state transmit delay.
- **Priority:** The router with the highest priority will be more eligible to become Designated Router. Setting this to 0 disables this router from participating in DR elections.
- **Intervals:** Set hello intervals. **Hello** sets the number of seconds for the Hello Interval timer value. Setting this value, Hello packets will be sent every timer value seconds. This value must be the same for all routers in the area. The default value is 10 seconds. **Dead** sets the number of seconds for the Router Dead Interval timer value used for Wait Timer and Inactivity Timer. This value must be the same for all routers attached an area. The default value is 40 seconds. **Retransmit** sets the number of seconds between retransmitting lost link state advertisements.
- **Sub-second Hellos:** Enable sub-second Hellos and set the number of Hellos per second. When set, Dead Interval is set to one second.

Areas

- **Area:** Areas are identified by a unique ID which may be a 32-bit unsigned integer or a dotted quad (like an IP address).
- **Default Cost:** Set the cost of default-summary LSAs announced to stubby areas.
- **Options:** Set options for this area. **Stub** indicates that this area is a stub and no area router will propagate routes external to OSPF and AS-External LSAs (Type-5s) or ASBR-Summary LSAs (Type-4) will be propagated into the area. Only Network-Summary (Type-3) and default-route summary advertisements will be propagated. **Not-So-Stubby** indicates this area is Not-So-Stubby or NSSA. This is similar to a stubby area except external routes are propagated as Type-7 LSAs. NSSA Type-7 NSSAs can optionally be configured to be translated to Type-5 LSAs with the **NSSA Translate** option set. **No Summary** Prevents ABR from injecting inter-area summaries into the specified stub or Not-So-Stubby area. Default routes will be injected as a type 3 summary LSA.
- **NSSA Type 7-to-5 Translation:** Method of translating Type-7 LSAs to Type-5 when propagating external routes. **Via Election** indicates this router is an NSSA Border Router but other border routers exist in the topology. It will perform Type-7 to Type-5 translation unless another border router has Always set or is set to Via Election and has a higher router-id. **Always** indicates this is an NSSA Border Router and must always perform Type-7 to Type-5 LSA translations. **Never** indicates that this router must never perform Type-7 to Type-5 LSA translations.
- **Shortcut:** Enable or disable shortcuts through non-backbone areas. **Default** will shortcut only if the backbone link is down. Requires that **ABR Type** be set to **Shortcut**.
- **Access-List Filter:** Filter Type-3 summary LSAs to/from area using access lists. This is only applicable on ABR.
- **Prefix-List Filter:** Filter Type-3 summary LSAs to/from area using prefix lists. This is only applicable on ABR.



Redistribute

- **Default Originate:** Enable broadcasting default route. **Always** will cause the default route (0.0.0.0/0) to be broadcast even if it is not in the routing table. **Metric** specifies the metric of the default route. **Metric Type** is the OSPF metric type (default Type-2). **Route Map** specifies an optional route map to filter routes.
- **Default Metric:** Specify the default metric for routes redistributed to OSPF. This can be overridden under the **Redistribute** configuration.
- **Default Distance:** Sets the default administrative distance for **intra-area**, **inter-area** and **external** routes. Specific distances can be set under **Distances**. The default is 110.
- **Distances:** Specify administrative distances for **intra-area**, **inter-area**, or **external** routes. This overrides the value set in **Default Distance**.

The 'Redistribute Options' window shows fields for 'Default Originate' (checkbox), 'Default Metric' (text box), 'Default Distance' (text box with value 110), and 'Distances' (tabs for External, Inter-Area, Intra-Area). There are also fields for 'Metric Type' and 'Route Map'.

RIP

RIP (Routing Information Protocol) is a widely deployed interior gateway protocol. RIP is a distance-vector protocol based on the Bellman-Ford algorithms. As a distance-vector protocol, RIP sends updates from one router to its neighbors periodically, allowing the convergence to a known topology. In each update, the distance to any given network will be broadcast to its neighboring router. The router supports RIP version 2 as described in RFC2453 and RIP version 1 as described in RFC1058.

RIP Editor

- **Name:** Unique name of the policy.
- **Metric:** RIP metric is a value for distance for the network. Usually RIP increments the metric when the network information is received. The metric for redistributed routes is set to 1.
- **Protocol Version:** RIP can be configured to send either version 1 or version 2 packets. The default is to send RIPv2 while accepting both RIPv1 and RIPv2 (and replying with packets of the appropriate version for REQUESTS / triggered updates).
- **Password:** RIPv2 allows packets to be authenticated via either an insecure plain text password, included with the packet, or a more secure MD5 based HMAC (keyed-Hashing for Message Authentication). RIPv1 cannot be authenticated at all, so when authentication is configured RIP will discard routing updates received via RIPv1 packets.
- **Plain text password:** Select to use a plain text password instead of an MD5 HMAC. WARNING: A plain text password is insecure.
- **Enabled:** Click to enable/disable the policy. (Default: enabled.)
- **Timers:** **Update** specifies the period at which the routing table is sent to all neighbors. Default is 30 seconds. **Timeout** specifies the length of time that the route is valid. Default is 180 seconds. **Garbage** specifies the garbage collection timer that triggers removal of the route from the routing table. Default is 120 seconds.

The 'RIP Editor' window contains fields for 'Name', 'Metric', 'Protocol Version' (dropdown), 'Password' (with 'Unmask Password' button), 'Plain text password' (checkbox), 'Enabled' (checkbox), and 'Timers' (Update, Timeout, Garbage). Below are 'Offset list in' and 'Offset list out' sections, each with 'Access list' (dropdown), 'Offset' (text box), and 'Device' (dropdown).



- **Offset list in:** Offset-list adds the specified offset to the incoming and outgoing metric for routes matched by the specified access-list. If the offset is 0, no action is taken.
- **Offset list out:** Offset-list adds the specified offset to the incoming and outgoing metric for routes matched by the specified access-list. If the offset is 0, no action is taken.

Device:	<input type="text"/>	
Send version:	<input type="text"/>	
Receive version:	<input type="text"/>	
Passive:	<input type="checkbox"/>	
No split horizon:	<input type="checkbox"/>	
Distribute Access-list In/Out:	<input type="text" value="In"/>	<input type="text" value="Out"/>
Distribute Prefix-list In/Out:	<input type="text" value="In"/>	<input type="text" value="Out"/>

Networks: Set the RIP-enabled interfaces by network. RIP is enabled on the interfaces that have addresses within the network range.

Interfaces: Enable RIP on a specific interface. Useful if the interface's IP addresses are dynamic.

- **Device:** Select network interface device.
- **Send version:** Select the RIP version that will be sent on this interface, overriding the global setting. Version can be 1 or 2, or 0 to select both.
- **Receive version:** Select the RIP version that will be accepted on this interface, overriding the global setting. Version can be 1 or 2, or 0 to select both.
- **Passive:** Select passive mode for the interface. In passive mode, RIP routing updates are accepted by, but not sent out of, the interface.
- **No split horizon:** Disable the split horizon mechanism. Enabling prevents RIP from advertising routes over the interface on which they were learned.
- **Distribute Access-list In/Out:** Specify access-lists that filter the incoming and outgoing distribution of RIP routes.
- **Distribute Prefix-list In/Out:** Specify prefix-lists that filter the incoming and outgoing distribution of RIP routes.

Neighbors: When a neighbor doesn't understand multicast, this command is used to specify neighbors. In some cases, not all routers will be able to understand multicasting, where packets are sent to a network or a group of addresses. In a situation where a neighbor cannot process multicast packets, it is necessary to establish a direct link between routers. The neighbor command allows the network administrator to specify a router as a RIP neighbor. The no neighbor a.b.c.d command will disable the RIP neighbor. Assign a neighbor by inputting an IP address.

Redistribute Routes: Redistribute routes of the specified protocol or kind into RIP, with the metric type and metric set (if specified), filtering the routes using the given route map (if specified). Redistributed routes may also be filtered with distribute lists.

- **Type:** The type is the source of the route. Select from: Main, Connected, Static, OSPF, BGP.
- **Metric:** RIP metric is a value for distance for the network. Usually RIP increments the metric when the network information is received. The metric for redistributed routes is set to 1.
- **Route Map:** Route maps provide a means to filter and/or apply actions to routes, allowing policies to be applied to routes.

RIPng

RIPng (RIP next generation) extends RIPv2 to support IPv6. See [RIPng on Wikipedia](#) and [RFC 2080](#) for details.

RIPng Editor

- **Name:** Unique name of the policy.



- **Metric:** RIPng metric is a value for distance for the network. Usually the RIP service increments the metric when the network information is received. The metric for redistributed routes is set to 1.
- **Enabled:** Click to enable/disable the policy. (Default: enabled.)

Networks: Set the RIPng-enabled interfaces by network using IPv6 addresses. RIPng is enabled on the interfaces that have addresses within the network range.

Routes: Set RIPng static routing announcement of specified network address.

Redistribute Routes: Redistribute routes of the specified protocol or kind into RIPng, with the metric type and metric set if specified, filtering the routes using the given route-map if specified.

- **Type:** The type is the source of the route. Select from: Main, Connected, Static, OSPF, BGP.
- **Metric:** RIPng metric is a value for distance for the network. Usually the RIP service increments the metric when the network information is received. The metric for redistributed routes is set to 1.
- **Route Map:** Route maps provide a means to filter and/or apply actions to routes, allowing policies to be applied to routes.

QoS

When QoS (Quality of Service, also known as “Traffic Shaping”) is enabled, the router will control the flow of Internet traffic according to the user-defined rules. In other words, Traffic Shaping improves performance by allowing the user to prioritize applications.

Enable QoS: Click on this box to open options for controlling Internet traffic. You can assign maximum Upload Speed and Download Speed values and define your own Traffic Shaping rules.

WAN Profile Speeds

Upload Speed and Download Speed: Setting the Upload Speed and Download Speed is required to control traffic flow accurately. Adjust the sliding bar to restrict the maximum upload and/or download speed for the Internet source(s) you are using. For example, you might restrict the upload speed to prioritize available bandwidth for download or to reduce overall bandwidth use in order to lower costs. It is recommended that you experiment with different values for your particular Internet connection for best results.

NOTE: Upload speed is the speed at which data can be transferred to your ISP. Download speed is the speed at which data can be transferred to you from your ISP. You can test your connection speeds with a service such as speedtest.net.

WAN Profile Speeds	
Edit	
Profile Name	Upload Bandwidth ↑
3G-only Modems	1300 Kb/s
WiFi as WAN	10000 Kb/s
LTE-only Modems	25000 Kb/s
LTE/3G Multi-mode Modems	25000 Kb/s
Modem-9cd858ae	25000 Kb/s
Modem-9d061f77	25000 Kb/s
Ethernet	40000 Kb/s



Queues

Queues and rules work in conjunction to prioritize bandwidth for the most critical operations. Multiple rules can be associated with one queue. Use rules to associate your more critical operations with queues that have higher bandwidth settings. For example, you

might have two queues, one for “critical” and one for “secondary” with critical having most of the bandwidth percentage. Use rules to associate your most important bandwidth needs (POS system, VoIP, etc.) with the critical queue. Restrict the bandwidth available for less important functions with the secondary queue.

Assign percentages of both upload and download bandwidth to each queue. If you assign 80% download bandwidth to the first queue, the next queue will be forced to be 20% or less.

Click **Add** to create a new Traffic Shaping/QoS queue.

Queue Name: Choose a name that is meaningful to you.

DSCP (DiffServ) Tag: Differentiated Services Code Point (DSCP) is the successor to TOS (Type of Service). Use this field to ‘tag’ the traffic by putting the value in the DSCP header of each IP packet that flows through this queue. Use the value of ‘0’ to clear the existing DSCP value in the packet header.

DSCP Tagging is sometimes used so that other networking equipment, upstream or post-NAT, can do traffic shaping based on the DSCP Tags as opposed to IP addresses or ports.

This setting is optional.

Upload Bandwidth

Enable Upload QoS: (Default: Enabled.) Deselect if you want your rule to apply to download traffic only. Leave this selected to include upload restrictions with this queue.

Borrow Spare Bandwidth: (Default: Enabled.) When this is enabled, the interfaces/protocols associated with this rule will borrow unused bandwidth from other rules. Disabling borrowing will restrict the traffic to the specified bandwidth. Higher priority queues will be offered excess bandwidth first.

Upload Bandwidth: This is the percentage of the connected WAN upload bandwidth that will be reserved for the specified traffic. The maximum value is adjusted to the remaining percentage after other rules receive their share.

Upload Priority: The priority value has two different effects on traffic. Higher priority traffic is handled before lower priority traffic, which can lead to shorter response times. Also, when spare bandwidth is available it is offered to higher priority queues first. Move the slider to select from the following options (Default: Normal):

- Lowest
- Lower
- Below Normal
- Normal

Queues				
<div> + Add ✎ Edit ✖ Remove </div>				
Queue Name	Upload Bandwidth	Upload Priority	Download Bandwidth	Download Priority
<input type="checkbox"/> test	0% (borrow)	Normal	0% (borrow)	Normal

Edit

Queue Name: Queue Name-Description

DSCP (DiffServ) Tag: Optional

Upload Bandwidth

Enable Upload QoS: ☒

Borrow Spare Bandwidth: ☒

Upload Bandwidth: 0 %

Upload Priority: Normal

Download Bandwidth

Enable Download: ☒

Borrow Spare Bandwidth: ☒

Download Bandwidth: 0 %

Download Priority: Normal

Cancel

Save



- Above Normal
- High
- Higher
- Highest

Click **Next** to continue to the next page.

Download Bandwidth

Enable Download QoS: (Default: Enabled.) Deselect if you want your rule to apply to upload traffic only. Leave this selected to include download restrictions with this queue.

Borrow Spare Bandwidth: (Default: Enabled.) When this is enabled, the interfaces/protocols associated with this rule will borrow unused bandwidth from other rules. Disabling borrowing will restrict the traffic to the specified bandwidth. Higher priority queues will be offered excess bandwidth first.

Download Bandwidth: This is the percentage of the connected WAN upload bandwidth that will be reserved for the specified traffic. The maximum value is adjusted to the remaining percentage after other queues receive their share.

Download Priority: The priority value has two different effects on traffic. Higher priority traffic is handled before lower priority traffic, which can lead to shorter response times. Also, when spare bandwidth is available it is offered to higher priority queues first. Move the slider to select from the following options (Default: Normal):

- Lowest
- Lower
- Below Normal
- Normal
- Above Normal
- High
- Higher
- Highest

Click **Finish** to save this queue.

Rules

A traffic shaping rule identifies a specific message flow and assigns that flow to one of the queues created above.

Click **Add** to create a new Traffic Shaping rule.

Traffic Shaping / QoS Rule Editor

The first page of the Traffic Shaping / QoS Rule Editor allows you enable/disable the rule, name the rule, specify a protocol for the rule, and select a queue to associate the rule with.

Rule Enabled: (Default: Enabled.) Deselect this to disable this rule. This can be useful for quickly changing configurations. If both upload QoS and download QoS are disabled then the rule will disable automatically.

Rule Name: Create a name for the rule that is meaningful to you.

Protocol: The protocol used by the messages: TCP/UDP, TCP, UDP, or ICMP. Select "Any" if your rule does not control a specific type of message that uses a specific protocol.

Queue Name: Select a queue to associate this rule with.

Click **Next** to continue to the next page.



Use ports and/or IP addresses to define the type(s) of traffic attached to this rule. Leaving any field blank will match all values; all fields are optional.

Source Port(s) and/or Destination Port(s): Enter a port number between 1 and 65535. To enter a single port number, input the number into the left box. To enter a range of ports, fill in both boxes separated by the colon. For example "80:90" would represent all ports between 80 and 90 including 80 and 90 themselves.

Source IP Address, Source Netmask, Destination IP Address, and Destination Netmask: Specify an IP address or range of IP addresses by combining an IP address with a netmask for either "source" or "destination" (or both). Source vs. destination is defined by traffic flow. Leave these blank to include all IP addresses (such as if your rule is defined by a particular port instead).

EXAMPLE: If you want to associate this rule with your guest LAN, you could input the IP address and netmask for the guest LAN here (leaving the last slot "0" to allow for any user attached to the guest network):

- Source IP Address: 192.168.10.0
- Source Netmask: 255.255.255.0

Application Set: Application sets can be defined in the Application Sets tab of the Firewall Configuration page. The application identification might not take place until multiple packets have already bypassed a rule. Application sets require an active license to exist on the device for them to function.

DSCP (DiffServ): Differentiated Services Code Point (DSCP) is the successor to TOS (Type of Service). Use this field to select traffic based on the DSCP header in each IP packet. This field is sometimes set by latency sensitive equipment such as VoIP phones. This setting is optional.

DSCP Negate: When checked this rule will match on any packet that does not match the DSCP field.

Click **Finish** to save this rule.

DNS SERVERS

DNS, or Domain Name System, is a naming system that translates between domain names (www.cradlepoint.com, for example) and Internet IP addresses (206.207.82.197). A DNS server acts as an Internet phone book, translating between names that make sense to people and the more complex numerical identifiers. The DNS page for the device has these distinct functions:

- **DNS Settings:** By default your router is set to automatically acquire DNS servers through your Internet provider (Automatic). DNS Settings allows you to specify DNS servers of your choosing instead (Static).
- **Split DNS:** Enable or disable the redirecting of specified domains to alternate DNS servers.



- **Dynamic DNS Configuration:** Allows you to host a server (Web, FTP, etc.) using a domain name that you have purchased (www.example.com) with your dynamically assigned IP address.
- **Known Hosts Configuration:** Allows you to map a name (printer, scanner, laptop, etc.) to an IP address of a device on the network.

DNS Settings

You have the option to choose specific DNS servers for your network instead of using the DNS servers assigned by your Internet provider. The default DNS servers are usually adequate. You may want to assign DNS servers if the default DNS servers are performing poorly, if you want WiFi clients to access DNS servers that you use for customized addressing, or if you have a local DNS server on your network.

Mode: Automatic or Static (default: Automatic). Switching to "Static" enables you to set specific DNS servers in the **Primary DNS** and **Secondary DNS** fields.

Primary DNS and Secondary DNS: If you choose to specify your DNS servers, then enter the IP addresses of the servers you want as your primary and secondary DNS servers in these fields. The DNS server settings will be pre-populated with public DNS server IP addresses. You can override the IP address with any other DNS server IP address of your choice. For example, Google Public DNS servers have the IP addresses 8.8.8.8 and 8.8.4.4 while 4.2.2.2 and 4.2.2.3 are servers from Level 3 Communications.

Force All DNS Requests To Router: Enabling this will redirect all DNS requests from LAN clients to the router's DNS server. This will allow the router even more control over IP addresses even when clients have their own DNS servers statically set.

Split DNS

Split DNS allows you create two zones for the same domain, one to be used by the internal network, the other used by the external network. Split DNS directs internal hosts to an internal domain name server for name resolution and external hosts are directed to an external domain name server for name resolution.

Primary Split DNS and Secondary Split DNS: If you choose to specify your DNS servers, then enter the IP addresses of the servers you want as your primary and secondary DNS servers in these fields. The Secondary DNS is optional.

Domain: Click **Add** to add desired domain for Split DNS.

Dynamic DNS Configuration

The Dynamic DNS feature allows you to host a server (Web, FTP, etc.) using a domain name that you have purchased (www.yourname.com) with your dynamically assigned IP address. Most broadband Internet Service Providers assign dynamic (changing) IP addresses. When you use a Dynamic DNS service provider, you can enter your host name to connect to your server, no matter what your IP address is.

- **Enable Dynamic DNS:** Enable this option only if you have purchased your own domain name and registered with a Dynamic DNS service provider.
- **Server Type.** Select a dynamic DNS service provider from the dropdown list:
 - DynDNS
 - DNS-O-Matic
 - ChangeIP



- **NO-IP**
- **Custom Server (DynDNS clone)**
- **Custom Server Address.** Only available if you select Custom Server from the Server Address dropdown list. Enter your custom DynDNS clone server address here. For example: www.mydyndns.org.
- **Use HTTPS:** Use the more secure HTTPS protocol. This is recommended, but can be disabled if not compatible with the server.
- **Host name:** Enter your host name, fully qualified. For example: myhost.mydomain.net.
- **User name:** Enter the user name or key provided by the dynamic DNS service provider. If the dynamic DNS provider supplies only a key, enter that key for both the **User name** and **Password** fields.
- **Password:** Enter the password or key provided by the dynamic DNS service provider.

The screenshot shows the 'Dynamic DNS Configuration' interface. It includes a checkbox for 'Enable Dynamic DNS', a 'Client Status' message indicating the service needs configuration, a 'Server Type' dropdown set to 'DynDNS', and a section for configuring the service with a provider. This section has checkboxes for 'Use HTTPS' and input fields for 'Host Name', 'User Name', and 'Password'. Below this is the 'Advanced Dynamic DNS Settings' section with input fields for 'Update period (hours)' (set to 576) and 'Override External IP' (set to 0.0.0.0). At the bottom are 'Reset' and 'Save' buttons.

Advanced Dynamic DNS Settings

Update period (hours): (Default: 576) The time between periodic updates to the dynamic DNS, if your dynamic IP address has not changed. The timeout period is entered in hours so valid values are from 1 to 8760.

Override External IP: The external IP is usually configured automatically during connection. However, in situations where the unit is within a private network behind a firewall or router, the network's external IP address will have to be manually configured in this field.

You may find out what your external IP address is by going to <http://myip.dnsomatic.com> in a web browser.

Known Hosts Configuration

The Known Hosts Configuration feature allows you to map a name (printer, scanner, laptop, etc.) to an IP address of a device on the network. This assigns a new hostname that can be used to conveniently identify a device within the network, such as an office printer.

Click **Add** to name a device in your network.

Fill in the following fields:

- **Hostname:** Choose a name that is meaningful to you. No spaces are allowed in this field.
- **IP address:** The address of the device within your network.

EXAMPLE: a personal laptop with IP address 192.168.0.164 could be assigned the name "MyLaptop."

Since the assigned name is mapped to an IP address, the device's IP address should not change. To ensure that the device keeps the same IP address, go to **NETWORKING > Local Networks > DHCP Server** and reserve the IP address for the device by selecting the device in the **Active Leases** list and clicking **Reserve**.

The screenshot shows the 'Known Hosts Configuration' interface. It has buttons for 'Add', 'Edit', and 'Remove'. Below is a table with columns: 'Hostname', 'IP Version', 'IPv6 Address', and 'IPv4 Address'. A single row is visible with 'sample.c...' in the Hostname column, 'ip4' in the IP Version column, and '1.2.3.4' in the IPv4 Address column.



WIFI AS WAN

WiFi as WAN uses an outside WiFi network as its Internet source. When WiFi as WAN is enabled, the router will find other WiFi networks that you can select and connect to. Unless a selected WiFi source is on an unprotected network, you will need to know its password or key.

To enable WiFi as WAN, first select the desired WiFi radio:

- WiFi Radio #1 (2.4 GHz)
- WiFi Radio #2 (5 GHz)

All Cradlepoint routers and some other routers use the same default IP address for the primary network: 192.168.0.1. If you attempt to set up WiFi as WAN and there is an "IP conflict," you need to change the IP address. The router is attempting to use the same IP address for both WAN and LAN, which is impossible. Go to **Network Settings > WiFi / Local Networks**. Select the network and click **Edit**. You can change the IP address under **IPv4 Settings**. For example, you might change 192.168.0.1 to 192.168.1.1.

Saved Profiles

This is a list of WiFi networks that have already been configured as WAN sources. The router will attempt to connect to any of these access points using the password you have configured. If more than one access point is in range, then the router will connect with the highest priority network.

Network: The name (SSID, or Service Set Identifier) that is broadcast by the access point.

BSSID: The numeric ID of the network (Basic Service Set Identifier). This parameter is required when trying to connect to a hidden network using WiFi as WAN. It is optional when connecting to a visible network. If it is set in a profile, both the SSID and BSSID must match to connect to an access point. If the BSSID is not set in a profile, then the router will connect to any access point that matches the given SSID.

Auth Mode: The type of encryption that is used by the network.

- None
- WEP Auto
- WEP Open
- WEP Shared
- WPA1 Personal
- WPA2 Personal
- WPA1 & WPA2 Personal

You have two options for adding network profiles:

- **Automatic** – Select a WiFi network in **Site Survey** and click **Import**
- **Manual** – Click on **Add** under **Saved Profiles** and input the required information.

Site Survey

This is a list of WiFi networks that the router can currently find, along with information about the network such as its mode and channel. Click "Refresh" if a WiFi

Network	BSSID	RSSI	Mode	Auth Mode	Channel
SSID1	00:11:22:33:44:55	-45	b/g	wpa2psk	1
SSID2	00:11:22:33:44:55	-42	b/g	wpa2psk	1
SSID3	00:11:22:33:44:55	-71	b/g	wpa2psk	11
SSID4	00:11:22:33:44:55	-48	b/g	wpa2psk	11
SSID5	00:11:22:33:44:55	-44	b/g	none	1
SSID6	00:11:22:33:44:55	-41	b/g	wpa2psk	1
SSID7	00:11:22:33:44:55	-43	b/g	wpa2psk	6
SSID8	00:11:22:33:44:55	-81	b/g	wpa2psk	1
SSID9	00:11:22:33:44:55	-79	b/g	wpa2psk	2
SSID10	00:11:22:33:44:55	-70	b/g	wpa2psk	11
SSID11	00:11:22:33:44:55	-70	b/g	wpa2psk	11



network you want to connect to is not listed. You can sort the list based on any of the fields by clicking on the field name.

If you import a network from **Site Survey**, most of the information about the network will already be completed. You need to input the password (if there is one) and then click submit to save the WiFi as WAN profile.

Wireless Scan Settings

Scan Interval: How often WiFi as WAN scans the environment for updates. (Default: 60 seconds. Range: 5–3600 seconds.)

Scan While Connected: Continue to scan for WiFi as WAN profile updates when connected. Each time a scan occurs the wireless communication of the router will be temporarily interrupted. Normally this should be disabled.

WAN AFFINITY

WAN Affinity rules allow you to manage traffic in your network so that particular bandwidth uses are associated with particular WAN sources. This allows you to prioritize bandwidth.

EXAMPLE: You could specify that your guest LAN is only associated with your Ethernet connection with no failover. Then if your Ethernet connection goes down and the embedded modem connects for failover for your primary LAN, your guest LAN will not take bandwidth from your primary LAN, saving you money.

Click **Add** to open the WAN Affinity Policy Editor and create a new WAN Affinity rule.

Name: Give a name for your rule that is meaningful to you.

DSCP (DiffServ): Differentiated Services Code Point is the successor to TOS (Type of Service). Use this field to select traffic based on the DSCP header in each IP packet. This field is sometimes set by latency sensitive equipment such as VoIP phones. If you know specific DSCP values, you can input one here.

DSCP Negate: When checked this rule will match on any packet that does NOT match the DSCP field.

Protocol: Select from the dropdown list to specify the protocol for a particular data use. Otherwise, leave "Any" selected.

- Any
- ICMP

Name	Source	Destination	Protocol	Failover	WAN Device(s)
test	any	any	TCP	true	ethernet-wan



- TCP
- UDP
- GRE
- ESP
- SCTP

Source IP Address, Source Netmask, Destination IP Address, and Destination Netmask: Specify an IP address or range of IP addresses by combining an IP address with a netmask for either “source” or “destination” (or both). Source vs. destination is defined by traffic flow. Leave these blank to include all IP addresses (such as if your rule is defined by a particular port instead).

EXAMPLE: If you want to associate this rule with your guest LAN, you could input the IP address and netmask for the guest LAN here (leaving the last slot “0” to allow for any user attached to the guest network):

- **Source IP Address:** 192.168.10.0
- **Source Netmask:** 255.255.255.0

Failover: (Default: Selected.) When this is selected and traffic from the chosen WAN device for this rule is interrupted, the router will fail over to another available WAN device. Deselect this option to restrict this traffic to only the selected WAN interface.

When	Condition	Value
Port	Is	USB Port 1
Type	Is not	WiMax

- **When:**
 - **Port** – Select by the physical port on the router that you are plugging the modem into (e.g., “USB Port 2”).
 - **Manufacturer** – Select by the modem manufacturer (e.g., “Cradlepoint Inc.”).
 - **Model** – Set your rule according to the specific model of modem.
 - **Type** – Select by type of Internet source (Ethernet, LTE, Modem, Wireless as WAN, WiMAX).
 - **Serial Number** – Select a 3G or LTE modem by the serial number.
 - **MAC Address** – Select from a dropdown list of attached devices.
 - **Unique ID** – Select by ID. This is generated by the router and displayed when the device is connected to the router.
- **Condition:** Select “is,” “is not,” “starts with,” “contains,” or “ends with” to create your condition’s statement.
- **Value:** If the correct values are available, select from the dropdown list. You may need to manually input the value.

Load Balance Algorithm: Select the Load Balance Algorithm for this WAN Affinity rule from the following dropdown options:

- **Round-Robin:** Evenly distribute each session to the available WAN connections.
- **Rate:** Distribute load based on the current upload and download rates. A WAN device’s upload and download bandwidth values can be set in **CONNECTION MANAGER**.
- **Spillover:** This was the default algorithm in older (version 3) firmware. Load is always given to devices with the most available bandwidth. The estimated bandwidth rate is based on a combination of the upload and download configuration values and the observed capabilities of the device.
- **Data Usage:** This mode works in concert with the Data Usage feature. The router will make a best effort to keep data usage between interfaces at a similar percentage of the assigned data cap in the data usage rule for each interface, rather than distributing sessions based solely on bandwidth. For proper functioning you need to create data usage rules for each WAN device you will be load balancing. Make certain to select the “Use with Load Balancing” checkbox in the data usage rule editor.



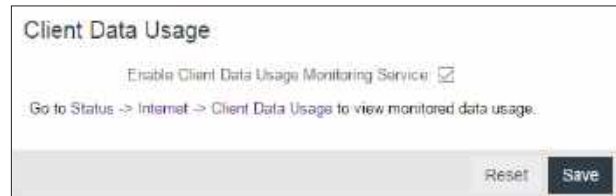
CLIENT DATA USAGE

Client Data Usage displays upload and download traffic for each LAN client. Click **Enable Client Data Usage Monitoring Service** to begin tracking this information. This data is not retained between router reboots.

For each client this shows: Name, IP address, MAC address, amount of data uploaded (MB), amount of data downloaded (MB), and when traffic was last sent or received for that client ("Last Traffic").

The names that are shown are received during a DHCP exchange. If a client disconnects and reconnects with a new IP address there will be an additional entry in this list.

Pressing **Reset Statistics** will restart all counters at 0.



NHRP

Next Hop Resolution Protocol is a protocol used to discover addresses of clients on Non-Broadcast Multiple Access (NBMA) networks. It is used to create next-generation VPN technologies that allow shortcutting between spokes. With NHRP, systems attached to an NBMA network dynamically learn the NBMA address of the other systems that are part of that network, allowing these systems to directly communicate without requiring an intermediate hop.



NOTE: NHRP Configuration requires a feature license not included with ECM Prime. Go to **SYSTEM > Administration > Feature Licenses** to enable this feature.

The NHRP Supported Interfaces table displays the following fields for each configured NHRP interface:

- **Name:** Name of the GRE tunnel that NHRP will use
- **Protocol Address/Prefix:** GRE tunnel endpoint mapping that NHRP associates with the NBMA server
- **NBMA Address:** NBMA server address the protocol address/prefix is associated with
- **Flags:**
 - **SD:** Shortcut-Destination
 - **N:** Non-Caching
 - **S:** Shortcut
 - **R:** Redirect

Click **Add** to create a new NHRP interface.

- **Enabled:** Enable or disable the interface.
- **Name:** Give the interface a unique name that matches the mGRE (multipoint GRE) tunnel. Select from configured GRE tunnels or input manually.
- **Peer Authentication:** Embeds the secret plaintext password to outgoing NHRP packets. Incoming NHRP packets on this interface are discarded unless this password is present. Max length: eight characters.



- **Holding Time:** Specifies the holding time for NHRP registration requests and resolution replies.
- **Shortcut-Destination:** Reply with authoritative answers on NHRP resolution requests destined to addresses in this interface (instead of forwarding the packets).
- **Non-Caching:** Disables caching of peer information from forwarded NHRP resolution reply packets.
- **Shortcut:** Enable creation of shortcut routes.
- **Redirect:** Enable sending of proprietary enterprise-style NHRP traffic indication packets.
- **Multicast:** Determines how multicast packets should be forwarded through NHRP interfaces.
 - **NHS:** Multicast packets will be forwarded to each statically configured next hop server. This is default and is typical for the configuration of an NHRP spoke.
 - **Dynamic:** Multicast packets will be forwarded to each connected peer. This is typically used for an NHRP hub.

You also have the option to create static mappings for this interface. Click **Add** in the table to open the static mapping editor.

- **Protocol Address:** Mapped endpoint to from protocol address to NBMA address
- **Protocol Prefix:** Optional prefix for protocol address
- **NBMA Address:** Destination mapped address from protocol address/prefix
- **Register:** This optional parameter specifies that a **Registration Request** should be sent to this peer on startup (displays flag **R** in the static mapping table if selected)
- **Proprietary OS:** This should be enabled if the statically mapped peer is running proprietary OS (displays flag **C** in the static mapping table if selected).

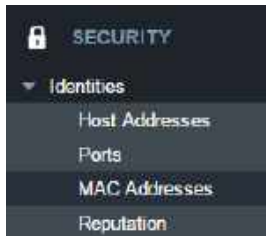


SECURITY



IDENTITIES

Identities are reusable groups of items that are added to filter policy rules. A match on any single item in the group will cause the rule to match. Identities are referenced in rules by their name. Choosing descriptive names like “NW Sales Team” or “Engineering” will aid in understanding existing rules and in choosing identities for new rules.



HOST ADDRESSES

A Host identity can contain IPv4, IPv6, and Fully Qualified Domain Name addresses. A single identity can contain a combination of IPv4 and IPv6 addresses. IPv4/6 addresses cannot be combined with FQDN addresses in the same identity.

IP addresses are entered using CIDR notation, e.g. 1.2.3.4/32 and 0123:4567::CDEF/128. FQDN addresses are entered with at least one dot separating a top-level domain from a root zone, e.g. cradlepoint.com.

To add a Host Address Identity, click **Add**.

PORTS

A port identity member can be entered as a single Start port number or as a port range by entering both a Start and End port number.

To add a Port Identity, click **Add**.

MAC ADDRESSES

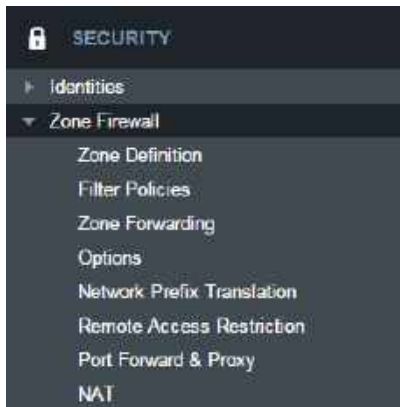
MAC addresses are entered in the form aa:bb:cc:dd:ee:ff.

To add a MAC Address Identity, click **Add**.

REPUTATION

A reputation file contains a list of IPv4 and IPv6 addresses and networks with CIDR notation, one address or network per line. Reputation identity allows you to upload a file from a reputation service provider (e.g., www.spamhaus.org/drop/). It also provides a way to maintain large lists of IPs that need firewall attributes applied to them. Files should be in the format where each line starts with an IP address or IP network and prefix length. All other lines are rejected. Currently we support adding 65535 IPs per reputation identity.

To add a Reputation Identity, click **Add**, then select and upload your file.



ZONE FIREWALL

ZONE DEFINITION

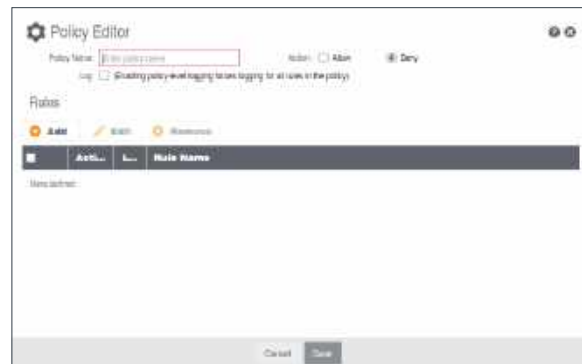
A Zone is a group of network interfaces. By default all interfaces within a zone are allowed to initialize network communication with each other, however any network traffic initialized outside of a zone to the interfaces within the zone will be denied.

To add a zone, click **Add**.

FILTER POLICIES

A Filter Policy is a one-way filter applied to initialized network traffic flowing from one zone to another. A Filter Policy needs to be assigned to a Forwarding for it to take effect. Filter Policies can either be Added, Edited, or Removed.

- **Default Allow All** is a preconfigured policy to allow all traffic initialized from one zone to flow to another zone. The state of the connection is tracked to allow responses to traverse the zones back to the source. LAN to WAN forwardings use this policy by default. The policy can be removed or altered to filter the traffic flow.
- **Default Deny All** is a preconfigured policy to deny all traffic initialized from one zone to be blocked to another zone. WAN to LAN forwardings use this policy by default. The policy can be removed or altered to filter the traffic flow.



Click **Add** to create a new filter policy, or select an existing policy and click Edit to open the filter policy editor.

- **Name:** Create a name meaningful to you.
- **Action:** Choose either **Allow** or **Deny**. This is the action taken by the firewall if none of the filter policy rules match the traffic being filtered.
- **Log:** When checked, every rule in the policy will log matching packets as if the rule's Log option had been selected.

Click **Add** to create a new rule for this filter policy, or select an existing rule and click Edit to open the Rule Editor.

- **Name:** Create a rule name meaningful to you.
- **Action:** Choose either Allow or Deny. This is the action taken by the firewall if the rule criteria match the traffic being filtered.
- **Log:** When checked, each packet matching this filter rule will be logged in the System Log.
- **IP Version:** Select the IP version to match.
- Enter match criteria under **Source**, **Destination**, **Protocols** and **Application Sets**.



- **Source:** Select defined identities or enter individual criteria for the appropriate **Host**, **Port** and **MAC** address columns to match the source of the traffic.
 - **Host:** Enter an IP address or select a host identity.
 - **Port:** Enter a port, port range, or select a port identity.
 - **MAC:** Enter a MAC address or select a MAC address identity.
- **Destination:** Select defined identities or enter individual criteria for the appropriate Host, Port and MAC address columns to match the destination of the traffic. See **Source** for the column definitions.
- **Protocols:** Select protocols (such as TCP, UDP, GRE, etc) from the defined list or enter a numeric code for other protocols to match traffic of that protocol.
- **Application Sets:** Select the defined application set or sets to match traffic related to those sets.

The screenshot shows the 'Rule Editor' window. It has a 'Rule Name' field at the top. Below it are tabs for 'Source', 'Destination', 'Protocols', and 'Application Sets'. The 'Source' tab is active, showing three columns: 'Host', 'Port', and 'MAC'. Each column has a 'New object' button. At the bottom, there are 'Cancel' and 'Save' buttons.

ZONE FORWARDING

Forwardings define how Filter Policies affect traffic flowing between zones in one direction. Simply configure the Source Zone, Destination Zone, and Filter Policy to define a Forwarding. Forwardings can be Added, Edited, Removed, or Toggled. Toggling a Forwarding will either enable or disable the Forwarding.

Source and Destination zones are chosen from the list of Zone Definitions. In addition, two special zones can be selected for forwarding endpoints:

- The **All** zone will match any traffic handled by the router and is used as an endpoint for IP Filter Rules migrated from previous firmware versions. User editable zones are preferred when adding new forwardings.
- The **Router** zone will match any traffic initialized from or directed to router services and can be used to filter router service traffic. An example of traffic initialized by a router service would be the ECM Management service. An example of traffic destined to a router service would be the SNMP service.

The screenshot shows a table titled 'Forwardings'. It has columns for 'Status', 'Source Zone', 'Destination Zone', and 'Filter Policy'. There are four rows of data, each with a checkbox in the 'Status' column.

Status	Source Zone	Destination Zone	Filter Policy
<input type="checkbox"/> Enable	WAN Zone	Primary LAN Zone	Default Deny All
<input type="checkbox"/> Enable	Primary LAN Zone	WiFi Zone	Default Deny All
<input type="checkbox"/> Enable	WAN Zone	Guest LAN Zone	Default Deny All
<input type="checkbox"/> Enable	Guest LAN Zone	WiFi Zone	Default Allow All

OPTIONS

Firewall Options

- **Anti-Spoof:** Anti-Spoof checks help protect against malicious users faking the source address in packets they transmit in order to either hide themselves or to impersonate someone else. Once the user has spoofed their address they can launch a network attack without revealing the true source of the attack or attempt to gain access to network services that are restricted to certain addresses.
- **Log Web Access:** Enable this option to create a syslog record of web (IP port 80) access. Each entry will contain the the IP address of the server and the client. Note that this may create a lot of log entries, especially on a busy network. Sending the system log to a syslog server is recommended.



Application Gateways

Enabling an application gateway makes pinholes thru the firewall. This may be required for some applications to function, or for an application to improve functionality or add features.

NOTE: Exercise caution in enabling application gateways as they impact the security of your network.

- **PPTP:** For virtual private network access using Point to Point Tunneling Protocol.
- **SIP:** For Voice over IP using Session Initiation Protocol.
- **TFTP:** Enables file transfer using Trivial File Transfer Protocol.
- **FTP:** To allow normal mode when using File Transfer Protocol. Not needed for passive mode.
- **IRC:** For Direct Client to Client (DCC) transfer when using Internet Relay Chat. You may wish to forward TCP port 113 for incoming identd (RFC 1413) requests.

DMZ (Demilitarized Zone)

A DMZ host is effectively not firewalled in the sense that any computer on the Internet may attempt to remotely access network services at the DMZ IP address. Typical uses involve running a public web server, supporting older games, or sharing files.

NOTE: As with port forwarding, caution should be used when enabling the DMZ feature as it can threaten the security of your network.

NETWORK PREFIX TRANSLATION

Network Prefix Translation is used in IPv6 networks to translate one IPv6 prefix to another. **IPv6 prefix translation** is an experimental specification (**RFC 6296**) trying to achieve address independence similar to NAT in IPv4. Unlike NAT, however, NPT is stateless and preserves the IPv6 principle that each device has a routable public address. But it still breaks any protocol embedding IPv6 addresses (e.g. IPsec) and is generally not recommended for use by the IETF. NPT can help to keep internal network ranges consistent across various IPv6 providers, but it cannot be used effectively in all situations.

The primary purpose for Cradlepoint's NPT implementation is for failover/failback and load balancing setups. LAN clients can potentially retain the original IPv6 lease information and may experience a more seamless transition when WAN connectivity changes than if not utilizing NPT.

Mode:

- **None** – No translation is performed
- **Load Balance Only** – (Default) Only translate networks when actively load balancing
- **First** – Use the first IPv6 prefix found
- **Static** – Always use a static IPv6 translation (input the prefix here)

Transitioning from short prefix to a longer prefix (such as from /48 to /64) is not without problems, as some of the LANs may lose IPv6 connectivity.

REMOTE ACCESS RESTRICTION

Add any IPv4 addresses that need access to remote administration to this list. Clicking **Add** will allow the addition of IP address and netmask pairs to the administration filter. **Edit** will allow you to change settings for the selected address. **Remove** will remove a selected entry.



PORT FORWARD & PROXY

A port forwarding rule allows traffic from the Internet to reach a computer on the inside of your network. For example, a port forwarding rule might be used to run a Web server.

NOTE: Exercise caution when adding new rules as they impact the security of your network.

Click **Add** to create a new port forwarding rule, or select an existing rule and click **Edit**.

Add/Edit Port Forwarding Rule

- **Name:** Name your rule.
- **Enabled:** Toggle whether your rule is enabled. Selected by default.
- **Use Port Range:** Changes the selection options to allow you to input a range of ports (if desired).
- **Internet Port(s):** The port number(s) as you want it defined on the Internet. Typically these will be the same as the local port numbers, but they do not have to be. These numbers will be mapped to the local port numbers.
- **Local Computer:** Select the IP address of an attached device from the dropdown menu, or manually input the IP address of a device.
- **Local Port(s):** The port number(s) that corresponds to the service (Web server, FTP, etc.) on a local computer or device. For example, you might input "80" in the Local Port(s) field to open a port for a Web server on a computer within your network. The Internet Port(s) field could then also be 80, or you could choose another port number that will be used across the Internet to access your Web server. If you choose a number other than 80 for the Internet Port, connections to that number will be mapped to 80 – and therefore the Web server – within your network.
- **Protocol:** Select from the following options in the dropdown menu:
 - TCP
 - UDP
 - TCP & UDP

Click **Save** to save your completed port forwarding rule.

Port Proxying Rules

A port proxying rule allows traffic from the local LAN to be redirected to a specific computer/IP address on the Internet.

Click **Add** to create a new port proxying rule, or select an existing rule and click **Edit**.

Add/Edit Port Proxying Rule

The image shows two tables side-by-side. The top table is titled 'Port Forwarding Rules' and has columns: Name, Internet Port(s), Forwarding to, Protocol, and Enable. It has buttons for Add, Edit, and Remove. The bottom table is titled 'Port Proxying Rules' and has columns: Name, Local Port(s), Proxying to, Protocol, and Enable. It also has buttons for Add, Edit, and Remove.

The image shows the 'Edit' dialog box for a Port Forwarding Rule. It contains fields for: Name (Name your rule...), Enabled (checked), Internet Port(s) (with a range selector), Local Computer (a dropdown menu), Local Port(s) (with a range selector), and Protocol (a dropdown menu set to TCP & UDP). There are Save and Cancel buttons at the bottom right.

The image shows the 'Edit' dialog box for a Port Proxying Rule. It contains fields for: Name (Name your rule...), Enabled (checked), Local Port(s) (with a range selector), Remote Computer (a dropdown menu), Remote Port(s) (with a range selector), and Protocol (a dropdown menu set to TCP & UDP). There are Save and Cancel buttons at the bottom right.



- **Name:** Name your rule.
- **Enabled:** Toggle whether your rule is enabled. Selected by default.
- **Use Port Range:** Check this box to create a rule which proxies a contiguous range of ports instead of a single port. The remote port(s) will require the same number of contiguous ports.
- **Local Port(s):** Specify the IP port(s) on the LAN to proxy to a remote computer.
- **Remote Computer:** Specify the remote computer to receive proxied traffic.
- **Remote Port(s):** Specify the IP port (first if a range) on the remote computer to receive proxy traffic.
- **Protocol:** Select the IP protocol traffic to proxy from the following options in the dropdown menu:
 - TCP
 - UDP
 - TCP & UDP

Click **Save** to save your completed port proxying rule.

NAT

Zone NAT is similar to Port Forwarding and provides that functionality by mapping ports available on interfaces associated with the Zone to ports available on local clients. Zone NAT also has the ability to map many types interfaces selectable via a Zone. For example, GRE interfaces can be used to port forward traffic from the GRE endpoints to local client thereby limiting exposure to the local LAN while still gaining the benefits of GRE.

Click **Add** to create a Zone NAT.

- **Source Zone Name:** The Zone created in Zone Firewall. Select the Zone to NAT.
- **Original Destination IP:** Specify which inbound traffic to this router will have the destination IP translated to an internal network.
- **Inbound Port(s):** Specify the IP port(s) on the inbound traffic to forward to a local computer.
- **Local Computer:** Specify the local computer to receive forwarded traffic.
- **Local Port(s):** Specify the IP port (first if a range) on the local computer to receive forwarded traffic.
- **Protocol:** Select the IP protocol traffic to forward.

Dynamic 1:1 NAT

Dynamic NAT allows translating the destination ip of incoming network traffic to a local network. All ports and protocols will be forwarded. Netmasks should generally match. If the local network range is larger than the incoming destination range then network traffic will begin using port overloading. One-to-One NAT can be accomplished by specifying a host address or a /32 cidr address.

Click **Add** to create a Dynamic 1:1 NAT.



CLOUD-BASED SECURITY

Select a third-party **Cloud Provider** from the dropdown list.

- Zscaler Internet Security
- Zscaler Secure Web Gateway
- Umbrella by OpenDNS

Zscaler

Zscaler is a cloud-based web filtering and security provider that offers several plan options. Depending on your Zscaler implementation, this could include:

- Global Cloud Platform
- Real-Time Reporting
- Behavioral Analysis
- URL Filtering
- Advanced Threat Protection
- Inline Anti-Virus & Anti-Spyware
- Web 2.0 Control
- Data Loss Prevention
- Bandwidth Management
- Web Access Control
- And more...

NOTE: Zscaler requires a feature license. Go to **SYSTEM > Feature Licenses** to enable this feature.

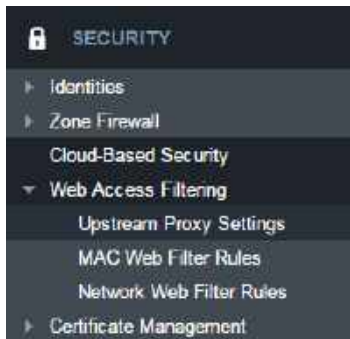
Enter your Zscaler account information to enable these settings. Input local network information (Network Address and Netmask) to assign your Zscaler implementation to one or more local network(s).

Umbrella by OpenDNS

Umbrella by OpenDNS is a cloud-based web filtering and security solution that protects you online by filtering websites. Go to <http://www.opendns.com/business-security> for information about Umbrella.

Enter your Umbrella account information in order to use these content filtering settings.

OpenDNS ISP Filter Bypass Algorithm: It is possible that your Internet Service Provider (ISP) uses the port that OpenDNS is configured to access, port 53, which will prevent OpenDNS filtering. If OpenDNS does not appear to be working correctly, enabling this will attempt to bypass those ports when using an OpenDNS content filtering level.



WEB ACCESS FILTERING

UPSTREAM PROXY SETTINGS

Upstream Proxy Settings

Enabled: Select whether the use of an Upstream Proxy server is enabled.

Proxy Address: The Proxy Address is the address the desired HTTP proxy is hosted at. Addresses can be input as host names or as IP addresses. If the proxy is unavailable HTTP traffic will fail to cross the network and a notification page will be shown.

HTTP Port: The port the HTTP Proxy is listening on.

HTTPS Port (Optional): The port for the proxy to forward HTTPS traffic to.

HTTPS is not transparently intercepted and must have the LAN clients configured to use the Cradlepoint router as a proxy for HTTPS to work properly.

MAC WEB FILTER RULES

MAC Address WebFilter Rules allow you to control access from a specific MAC address to external domains or websites. To add a rule, click **Add**.

- **MAC Address:** Enter MAC Address.
- **Filter Action:** Select Block or Allow.
- **Domain/URL/IP:** Enter the Domain Name or URL (address) of the website you wish to control access for, e.g. www.google.com. To make sure the full domain is blocked, enter the most inclusive domain (e.g. google.com will effectively block www.google.com as well as maps.google.com and images.google.com). Alternatively you can use an IP address, e.g. 8.8.8.8, or address range written in CIDR notation, e.g. 8.8.8.0/24.
- **Rule Priority:** Higher number rules overrule lower number rules.
- **Enabled:** A rule can be enabled or disabled by selecting or deselecting the checkbox.

Use **MAC Address WebFilter Defaults** together with **MAC Address WebFilter Rules** to control website access for specific MAC addresses. By default, each MAC address is allowed website access. Click **Add/Edit** to change this setting for a MAC address.

Input the **MAC Address** and **Default Action** you would like to apply to that MAC address.

Default Action: Select from the following dropdown options:

- Allow Access (default)
- Block Access

When a network is set to **Allow Access**, it will allow access to sites not specifically blocked in the WebFilter Rules. When a network is set to **Block Access**, it will block access to sites not specifically allowed in the WebFilter Rules.



NETWORK WEB FILTER RULES

Domain / URL filter rules allow you to control access from your network to any external domain or website. Rules are assigned to a specific LAN network and the highest priority rule will have precedence when there is a conflict. Addresses can be added by URL/Domain name or by IP address. IP address ranges can be filtered by using CIDR notation, e.g. 4.2.2.2/24.

Exceptions to existing rules can be created by adding another rule with higher priority. For example if access to maps.example.com is desired, but example.com is blocked with a priority of 50. The addition of an allow rule for maps.example.com with a priority of 49 or less will allow access.

When creating rules keep in mind that some sites use multiple domains so each domain may need a rule added to produce the desired behavior.

To add a Network Web Filter Rule, click **Add**.

Edit or Add Network Rule:

Enter the Domain Name or URL (address) of the website you wish to control access for, i.e. **www.example.com**. To make sure the full domain is blocked, enter the most inclusive domain, i.e. **example.com** will effectively block **www.example.com** as well as **mail.example.com** and **images.example.com**. Alternatively you can use an IP address, i.e. **8.8.8.8** or address range written in CIDR notation, i.e. **8.8.8.0/24**.

Addresses that have an Allow action assigned will have access allowed while Addresses with a Block action assigned will be blocked.
When multiple rules conflict the rule with the highest priority is used.

Assigned Network:

Domain/URL/IP:

Filter Action:

Rule Priority:

Enabled: ☒

Default Network Filter Settings

When a network is set to Allow (Blacklist) it will allow access to those sites not blocked in the Filter Rules. Selecting Block (Whitelist) will only allow access to websites with an Allow action in the Filter rules, all other sites will be blocked.

Selecting to Filter URLs by IP Address will cause the router to perform a DNS lookup on URL entries and the IP addresses will be appended to the appropriate block/allow list. This can have side effect of being very strict and sites that are hosted across many domains may need every domain added the list for full functionality.

The settings can be changed by selecting a network and clicking the **Edit** button.

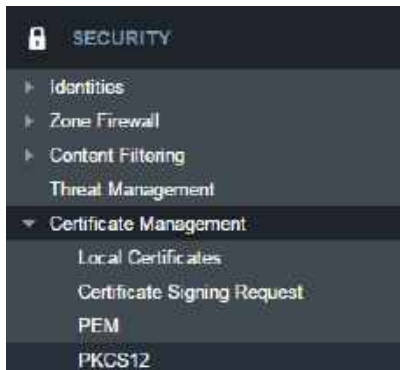
Edit or Add Default Filter Settings: Primary LAN

When a network is set to Allow (Blacklist) it will allow access to any site not blocked in the Filter Rules. Selecting Block (Whitelist) will only allow access to websites with an assigned Allow action in the Filter rules, all other sites will be blocked.

Selecting to Filter URLs by IP Address will cause the router to perform a DNS lookup on URL entries and the IP addresses will be appended to the appropriate block/allow list. This can have side effect of being very strict and sites that are hosted across many domains may need every domain added the list for full functionality.

Default Action:

Filter URLs by IP Address:



CERTIFICATE MANAGEMENT

LOCAL CERTIFICATES

This is a table of local certificates, including certificate details.

- **Name:** Friendly description of the certificate.
- **Location:** The certificate issuer's locality (city, town, etc.)
- **Organization Information:** The organization to which the certificate issuer belongs
- **Common Name:** Name used to match authentication credentials

To add a local certificate, click **Add**.

Remove a local certificate by selecting the certificate and clicking the **Remove** button.

Local Certificates:

[Add](#) [Remove](#)

<input type="checkbox"/>	Name	Location	Organization Information	Common Name
<input type="checkbox"/>	OP Secure CA	N/A,N/A,N/A	N/A,N/A	AccessMyLAN.com Root Authority
<input type="checkbox"/>	OP Zscaler (CA)	San Jose, California, US	Zscaler, zPath	tlv.prod.zpath.net
<input type="checkbox"/>	OP Zscaler	Boise, Idaho, US	Cradlepoint, Inc. N/A	cradlepoint.com.tlv.prod.zpath.net

Add New Certificate:

General Description

Name:

Issuer

Set as CA certificate: ☐

Sign with CA certificate: ☒

Certificate Name:

Add certificate attributes: ☒

Attribute:

Subject

Country Name:

State or Province Name:

Local Name:

Organization Name:

Org. Unit:

Common Name:

Email Address:

Validity

Days:

Public Key Algorithm

Type: ☐ RSA ☐ DSA

Digest: ☐ MD5 ☐ SHA-128 ☐ SHA-256

Bits: ☐ 1024 ☐ 2048



CERTIFICATE SIGNING REQUEST

Request a certificate signature from a remote CA. Using an established, third-party CA increases the likelihood that your certificate will be trusted by others (see [security issues](#) for self-signed certificates for more information).

Generate a **certificate signing request** (CSR) by selecting a certificate from the dropdown list (**Certificate Name** field) and downloading the CSR. The CSR can then be sent to a remote CA for a signature. Once the certificate has been signed, import the certificate in PEM or PKCS #12 format.

When you export the CSR, select a **Digest**, or **cryptographic hash function**. These are listed in order of increasing security. More security requires more router resources.

- **MD5**
- **SHA-128**
- **SHA-256**

The form is titled "Certificate Signing Request". It contains a "Certificate Name" dropdown menu with "None" selected. Below it, there are three radio buttons for "Digest": "MD5", "SHA-128", and "SHA-256". At the bottom right, there is a "Download CSR" button.

PEM

PEM is a container format for encoding data – in this case, X.509 certificates. PEM was originally designed for encoding email (PEM stands for **Privacy-enhanced Electronic Mail**), but it has never been widely used for that purpose. The format is much more common for encoding digital certificates.

The PEM format uses **Base64** and **DER** (Distinguished Encoding Rules) encoding.

To import, choose a certificate file in PEM format from your computer or local device and upload it to the router. Give the certificate a name that is meaningful to you.

To export, select a local certificate from the dropdown list and download it to your computer or local device in PEM format.

There are two forms. The top form is titled "Import PEM CA Certificate" and has a "Name" field, a "Certificate File" field with a "Select File" button, and an "Import/Upload Certificate" button. The bottom form is titled "Export PEM Format CA Certificates" and has a "Certificate Name" dropdown menu and an "Export/Download Certificate" button.

PKCS12

PKCS #12 is one of the **public-key cryptography standards**. PKCS #12 files bundle public and private certificate keys in an archive file format. The PKCS #12 container format is more secure than the PEM container format because it is protected by an encryption key.

To import, choose a certificate file in PKCS #12 format from your computer or local device and upload it to the router. Give the certificate a name that is meaningful to you. PKCS #12 files are protected by a passphrase – you must know this key to import the file.



To export, select a local certificate from the dropdown list and download it to your computer or local device in PKCS #12 format. When you export this file, you must create a passphrase to protect it. This key is required for future use of the file.

Import PKCS12 Format Certificates

Name:

Passphrase: Unmask Password

Certificate File: Select File

Import/Upload Certificate

Export PKCS12 Format Certificates

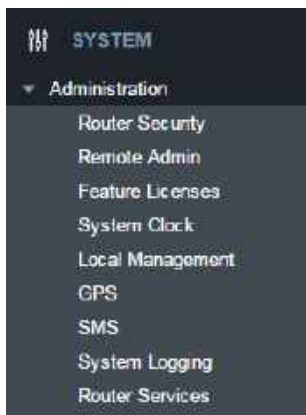
Certificate Name: None ▼

Passphrase: Unmask Password

Export/Download Certificate



SYSTEM



ADMINISTRATION

ROUTER SECURITY

When the router is configured to use the advanced security mode, several aspects of the routers configuration and networking functionality will be extended to support

high security environments. This includes support for multiple user accounts, increased password security and additional network spoofing filters. If you plan to use your router in a PCI DSS compliant environment this option is mandatory.

REMOTE ADMIN

Remote Management allows a user to enable incoming WAN pings or change settings for the router from the Internet using the router's Internet address.

Allow WAN pings – When enabled the functionality allows an external WAN client to ping the router.

Allow Remote Web Administration – When remote administration is enabled it allows access to these administration web pages from the Internet. With it disabled, you must be a client on the local network to access the administration website. For security, remote access is usually done via a non-standard http port. Additionally, encrypted connections can be required for an added level of security.

- **Require HTTPS Connection** – Requiring a secure (https) connection is recommended
- **HTTP Port:** Default – 8080. This option is disabled if you select “Require Secure Connection”
- **Secure HTTPS Port** – Default: 8443.

NOTE: You can restrict remote access to only specified IP addresses in **SECURITY > Zone Firewall > Remote Access Restriction**.



Allow Remote SSH Access – This will enable SSH access to the router from the Internet. It is only available when SSH access is enabled in the Local Management tab. Some carriers block the remote SSH access ports. If a ping to the router's WAN port does not work, it is unlikely that remote SSH access will work.

Remote Admin configuration page showing options for remote access:

- Allow WAN pager: ☐
- Allow Remote Web Administration: ☐ Remote Access can be restricted by IP address in the Firewall.
- Require HTTPS Connection: ☐
- HTTP Port: 8080
- Secure HTTPS Port: 8443
- Allow Remote SSH Access: ☐ Only applicable when SSH is enabled in the Local Management tab.

Buttons: Reset, Submit

FEATURE LICENSES

Some Cradlepoint features may require a license. These features are disabled by default. To obtain a feature license, contact your Cradlepoint sales representative.

Once you have obtained the feature license file, upload the file to enable the feature. A reboot is required after uploading a feature license file.

Feature Licenses page showing a table of licenses and an upload section:

Feature Name	Initial Duration	Days Remaining
Extended Enterprise License	1411	1411
CP Secure Threat Management	unlicensed	0
CP Secure Connect	unlicensed	0

Feature License File:

SYSTEM CLOCK

Enabling NTP will tell the router to get its system time from a remote server on the Internet. If you do not enable NTP then the router time will be based on when the router firmware was built, which is guaranteed to be wrong. Whenever the Internet connection is re-established and once a week thereafter the router will ask the server for the current time so it can correct itself.

You then have the option of selecting an NTP server and adjusting the NTP server port. Select the NTP server from the dropdown list. Any of the given NTP servers will be sufficient unless, for example, you need to synchronize your router's time with other devices in a network.

System Clock configuration page showing NTP settings:

- Enable NTP: ☒
- NTP server: pool.ntp.org
- NTP server port: 123
- Time Zone: (UTC -7) Mountain/Arizona
- Daylight Savings Time: ☒

Buttons: Reset, Save

- **Time Zone** – Select from a dropdown list. Setting your Time Zone is required to properly show time in your router log.
- **Daylight Savings Time** – Select this checkbox if your location observes daylight saving time.

LOCAL MANAGEMENT

- **Enable Internet Bounce Pages** – Bounce pages show up in your web browser when the router is not connected to the Internet. They inform you that you are not connected and try to explain why. If you disable bounce pages then you will just get the usual browser timeout. In the normal case when the router is connected to the Internet you don't see them at all.



- **Reboot Count** – Track number of router reboots.
- **Enable Login Banner** – Add the CLI banner to the router's login page.
- **Local Domain** – The local domain is used as the suffix for DNS entries of local hosts. This is tied to the hostnames of DHCP clients as DHCP_HOSTNAME.LOCAL_DOMAIN.
- **System Identifier** – This is a customizable identity that will be used in router reporting and alerting. The default value is the product name and the last three characters of the MAC address of the router.
- **Asset Identifier** – This is a customizable string that will be used in router reporting and alerting.
- **Require HTTPS Connection** – Check this box if you want to encrypt all router administration communication.
- **Secure HTTPS Port** – Enter the port number you want to use. The default is 443.
- **Enable SSH Server** – When the router's SSH server is enabled you may access the router's command line interface (CLI) using the standards-based SSH protocol. Use the username "admin" and the standard system password to log in.
- **SSH Server Port** – Default: 22.
- **Automatically Set System Identifier** – This will automatically set the system ID to the name of the first client that gets a DHCP lease. This feature cannot be used with email alerts but alerts can be sent to ECM.

GPS

If you have an attached device with GPS support, you can enable a graphical view of your router's location, which appears in **STATUS > GPS**. You can also enable GPS NMEA format sentence reporting to a server (LAN, WAN, or remote). This GPS reporting functionality requires a separate software client to listen/query for these sentences. SIM-based models with GPS support require that the SIM be inserted. Some carriers disable GPS support in otherwise supported modems. If you encounter issues with obtaining a fix, contact your carrier and ensure that GPS is supported.

GENERAL SETTINGS

Enable GPS – Enable support for querying GPS information from capable modems.

Enable GPS Lock LED – Use the USB LED to show if the GPS has received a fix. It will blink red if no fix is available or be solid green if a fix is available.

Enable GPS Keepalive – Poll the GPS every 10 seconds to keep hardware from sleeping.

TAIP Vehicle ID – Used for vehicle identification when using the TAIP protocol. Typically, a GPS fleet tracking application will use this identifier to identify TAIP messages as being sent from some unique vehicle.

GPS CLIENTS, SERVERS, AND SERIAL

GPS reporting requires separate software to listen/query for NMEA (or TAIP) sentences. The router must either act as a GPS server (which



separate clients can connect to) or as a GPS client (which reports to a server). Set up a GPS Server, GPS Client, or GPS Serial on the device by clicking on the **Add** button in the appropriate table.

- **GPS Clients** – Use this to set up a local client. This client will send periodic reports of GPS sentences to a remote server.
- **GPS Servers** – Use this to set up a local server. Clients can connect to and receive GPS sentences from this server.
- **GPS Serial** – Use this to set up a local serial. Clients can connect to and receive GPS sentences from this server.

Send to Client(s)

- **Enable this Server** – Enables a local server to which clients can connect and receive GPS sentences.
- **Server Name** – Your server's name should include only Aa-Zz, numerals, and '_'.
- **Enable GPS server on LAN** – Enables a server on the LAN side of the firewall which will periodically send GPS sentences to TCP connected clients.
- **Enable GPS server on WAN** – Enables a server on the WAN side of the firewall which will periodically send GPS sentences to TCP connected clients.
- **Port** – Choose a port between 1 and 65535.

Language Settings (NMEA)

- **Choose Language** – NMEA
- **Include System ID** – Include the router's "System ID" sentence with every data message. This can be useful when a single remote client or server is handling GPS position reports from multiple routers. This creates a custom GPS sentence with the System ID as part of the sentence and the checksum.
- **Prepend System ID** – Include the routers "System ID" sentence with every GPS message. This can be useful when a single remote client or server is handling GPS position reports from multiple routers. This simply prepends the system ID and a comma ahead of the GPS sentence.
- **Report NMEA GGA sentences** – Report GPS fix using NMEA GGA sentence format (if available).
- **Report NMEA RMC sentences** – Report GPS fix using NMEA RMC sentence format (if available).
- **Report NMEA VTG sentences** – Report GPS fix using NMEA VTG sentence format (if available).

Depending on your selections (and other possible factors), reporting may include proprietary sentences. For example, if you select Include System ID, the report will include proprietary sentences of the following format (in addition to the standard sentences):

```
$PCPTI,{System ID},{router timestamp},{GGA timestamp},{GGA checksum}*{checksum}
```

NOTE: "PCPTI" stands for Proprietary, CradlePoint, Identification (P-CPT-I).

Language Settings (TAIP)



The Trimble ASCII Interface Protocol (TAIP) was designed for vehicle tracking. For more information about TAIP, see these [instructions](#) from Trimble.

- **Choose Language** - TAIP
- **Enable Vehicle ID Reporting** - Include the vehicle ID # with every TAIP sentence. This can be useful when a single remote client or server is handling GPS position reports from multiple routers.
- **Enable TAIP sentence checksum reporting** - Include a checksum with each TAIP sentence.
- **Prepend a newline character to each TAIP sentence** - Prepends [CR][LF] characters to each TAIP sentence.
- **Report TAIP AL sentences** - Reports a GPS fix using TAIP AL sentence format.
- **Report TAIP CP sentences** - Reports a GPS fix using TAIP CP sentence format.
- **Report TAIP ID sentences** - Reports a GPS fix using TAIP ID sentence format.
- **Report TAIP LN sentences** - Reports a GPS fix using TAIP LN sentence format.
- **Report TAIP PV sentences** - Reports a GPS fix using TAIP PV sentence format.

Language Settings (Modem-Status) - A string containing GPS position as well as cellular modem status (RSRP, DBM, RSRQ, ECIO, etc). *NOTE: Modem-Status has no configurable options.*

Reporting Intervals

- **Default Time Interval (seconds)** - Set the interval in seconds between periodic GPS sentence reports. Use as long an interval as is practical for your application. The shorter the interval the more router resources and bandwidth will be used by the GPS subsystem. Too frequent reports may cause performance and/or availability issues. (Specifying a value of 0 seconds disables default time interval reporting.)
- **Stationary Time Interval (seconds)** - The time interval (seconds) while remaining stationary to pass before triggering reporting of GPS sentence(s). While the unit is stationary, the "Default Time Interval" is overridden and a report will be triggered every Stationary Time Interval. (Specifying a value of 0 seconds disables stationary time interval reporting.)
- **Stationary Event Threshold (seconds)** - When movement ceases for longer than the Stationary Event Threshold, a GPS report will be triggered. An additional GPS report will be triggered when movement resumes (i.e. when the Stationary Distance Threshold is exceeded). While stationary, additional GPS Reports can be triggered by the Default Time



Interval or Stationary Time Interval if desired. (Specifying a value of 0 seconds disables Stationary Event Threshold reporting.)

- **Stationary Distance Threshold (meters)** - The distance (meters) between two consecutive GPS fixes to discount, treating the unit as stationary to be used in conjunction with stationary time reporting. *Note:* Setting the Stationary Distance Threshold to values near the low end increases the possibility of incorrectly detecting the vehicle as moving due to GPS "jitter." (Specified in meters between 20 - 65535.)
- **Distance Interval (meters)** - The distance (meters) over ground between two GPS fixes, which when met will trigger reporting of GPS sentence(s). *Note:* Setting the Distance Interval to values near the lower end increases the possibility of incorrectly issuing a report due to GPS "jitter." (Specifying a value of 0 meters disables distance interval reporting.)

Send to Server(s)

- **Enable this client** - Enables periodic reporting of GPS sentences to a remote server. The router will buffer GPS sentences if errors are encountered or if the Internet connection goes down, and send the buffered sentences when the connection is restored.
- **Client name** - Your client's name should include only Aa-Zz, numerals, and '_'.
- **Server** - Remote server hostname or IP.
- **Port** - Remote server port.
- **Use UDP** - Using UDP instead of TCP reduces the load on the router and may save bandwidth. However, UDP does not provide any guarantee for delivery. The router will typically assume sentences have been received by the remote UDP server and will not buffer those sentences.
- **Number of stored sentences** - Set the maximum number of sentences that can be stored when the router does not have a connection to a server.
- **Specify Time Interval** - Restricts the GPS sentence reporting to a remote server to a specific time interval.
- **Start Time** - Reporting start time.
- **End Time** - Reporting end time.

NOTE: Language Settings and Reporting Intervals options are identical to those for Send to Client(s).

Send to Serial

- **Enable this client** - Enables periodic reporting of GPS sentences on the serial port. The serial port settings can be adjusted at **SYSTEM > Serial Redirector** under **Serial Adapter Configuration**.
- **Client name** - Your client's name should include only Aa-Zz, numerals, and '_'.
- **Port** - Remote server port.

NOTE: Language Settings and Reporting Intervals options are identical to those for Send to Client(s).



NMEA GGA, RMC, and VTG SENTENCES

Some devices report GPS information with multiple NMEA (National Marine Electronics Association) sentence formats: GGA, RMC, and VTG. See the examples below. For more examples and information about NMEA sentences, see the following websites:

- <http://aprs.gids.nl/nmea/>
- <http://www.gpsinformation.org/dale/nmea.htm#nmea>

GGA

\$GPGGA – Essential fix data including 3D location and accuracy information

Example: `$GPGGA,1753405,4916.450,N,12311.127,W,2,06,1.5,117.3,M,-26.574,M,6.0,0138*47`

Sample Data	Description
1753405	Time of fix – 17:34:05 UTC
4916.450,N	Latitude 49 deg. 16.450 min North
12311.127,W	Longitude 123 deg. 11.127 min Wes
2	Fix quality: 0 = fix not available; 1 = GPS fix; 2 = Differential GPS fix; 3 = PPS fix; 4 = Real Time Kinematic; 5 = Float RTK; 6 = estimated (dead reckoning); 7 = Manual input mode; 8 = Simulation mode
06	Number of satellites being tracked
1.5	Horizontal dilution of precision (HDOP) – relative accuracy of horizontal position
117.312,M	Altitude in meters above mean sea level
-26.574,M	Geoidal separation: height of mean sea level above WGS-84 earth ellipsoid (negative value means mean sea level is below ellipsoid)
6.0	Time in seconds since last update from differential reference stations
0138	Differential reference station ID number
*47	Checksum – used by program to check for transmission errors

RMC

\$GPRMC – Recommended minimum specific GPS/transit data

Example: `$GPRMC,144317.0,A,4337.190528,N,11612.329073,W,0.0,329.2,161015,0.0,E,A*16`

Sample Data	Description
144317	Time of fix – 14:43:17 UTC
A	Navigation receiver warning A = OK, V = warning
4337.190528,N	Latitude 43 deg. 37.190528 min North
11612.329073,W	Longitude 116 deg. 12.329073 min West
0.0	Speed over ground, knots
329.2	Course made good, true
161015	Date of fix – 16 October 2015
0.0,E	Magnetic variation: 0.0 degrees East
A*16	Mode Indicator



VTG

\$GPVTG – Vector track and speed over ground

Example: \$GPVTG,054.7,T,034.4,M,005.5,N,010.2,K

Sample Data	Description
054.7,T	Track, degrees relative to true north
034.4,M	Track, degrees relative to magnetic north
005.5,N	Ground speed, knots
010.2,K	Ground speed, kilometers per hour

SMS

SMS (Short Message Service, or text messaging) requires a cellular modem with an active data plan. SMS is not designed to be a full remote management feature: SMS allows you to connect to the router for a few simple queries or commands with a text messaging service (e.g., from your phone). A modem that does not have an active data connection may still be reachable by SMS because Internet traffic and SMS traffic operate on separate channels, so SMS can be used to bring an offline router back online.

SMS is enabled on the router by default. However, it only works if SMS is supported and enabled on the modem. Most modems have SMS enabled by default, but the carrier may charge a fee for each text message sent or received. Contact your carrier to review these fees and/or to enable an SMS plan.

Important notes about SMS:

- Messages are limited to 160 characters.
- SMS is not a guaranteed delivery protocol. The carriers do not guarantee that the SMS message will be delivered to the modem or that the modem's response will be delivered to the sender. This means an administrator might have to send messages multiple times before the desired action is performed.
- SMS is a slow protocol. It can take seconds or up to a few minutes for messages to be delivered.
- SMS messages are not encrypted; they are sent in full readable text over the network.

Enable SMS support – SMS support is enabled by default on the router. Deselect this to disable.

Password – By default, the password is the last eight characters of the router's MAC address (i.e., the Default Password on the product label). You can change this password to anything between 1 and 16 characters. It should be long enough to be useful for security but short enough to easily type into your phone (or other texting client).

White List – This list is blank by default, which means that the router will accept SMS messages from any phone number. Leaving this blank is insecure, so Cradlepoint recommends that you add phone numbers to this list. Once any numbers are listed, only those numbers have the ability to connect to the router via SMS.



SYSTEM LOGGING

Logging Level: Setting the log level controls which messages are stored or filtered out. A log level of **Debug** will record the most information while a log level of **Critical** will only record the most urgent messages. Each level includes all messages from all of the levels below it on the list (e.g. “Warning” includes all “Error” and “Critical” messages as well).

- **Debug**
- **Info**
- **Warning**
- **Error**
- **Critical**

Enable Logging to a Syslog Server: Enabling this option will send log messages to a specified Syslog server. After enabling, type the Hostname or IP address of the Syslog server (or select from the dropdown menu).

- **Syslog Server Address:** Select the Hostname or IP address from the dropdown menu, or type this in manually.
- **Include System ID:** This option will include the router’s “System ID” at the beginning of every log message. This is often useful when a single remote Syslog server is handling logs for several routers.
- **Include UTF8 Byte Order Mark:** The log message is sent using UTF-8 encoding. By default the router will attach the Unicode Byte Order Mark (BOM) to the Syslog message in compliance with the Syslog protocol, RFC5424. Some Syslog servers may not fully support RFC5424 and will treat the BOM as ASCII text, which will appear as garbled characters in the log. If this occurs, disable this option.

Log to attached USB stick: Only enable this option if instructed by a Cradlepoint support agent. This will write a very verbose log file to the root level of an attached USB stick. Please disable the feature before removing the USB stick, or you may lose some logging data.

Verbose modem logging: Only enable this option if instructed by a Cradlepoint support agent.

Create support log: This functionality allows for a quick collection of system logging. Create this log file when instructed by a Cradlepoint support agent.

ROUTER SERVICES

By default, router services (Enterprise Cloud Manager, NTP, etc.) connect to the router via the WAN. In some setups it makes sense to use the LAN instead. For example, if your router is used strictly for 3G/4G failover behind another router, you may not want to use 3G/4G data unnecessarily. Select **Use LAN Gateway** to set your router services to connect via the LAN.

LAN Gateway Address: Input the IP address of the LAN side connection. If this is a 3G/4G failover router operating behind another router, the LAN Gateway Address is the IP address of that other router.

DNS Server and **Secondary DNS Server:** The primary and secondary DNS server numbers match the static DNS values (set at **NETWORKING > DNS Servers**). You can leave the default values or set them manually here. (Changing these values also changes the static DNS values.)



ENTERPRISE CLOUD MANAGER

Cradlepoint **Enterprise Cloud Manager** (ECM) is a cloud-based management service for configuring, monitoring, and organizing your Cradlepoint routers. Key features include the following:

- Group based configuration management
- Health monitoring of router connectivity and data usage
- Remote management and control of routers
- Historical record keeping of device logs and status

Registering Your Router – Once you have signed up for ECM, click on the Register Router button to begin managing the router through ECM. Input your ECM Username and ECM Password and click Register. You have now registered the device with Enterprise Cloud Manager.

Suspending the ECM Client – Click on the Suspend Client button to stop communication between the device and ECM. Suspending the client will make it stop any current activity and go dormant. It will not attempt to contact the server while suspended. This is a temporary setting that will not survive a router reboot; to disable the client altogether use the Advanced Enterprise Cloud Manager Settings panel (below).

Enterprise Cloud Manager Settings (Advanced)

- **Enabled:** Enable the ECM client to contact the server. While this box is unchecked, the ECM client will never attempt to contact the server. (Default: Enabled)
- **Server Host:Port:** The DNS hostname and port number for your ECM server. (Default: stream.cradlepoint.com)
- **Session Retry Timer:** How long to wait, in seconds, before starting a new ECM session following a connection drop or connectivity failure. Note that this value is a starting point for an internal backoff timer that prevents superfluous retries during connectivity loss.
- **Unmanaged Checkin Timer:** How often, in seconds, the router checks with ECM to see if the router is remotely activated. Note that this value is a starting point for an internal backoff timer that reduces network usage over time.
- **Maximum Alerts Buffer:** The maximum number of alerts to buffer when offline.

DEVICE ALERTS

The Device Alerts submenu choice allows you to receive email notifications of specific system events. *YOU MUST ENABLE AN SMTP EMAIL SERVER TO RECEIVE ALERTS.*

Alerts can be included for the following:

- **Firmware Upgrade Available:** A firmware update is available for this device.
- **System Reboot Occurred:** This router has rebooted. This depends on NTP being enabled and available to report the correct time.
- **Unrecognized MAC Address:** Used with the MAC monitoring lists. An alert is sent when a new unrecognized MAC address is connected to the router.



- **WAN Device Status Change:** An attached WAN device has changed status. The possible statuses are plugged, unplugged, connected, and disconnected.
- **Configuration Change:** A change to the router configuration.
- **Login Success:** A successful login attempt has been detected.
- **Login Failure:** A failed login attempt has been detected.
- **Account Locked:** Account has been locked due to excessive failed login attempts.
- **IP Address Banned:** An IP address has been banned.
- **VPN Tunnel Goes Down:** Sends an alert when a VPN tunnel goes down.
- **Feature License Expiration:** Sends an alert when a feature license is about to expire.
- **Router SDK Application:** A router SDK Application may send an alert.
- **Full System Log:** The system log has filled. This alert contains the contents of the system log.
- **Recurring System Log:** The system log is sent periodically. This alert contains all of the system events since the last recurring alert. It can be scheduled for daily, weekly and monthly reports (**Frequency**). You also choose the **Time** you want the alert sent.

SMTP Mail Server

Since your router does not have its own email server, to receive alerts you must enable an SMTP server. This is possible through most email services (Gmail, Yahoo, etc.)

Each SMTP server will have different specifications for setup, so you have to look those up separately. The following is an example using Gmail:

- **Server Address:** smtp.gmail.com
- **Server Port:** 587 (for TLS, or Transport Layer Security port; the router does not support SSL).
- **Authentication Required:** For Gmail, mark this checkbox.
- **User Name:** Your full email address
- **Password:** Your Gmail password
- **From Address:** Your email address
- **To Address:** Your email address

Once you have filled in the information for the SMTP server, click on the “Verify SMTP Settings” button. You should receive a test email at your account.

Delivery Options (Advanced)

Email Subject Prefix: This optional string is prefixed to the alert subject. It can be customized to help you identify alerts from specific routers.

Retry Attempts: The number of attempts made to send an alert to the mail server. After the attempts are exhausted, the alert is discarded.

Retry Delay: The delay between retry attempts.



SERIAL REDIRECTOR

A single USB Serial device can be used to establish a serial link to a host port on the router. The USB Serial device can also be accessed by running “serial” from an SSH session.

Telnet to Serial Configuration

- **Enabled:** Enabling Telnet to Serial will start a Telnet server that passes its connection to the serial adapter. Enabling this service is not necessary when accessing serial through SSH.
- **LAN:** Enable serial redirector for LAN connections.
- **Authenticated LAN:** Enable serial redirector for Authenticated LAN connections. You must be logged into the router to use the redirector.
- **WAN:** Enable serial redirector for WAN connections.
- **Server Port:** Enter a port number for the redirector to use. (Default: 7218)

Telnet to Serial Configuration

Enabled: ☐

LAN: ☒

Authenticated LAN: ☒

WAN: ☐

Server Port:

GPIO CONFIGURATION

GPIOs allow you to monitor inputs and produce outputs with simple conditions.

Special note for '1 on power cable' and '5 on expander' GPIOs: If either one of these pins is set to Ignition Sensing, you must leave the other pin unused and disconnected.

Wiring reference:

GPIO 1 - pins 7, 8 on serial cable

GPIO 2 - pins 2, 3 on serial cable

GPIO 3 - pins 4, 6 on serial cable

GPIO Name: Name of this GPIO. For example 'East door' or 'Vehicle engine'. This will be used to form an alert string e.g., 'East door is closed.' or 'Vehicle engine is running.'

Low State Name: Name of the low state of this gpio. For example 'closed' or 'not running'. This will be used to form an alert string e.g., 'East door is closed.' or 'Vehicle engine is running.'

High State Name: Name of the high state of this gpio. For example 'closed' or 'not running'. This will be used to form an alert string e.g., 'East door is closed.' or 'Vehicle engine is running.'

Alert Trigger State: Configure which active state should trigger an alert.

Input Delay Duration: Input delay duration setting aims to minimize the number of false positives by waiting a set number of seconds and confirming that the GPIO value is still the same, before triggering configured action. It's important to note that there is an additional 200ms delay, even when this setting is at 0 seconds.

Action: Used to configure the Input and Output General Purpose I/O pins.

- **Default/Low:** In this mode the output pin is not used and is at 0V (ground potential).

GPIO Configuration

GPIO	GPIO Name	Enabled	Action	Alert Trigger State
<input type="checkbox"/> 1 on power cable (out)		Enabled	Low (default)	No alert
<input type="checkbox"/> 2 on power cable (in)		Disabled	Input sensing (default)	No alert
<input type="checkbox"/> 1 on expander (in/out)		Disabled	Input sensing (default)	No alert
<input type="checkbox"/> 2 on expander (out/in)		Disabled	Input sensing (default)	No alert
<input type="checkbox"/> 3 on expander (in/out)		Disabled	Input sensing (default)	No alert
<input type="checkbox"/> 4 on expander (in/out)		Disabled	Input sensing (default)	No alert
<input type="checkbox"/> 5 on expander (in)		Disabled	Input sensing (default)	No alert

Edit 1 on power cable

Enabled: ☒

Direction: out

GPIO Name:

Low State Name:

High State Name:

Alert Trigger State: No alert

Input Delay Duration: second(s)

Action: Low (default)



- **Set High/Router Running:** In these modes the output pin is logic low while the router is booting and transitions to logic high when the router is fully running. If the router is reset, the output returns to low until the router has fully rebooted.
- **Modem Connected:** In this mode the output pin is logic low until the modem has connected to the tower. If the connection drops, this output is set low until the connection is restored.

Hardware note: The output pin is an open collector/drain.

SNMP CONFIGURATION

SNMP, or Simple Network Management Protocol, is an Internet standard protocol for remote management. You might use this instead of Enterprise Cloud Manager if you want to remotely manage a set of routers that include both Cradlepoint and non-Cradlepoint products.

SNMP Configuration

- **Enable SNMP:** Selecting “Enable SNMP” will reveal the router’s SNMP configuration options.

Network Settings

- **Enable SNMP on LAN:** Enabling SNMP on LAN will make SNMP services available on the LAN networks provided by this router. SNMP will not be available on guest or virtual networks that do not have administrative access.
- **LAN port #:** Use the LAN port # field to configure the LAN port number you wish to access SNMP services on. (Default: 161)
- **Enable SNMP on WAN:** Enabling SNMP on WAN will make SNMP services available to the WAN interfaces of the router.
- **WAN port #:** Use the WAN port # field to configure which publicly accessible port you wish to make SNMP services available on. (Default: 161)
- **SNMP Version**
 - **SNMPv1:** SNMP version 1 is the most basic version of SNMP. SNMPv1 will configure the router to transmit with settings compatible with SNMP version 1 protocols.
 - **SNMPv2c:** SNMP version 2c has the same features as v1 with some additional commands. SNMPv2c will configure the router to use settings and data formatting compatible with SNMP version 2c.
 - **SNMPv3:** SNMP version 3 includes all prior features with security available. SNMPv3 is the most secure setting for SNMP. If you wish to configure traps then you must use SNMP version 3.

SNMP Configuration

Enable SNMP: ☐

Network Settings

Enable SNMP on LAN: ☐

LAN port #:

Enable SNMP on WAN: ☐

WAN port #:

SNMP Version:

SNMP v1 & v2c Settings

Get community string:

Set community string:

General Settings

Note: System information via SNMP is by default Read-Writeable. However, if the value is set here, that field will become Read-Only.

System Contact:

System Name:

System Location:

SNMP v1 & v2c Settings

- **Get community string:** The “Get community string” is used to read SNMP information from the router. This string is like a password that is transmitted in regular text with no protection.



- **Set community string:** The “Set community string” is used when writing SNMP settings to the router. This string is like a password. It is a good idea to make it different than the “Get community string.”

SNMPv3

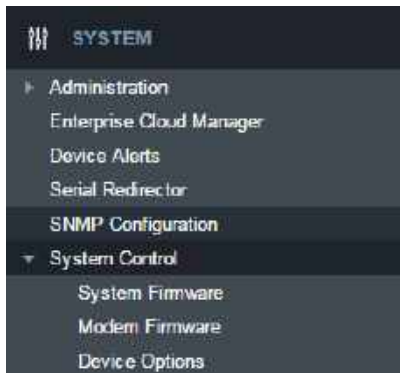
If you select SNMPv3, you have several additional configuration options for added security.

- **Authentication type:** Select the authentication and encryption type that will be used when connecting to the router from the following dropdown list. These settings must match the configuration used on any SNMP clients.
- **MD5 with no encryption**
- **SHA with no encryption**
- **MD5 with DES encryption**
- **SHA with DES encryption**
- **MD5 with AES encryption**
- **SHA with AES encryption**
- **Username:** Enter the Username configured on your SNMP host in the username field.
- **Password:** Enter the Password for your SNMP host in the password and verify password fields. This password must be at least eight characters long.
- **Enable SNMP traps:** Enabling traps will allow you to configure a destination server, community, and port for trap notifications. Trap notifications are returned to the server with SNMPv1.
- **Trap community string:** The trap notifications will be returned to the trap server using this SNMPv1 trap community name.
- **Address for trap server:** Enter the address of the host system that you want trap alerts sent to.
- **Trap server port #:** Enter the port number that the remote host will be listening for trap alerts on. (Default: 162)

General Settings

System information via SNMP is Read-Writable by default. However, if a value is set here, that field will become Read Only.

- **System Contact:** Input the email address of the system administrator.
- **System Name:** Input the router's hostname.
- **System Location:** Input the physical location of the router. This is simply a string for your own information.



SYSTEM CONTROL

SYSTEM FIRMWARE

This allows the administrator to load new firmware onto the router to add new features or fix defects. If you are happy with the operation of the router, you may not want to upgrade just because a new version is available. Check the firmware release notes (cradlepoint.com/firmware) for information to decide if you should upgrade.

Current Firmware Version:

Shows the number of the current firmware and the date it was updated.

Available Firmware Version:

If there is a new firmware version available, this will list



the version number. Click "Check Again" to have the router check for the newest firmware.

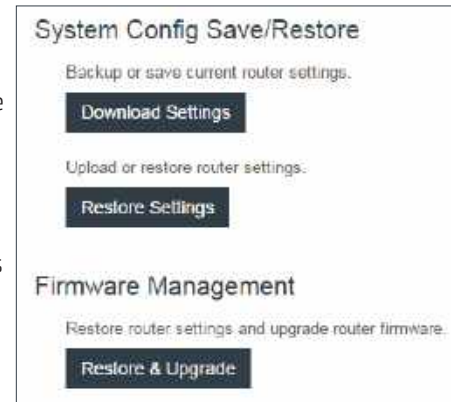
Automatic Firmware Check: Automatically check for new firmware updates once daily.

Manual Firmware Upload: Upload the router firmware from an attached computer. (Go to cradlepoint.com/firmware to download the firmware.)

System Config Save/Restore

Download Settings: Click on "Download Settings" to save your current settings to a file on a computer.

Restore Settings: Click on "Restore Settings" to restore your previous settings from a file on a computer.



Firmware Management

Load new firmware and restore your previous settings from a file on a computer without rebooting between steps.

MODEM FIRMWARE

This allows the administrator to load new firmware onto Cradlepoint modems attached to the router. Note that modem firmware is separate from router firmware. New modem firmware may be necessary to update the module due to carrier updates or defect resolution. If you are happy with the operation of the modem, you may not want to upgrade just because a new version is available. Please check the modem firmware release notes for information to decide if you should upgrade or not.

Most Cradlepoint modems contain a single firmware image that can be Checked, Updated or manually updated. With some modems (such as LPE), you have the ability to change the firmware to support a different carrier image. With other select modems (such as LP6), more than one modem firmware image may be locally stored within the device's memory.

You must first select the Cradlepoint modem you would like to update. Once selected, the appropriate modem firmware update options will display.



☒ Automatically check for new firmware

Modem Firmware Upgrade / Change Carrier

Select Modem: Internal LPE-VZ (INT1)

Carrier switching is supported on this modem.
To change carriers, select File to browse to an appropriate modem firmware package file.

Installed Firmware

Carrier	Current Package Version	Available Firmware Version	
VERIZON	05.05.16.02_VZW.005.013_010	Check for upgrade	Upgrade Check File

For modems supporting manual carrier switching (such as LPE), select **File** to browse to an appropriate, different modem firmware package file to load into the modem's memory.

Firmware updates can be performed on any firmware line item using the **Check/Upgrade** or **File** (manual) process.

The following actions are available to be configured:

☒ Automatically check for new firmware

Modem Firmware Upgrade / Change Carrier

Select Modem: MC480LPS (USB1)

The selected modem can support up to 4 firmware images. Use the grid below to check for and perform firmware upgrades.

Installed Firmware

Active	Carrier	Current Package Version	Available Firmware Version	
<input checked="" type="checkbox"/>	AT&T	02.08.02.00_ATT.002.009_0...	Up to date	Upgrade Check File
	Generic	02.08.02.00_GENERIC.002...	Up to date	Upgrade Check File
	Sprint	02.08.02.00_SP.002.008...	Up to date	Upgrade Check File
	Verizon	02.08.02.00_VERIZON.002...	Up to date	Upgrade Check File

- **Automatically check for new firmware:** Click the checkbox to indicate whether the system is to automatically check for available modem firmware updates. When enabled, the system checks once a day. This global setting applies to all modems connected to the router.
- **Select Modem:** Select the appropriate modem which you would like to update. Note that dual SIM devices are listed as a single modem.

In the Installed Firmware grid, you will see the following columns:

- **Active (Multi-firmware modems only):** Indicates which carrier package is currently active on the modem. *Note: You cannot select the active image. On multi-firmware modems, the carrier firmware is selected automatically.*
- **Carrier:** Displays the carrier supported by the modem firmware. For carriers not otherwise available, "Generic" will be displayed.
- **Current Package Version:** Displays the current firmware package version loaded on the modem.
- **Available Firmware Version:** Displays the firmware version available for upgrade or indicates status of the current firmware. If new firmware is available, the available upgrade version is displayed.
- **Upgrade:** Click this button to download the Available Firmware Version file and perform this over-the-air upgrade. If a connection error occurs, it is possible that HTTPS is blocked for the upgrade check. Enable Allow HTTP Firmware Check in **SYSTEM > System Control > System Firmware** to address this issue.
- **Check:** Click this button to refresh or update the Available Firmware Version status column.
- **File:** Click this button to manually upload a modem firmware file. Type the path/file or click Select Firmware File to browse to the local file location. Once entered, click Begin Firmware Upgrade. *Note: For modems which support manual carrier switching, find the appropriate modem firmware package file via ECM or the Cradlepoint portal.*



DEVICE OPTIONS

Reboot Options

- **Reboot the Device:** Manually restart the router.
- **Factory Reset Router:** Reset the router to its original settings. Once reset your SSID and admin password will match the sticker on the bottom of the router.
- **Device Console:** Access router's command line interface (CLI) console.

Scheduled Reboot

- **Scheduled Reboot:** Router will restart at user-specified time.
- **Enable Watchdog Reboot:** Router will restart when it determines an unrecoverable error condition has occurred.

DIAGNOSTICS

Ping Test

A simple test to check Internet connectivity. Type the Hostname or IP address of the computer you want to ping and click the 'Ping' button.

Speed Test

- **Tests Against Cradlepoint Server** - Up to ten speed tests are permitted against a Cradlepoint server.
- **WAN Device** - The WAN Device that is selected will have the test run on it. If no device is selected then the highest priority connected device will be used.
- **Custom Server** - Type the Hostname or IP address of the server to which you wish to perform a test. If left empty the test will be done to a Cradlepoint server.
- **Custom Port (Optional)** - The port to which the test is directed.
- **Max Duration** - The Max Duration is the Maximum amount of time for which the test should be run. The test may finish sooner if sufficient data is collected.
- **Data Limit** - The Data Limit is the limit of how much data will be transferred while measuring the connection speed; this should be limited to reduce the expense of a speed test. Setting the limit to 0 will cause the test to run until enough data is collected or the duration limit is met.
- **Test Type** - Select the type of test you would like to run. TCP Upload will test speed going to the server, TCP Download will test speed coming to the client, and UDP will measure the speed going to the server.



SETUP WIZARDS

ECM REGISTRATION

To register the router with Cradlepoint ECM you must first have an account. If you need to create an account you can signup at cradlepoint.com.

Once you've created an account, or if you already have one, you can enter your ECM username and password to register the router.

Enterprise Cloud Manager Registration

Register this router with the Cradlepoint Enterprise Cloud Manager (ECM) Service.

ECM Username:

ECM Password:

FIRST TIME SETUP

Administrator Password and Time Zone

Enter a password for the administrator who will have full access to the router's management interface.

You can use the default password on the back of your product, or you can create a custom Administrator Password.

Setting Your Administrator Password and Time Zone

To secure your router, please set and verify the administrator password below. Your default password is printed on the product label found on the back of your product. The administrator password allows you to modify all router settings.

This is separate from the WiFi security password (if applicable).

Administrator Password:

If you plan to use your router in a PCI DSS compliant environment, do not use this setting. Use the Administration > Router Security setting instead.

Selecting your Time Zone allows the router to keep the proper date and time for your location.

Time Zone:

Configuring Your Wireless Network

- **Wireless Network Name** - When you are browsing for available wireless networks, this is the name that will be broadcast from this router. This name is also referred to as the SSID. For security purposes, it is highly recommended you change the pre-configured wireless network name.
- **Enable Guest Network** - If the guest network is enabled, anyone can connect to the special guest network which allows limited connectivity to the Internet while preventing access to your local network.
- **Security Mode**
 - **Best (WPA2)**: Select this option if your wireless adapters support WPA2-only mode. This will connect to most new devices and is the most secure, but may not connect to older devices or some handheld devices such as a PSP.
 - **Good (WPA1 & WPA2)**: Select this option if your wireless adapters support WPA or WPA2. This is the most compatible with modern devices and PCs.
 - **Poor (WEP)**: Select this option if your wireless adapters only support WEP. This should only be used if a legacy device that only supports WEP will be connected to the router. WEP is insecure and obsolete and is only supported in the router for legacy reasons. The router cannot use 802.11n modes if WEP is enabled; router WiFi performance and range will be limited.
 - **None (OPEN)**: Select this option if you do not want to activate any security features.

Configuring Your Wireless Network

Your wireless network's name can be very personalized word or phrase. The name you select will identify your network when connecting to WiFi.

When you select Cradlepoint Guest Network, you will create a second public WiFi broadcast from your router, allowing guests to simply and easily join your connection.

Wireless Network Name:

Enable Guest Network: ☐

In order to protect your network from unauthorized users, it is highly recommended you choose the highest level of security that your attached devices will support.

Cradlepoint recommends the WPA2 security mode.

If you select an advanced security mode and are unable to connect to the router after saving your new settings, you can return your router to its original factory settings by pressing the Reset button found on the side of your router for ten seconds. This will restore your password to the last eight characters of your MAC address.

Security Mode:

WiFi Password:



- **WPA Password** - The WPA Password must be between 8 and 64 characters long. A combination of upper and lower case letters along with numbers and special characters is recommended to prevent hackers from gaining access to your network.

Configuring Your APN and Modem Authentication

If you are using a SIM-based modem (LTE/GSM/HSPA) with your Cradlepoint router you may need to configure the APN before it will properly connect to your carrier. Wireless carriers offer several APNs to choose with you can be instructed the appropriate one to use. You can use the default password on the back of your product, or you can create a custom Administrator Password.

NOTE: DO NOT USE THIS APN WIZARD if you have already configured an APN. Any specific modem settings will not be overwritten by this generic APN setup. Leave this setting as default and after finishing this Wizard go to the **CONNECTION MANAGER** page, select your modem, and edit the settings. The SIM PIN/APN tab has more available settings than are provided here.

Some modems require a username and password to be entered to authenticate with a carrier. Do not fill in the following fields unless you are sure your modem needs authentication.

- Authentication Protocol
- Username
- Password

Enable and Configure Failure Check

Failure check will test the connection to verify the WAN device is connected.

- **Idle Check Interval:** Set the number of seconds the router will wait between checks to see if the WAN is still available.
- **Failure Check:**
 - **Off:** Once the link is established the router takes no action to verify that it is still up.
 - **On:** Modems will be set to use the Passive DNS failure check type. Ethernet and WiFi as WAN connections will be set to use Active Ping.
- **Ping IP Address:** This IP address must be an address that can be reached through your WAN connection (modem/Ethernet). Some ISPs/Carriers block certain addresses, so choose an address that all of your WAN connections can use.

Summary

Review your settings and click **Finish** to exit or **Back** to edit.



IP PASSTHROUGH SETUP

IP passthrough takes a 3G/4G WAN data source (USB, ExpressCard, or Cradlepoint business-grade modem) and passes the IP address through to Ethernet LAN.

Enabling IP passthrough will make many changes to your router configuration. Please review this list and ensure they are compatible with how the router will be used.

- All Ethernet ports will be set to LAN
- All network groups except the primary network group will be removed
- All WAN devices will have Load Balance disabled and the highest priority device will be used
- All Wireless interfaces will be removed from the primary network group
- All Router based VPN and GRE services will be disabled
- The Routing Mode will be set to IP Passthrough
- The Subnet Selection Mode will be set to "Automatically Create Subnet" unless overridden via the **Subnet Selection Mode** dropdown

Any Ethernet WAN connections should be disconnected before IP passthrough is enabled.

IP Passthrough Setup

Enabling IP Passthrough will make many changes to your router configuration. Please review this list and ensure they are compatible with how the router will be used.

- All Ethernet ports will be set to LAN.
- All network groups except the primary network group will be removed.
- All WAN devices will have Load Balance disabled and the highest priority device will be used.
- All Wireless interfaces will be removed from the primary network group.
- All Router based VPN and GRE services will be disabled.
- The Routing Mode will be set to IP Passthrough.
- The Subnet Selection Mode will be set to "Automatically Create Subnet" unless overridden below.

Enabling IP Passthrough:

If IP Passthrough mode is what is desired then clicking the Enable IP Passthrough button will immediately configure the router to use IP Passthrough.

Additional settings for Passthrough are available under Networking -> Local Networks. Any Ethernet WAN connections should be disconnected before IP Passthrough is enabled.

Subnet Selection Mode:

I want to enable IP Passthrough:

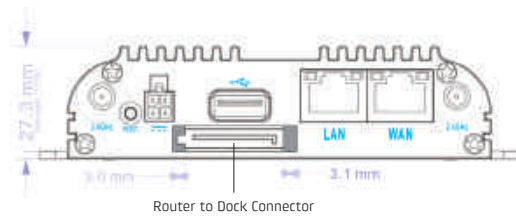
☐



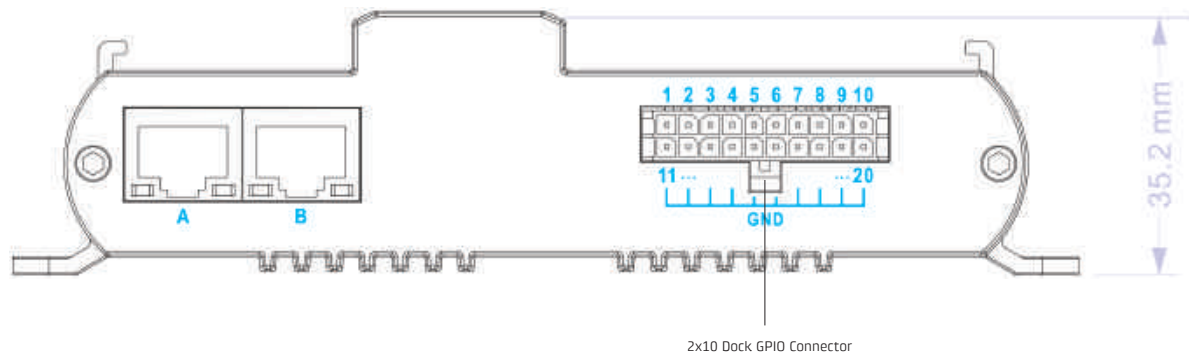
APPENDIX A

EXTENSIBILITY DOCK

PINOUTS

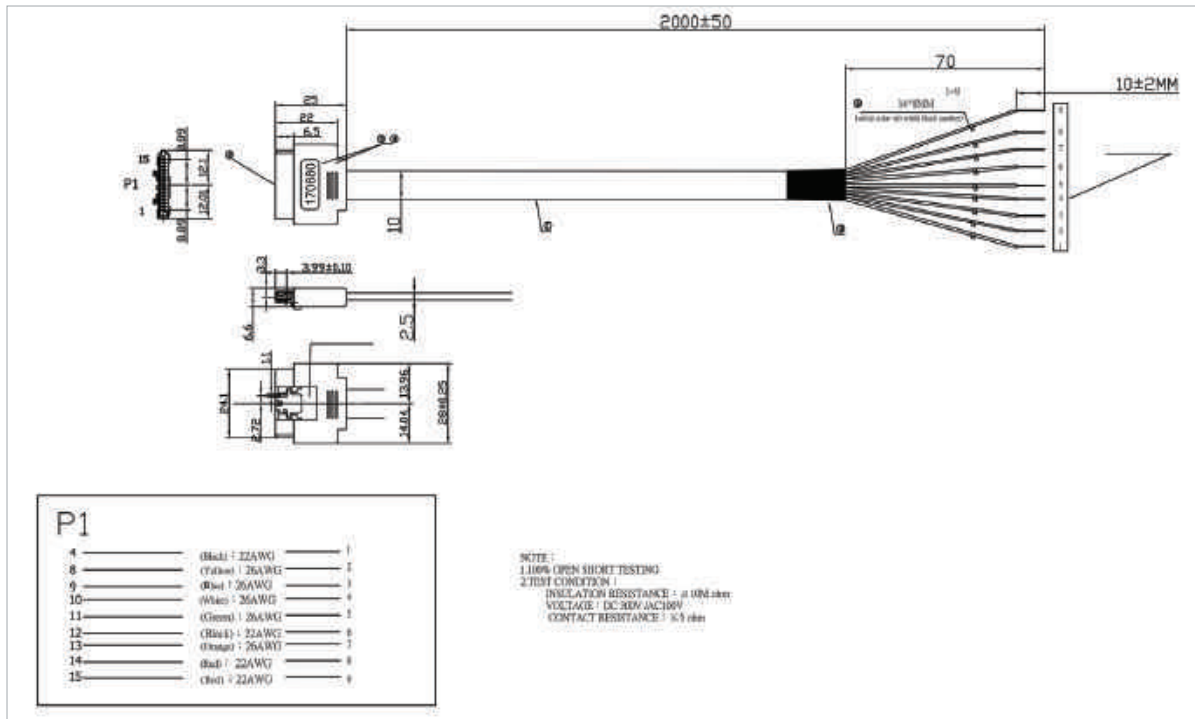


Router to Dock Connector	
Pin 1	Ethernet TX-
Pin 2	Ethernet TX+
Pin 3	Ethernet RX-
Pin 4	GND
Pin 5	Ethernet RX+
Pin 6	USB D-
Pin 7	USB D+
Pin 8	GPIO1
Pin 9	GPIO2
Pin 10	GPIO3
Pin 11	GPIO4
Pin 12	GND
Pin 13	Ignition Sense
Pin 14	Router power in/out (18 W in min; 6 W out max)
Pin 15	Router power in/out (18 W in min; 6 W out max)



2x10 Dock GPIO Connector	
Pin 1	Router+Dock power - input only (24 W min)
Pin 2	Router+Dock power - input only (24 W min)
Pin 3	Reserved
Pin 4	Reserved
Pin 5	GPI (ignition sense)
Pin 6	GPIO1
Pin 7	GPIO2
Pin 8	GPIO3
Pin 9	GPIO4
Pin 10	Low current 5 V output (50 mA max)
Pin 11-20	Ground

GPIO CABLE



Wire	Signal
Black (2)	GND
Yellow	GPIO1
Blue	GPIO2
White	GPIO3
Green	GPIO4
Orange	Ignition sense
Red (2)	Router power

- Ignition Sense threshold: max 3.4 V, protected to 33 V
- GPIOs: LLTL compatible, protected to 33 V

WARRANTY INFORMATION

Cradlepoint, Inc. warrants this product against defects in materials and workmanship to the original purchaser for a period of three (3) years from the date of shipment. This warranty is limited to a repair or replacement of the product, at Cradlepoint's discretion, as purchaser's sole and exclusive remedy. Cradlepoint does not warrant that the operation of the device will meet your requirements or be error free.



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 ¼" to ½" **undersized** from the item that it will be under. For example; a mattress that is 60 x 80, cut between 59"-59 ½" by 79" – 79 ½". 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



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www.NaturesHead.net**

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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



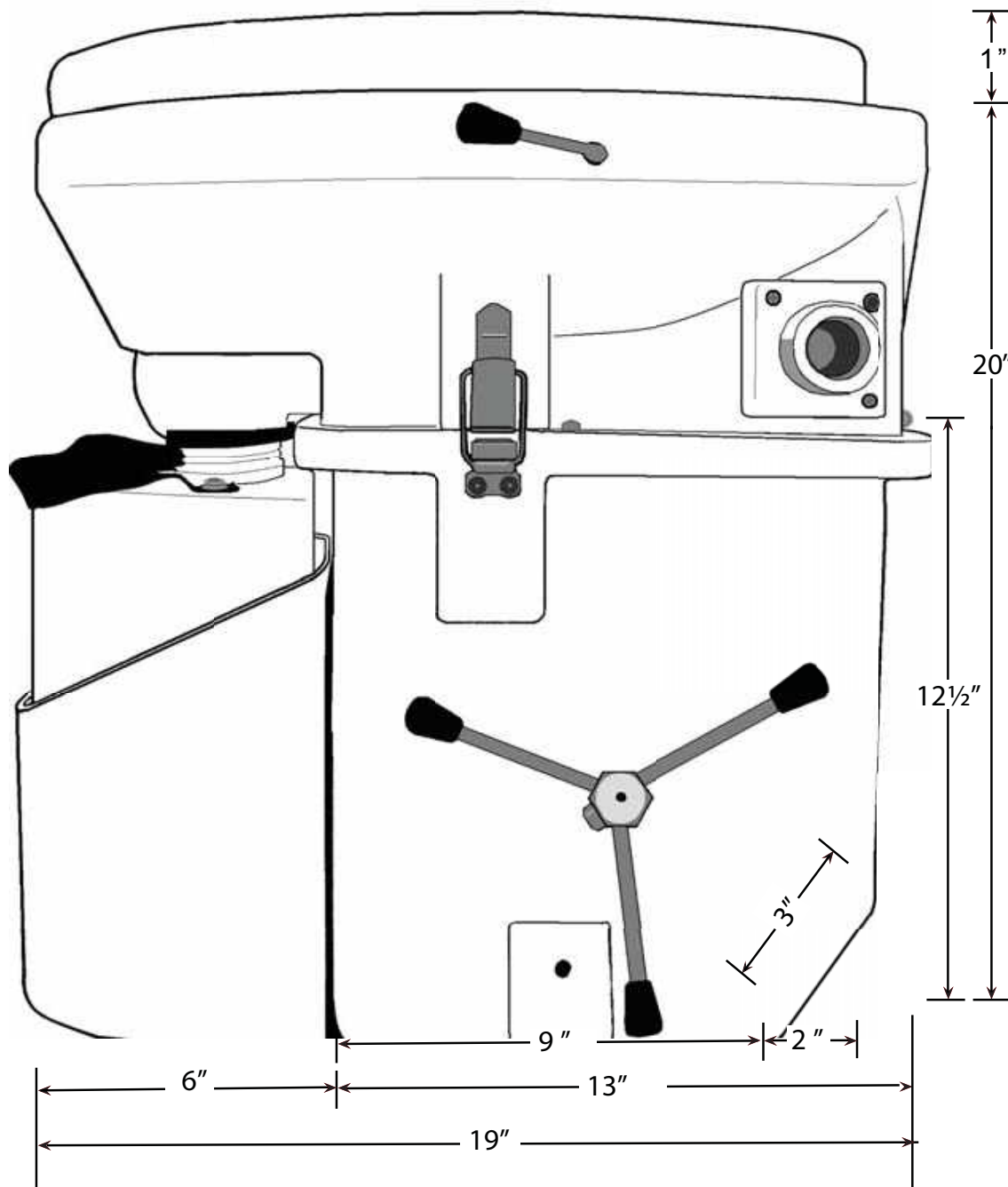
Example

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 ½ 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 ½ gallons.



INSTALLATION: Dimensions



Note:

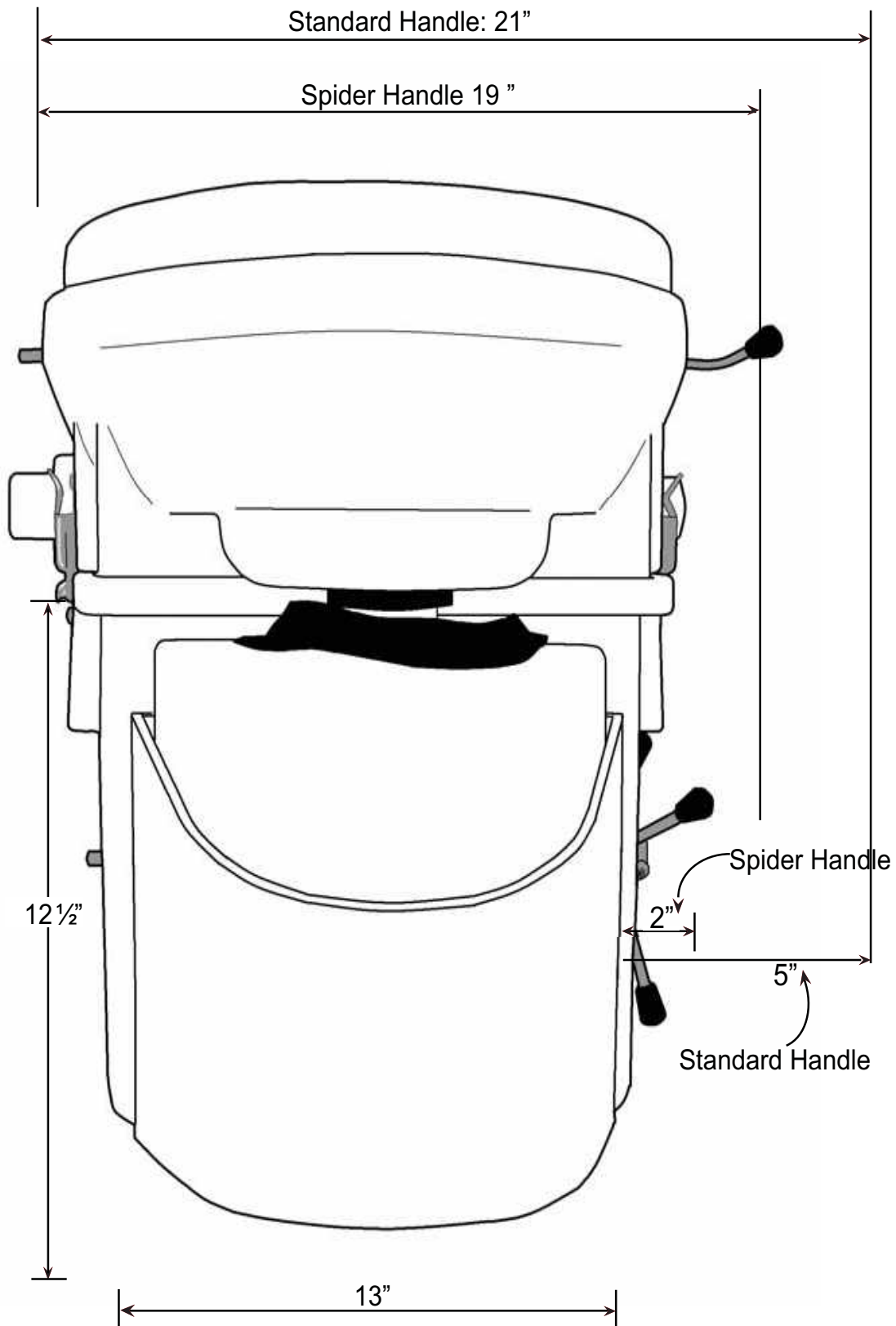
Dimensions can vary up to 4% due to the rotational moulding of polyethylene plastic.

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.



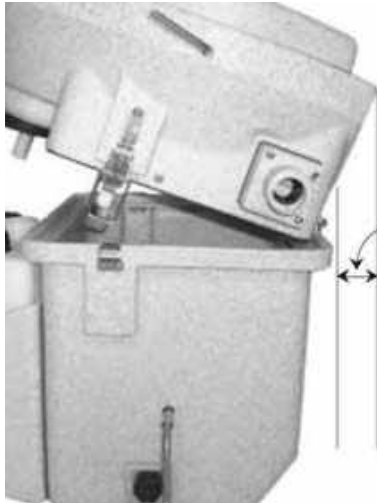
INSTALLATION: Dimensions





INSTALLATION: Location

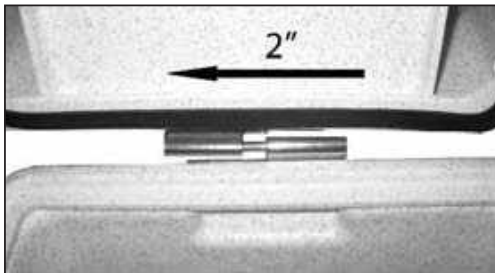
When selecting the location for your new Nature's Head®, be certain to allow enough space behind and on both sides for the toilet to function and be serviced.



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.



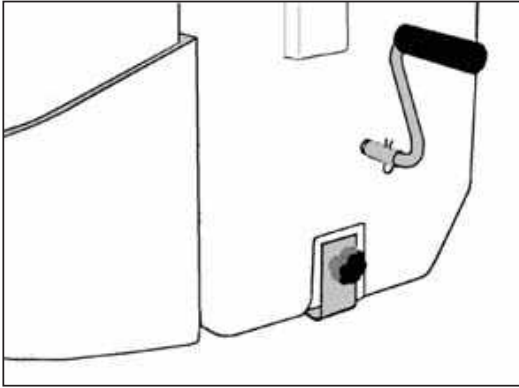
With the standard handle attached, the width of the unit is 21 inches.

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 side 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.

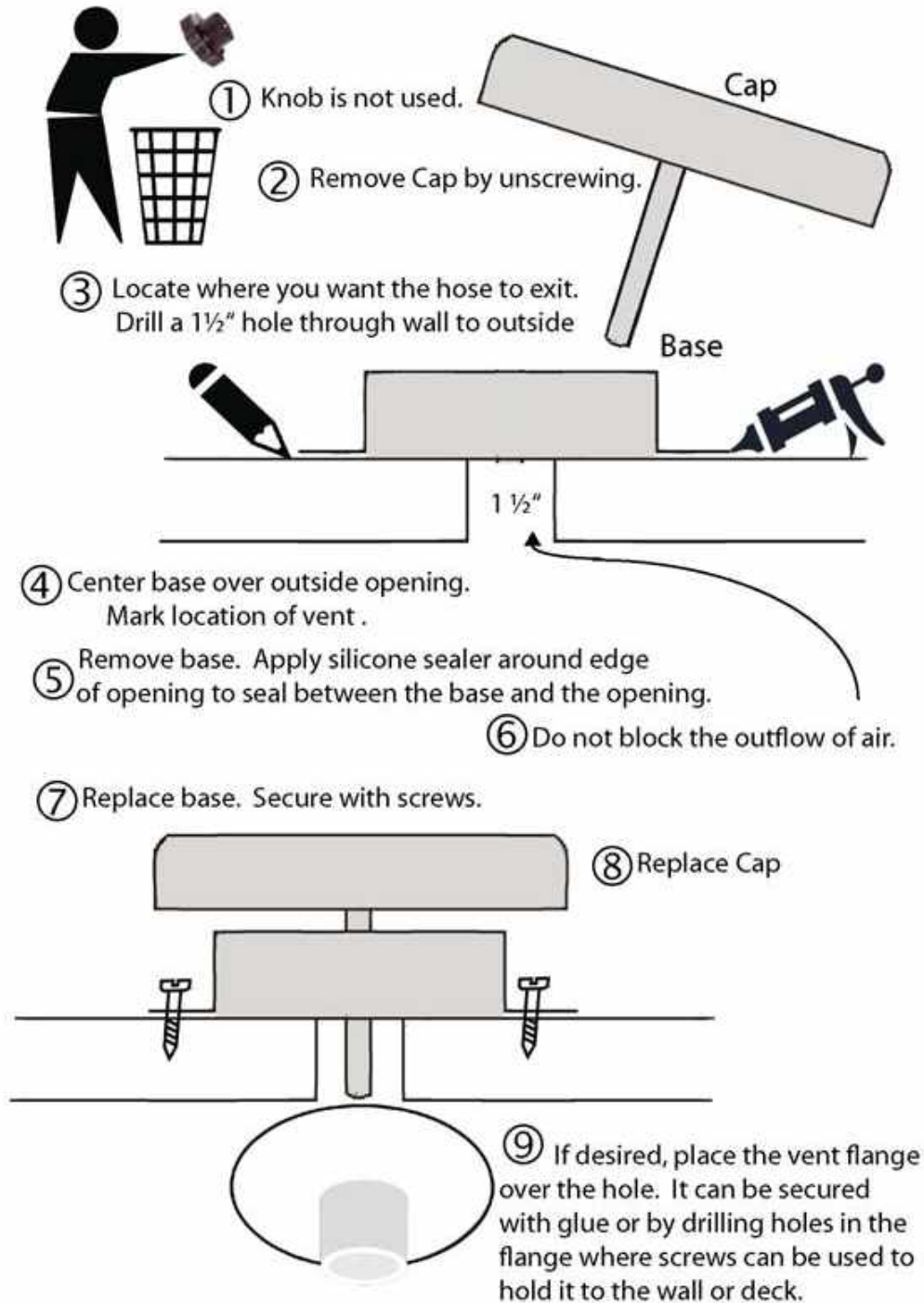
Clamping the hose to the fan housing is not necessary on the connection for the head, and normally not necessary on the exterior connector. With an overhead connection, you may find it necessary to clamp this end depending on the amount of support provided for the vent hose. If the hose is supported 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



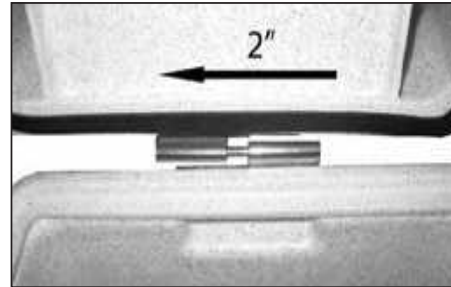
contents in an appropriate manner. The urine bottle maybe emptied into a conventional toilet or other appropriate facility. Many books and articles have been written on the benefits of using diluted urine as a fertilizer. This may also be part of your environmental plan for disposing of wastes in a cabin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



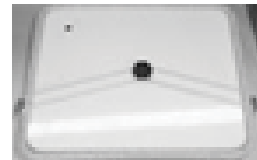
Extra Base, with Lid

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)

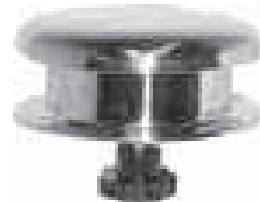
Optional 110 V adapter, used only when using 110V (house) power.



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.

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NATURE'S HEAD, INC.

PO Box 250

Van Buren, OH 45889

251-295-3043

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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>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.

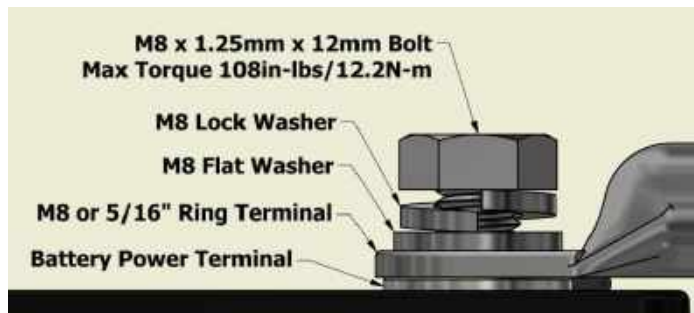
Lithium batteries do not release gas during normal use. There are no specific ventilation requirements for battery installation, although enough airflow should be provided to prevent excessive heat build-up.

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.

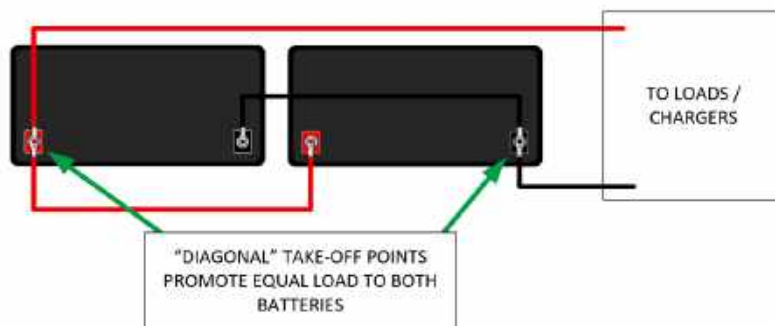


CAUTION: Do NOT place any washers between the battery power terminal and the ring terminal lug, as this could create a high resistance path and cause excessive heating of the connection which could then lead to permanent battery damage and/or fire.

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:

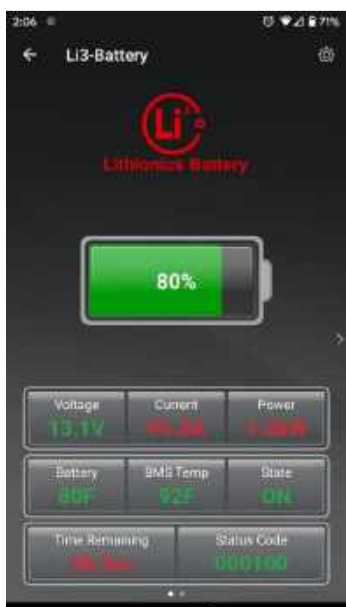
1. Fully charge the battery.
2. Turn the battery **OFF** using the battery power button.
3. Keep the battery in an environment according to the specifications shown above.

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:

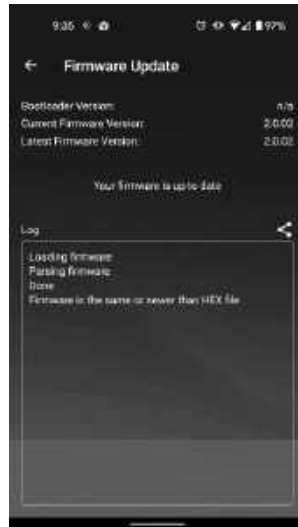
- 1) The battery must be in the ON position.
- 2) Bluetooth must be enabled on your device.
- 3) Open the Lithionics Battery® Monitor App and accept location permissions.
- 4) Under the Device List, select the battery you would like to monitor (the device name is identified by the battery serial number).

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.



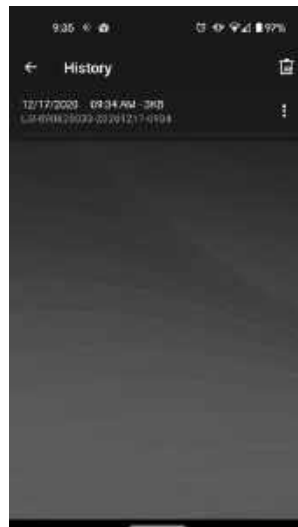
The **Status Code Reader** section of the app makes it easy to visualize the status by observing the color-coded table, see example to the left.

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

- 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.
- 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.
- 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.
- 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



Lithionics Battery®

GTX12V315A-E2107-CS200 User Guide

NeverDie® Compact Series 200 Internal BMS



Rev. A

NEVERDIE®
LITHIUM-ELECTRONICS - LITHIONICS BATTERY

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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 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.



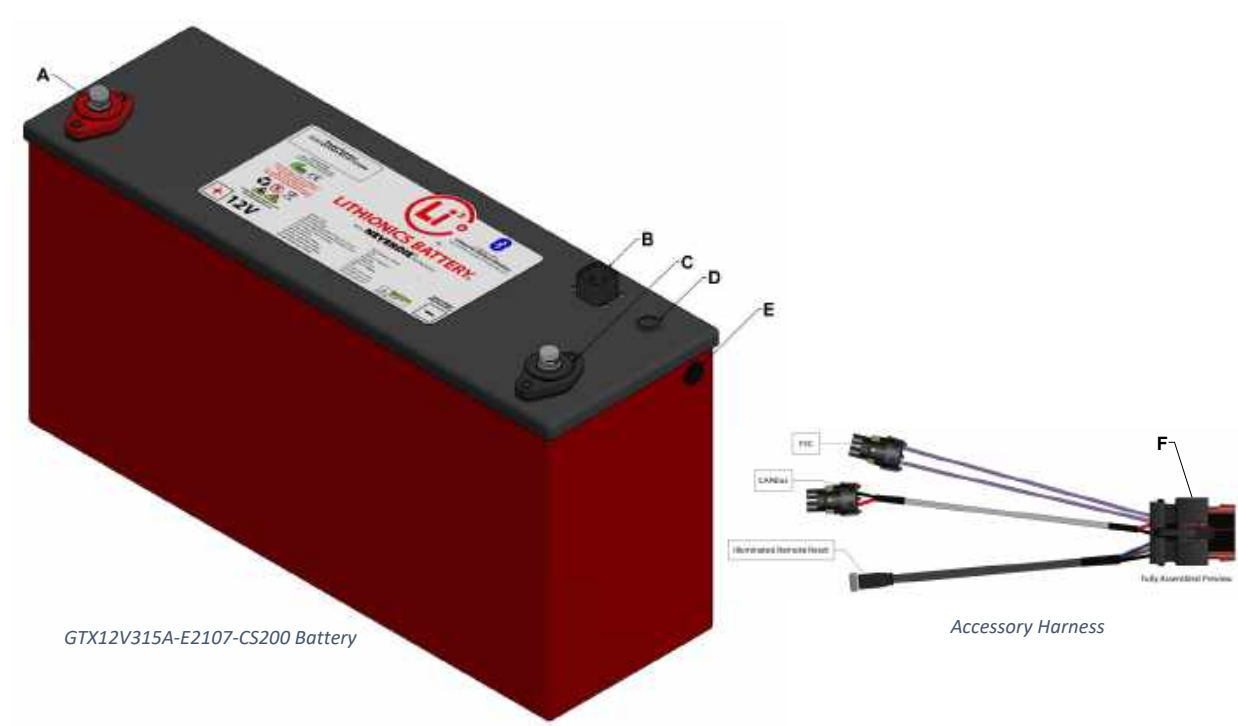
System Components

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.



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:

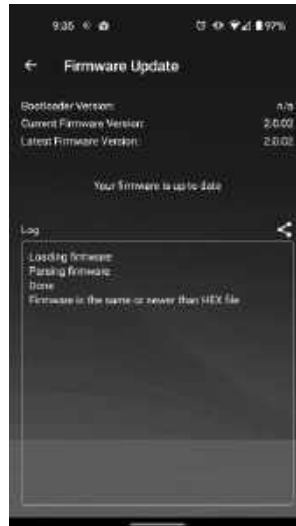
- 1) The battery must be in the ON position.
- 2) Bluetooth must be enabled on your device.
- 3) Open the Lithionics Battery® Monitor App and accept location permissions.
- 4) Under the Device List, select the battery you would like to monitor (the device name is identified by the battery serial number).

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.



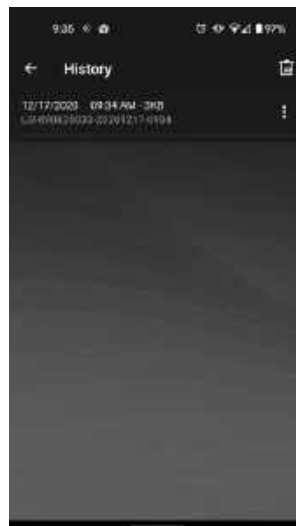
The **Status Code Reader** section of the app makes it easy to visualize the status by observing the color-coded table, see example to the left.

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.



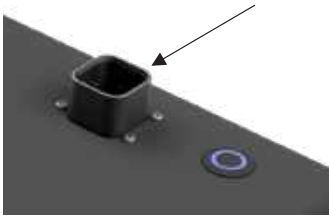
The Bluetooth app can also be used to access the **Firmware Update** section of the app. The BMS firmware version and update status can be found in the settings menu when connected to the Battery.

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

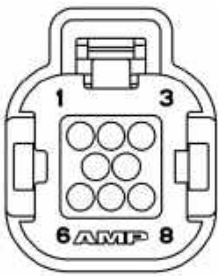


Mating cable extensions are available to integrate the accessory features.

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.

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



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

- 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.
- 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.
- 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.
- 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

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TECHNICAL MANUAL

For Lifeline® Batteries

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Revision F
May 6, 2019

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RECORD OF REVISIONS

Revision	Date
Initial Release	10/27/08
Rev. A	3/25/09
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.



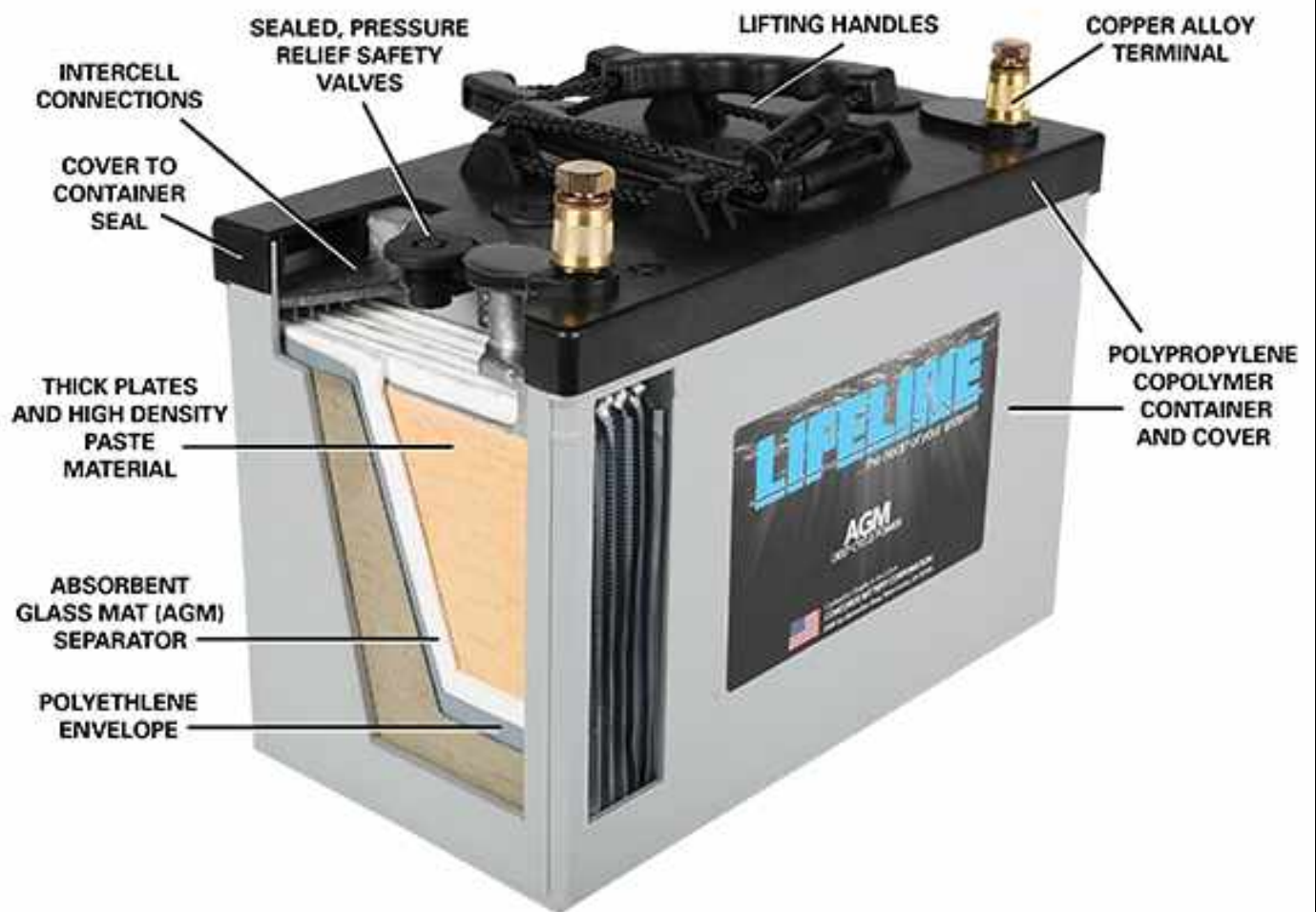
PRESSURE RELIEF SAFETY VALVE - Each cell in the battery employs a pressure relief safety valve. The valve is designed to release excess pressure that builds up over time to vent the small quantity of gasses that do not recombine inside of the battery. Once the pressure is released, the valve automatically 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.

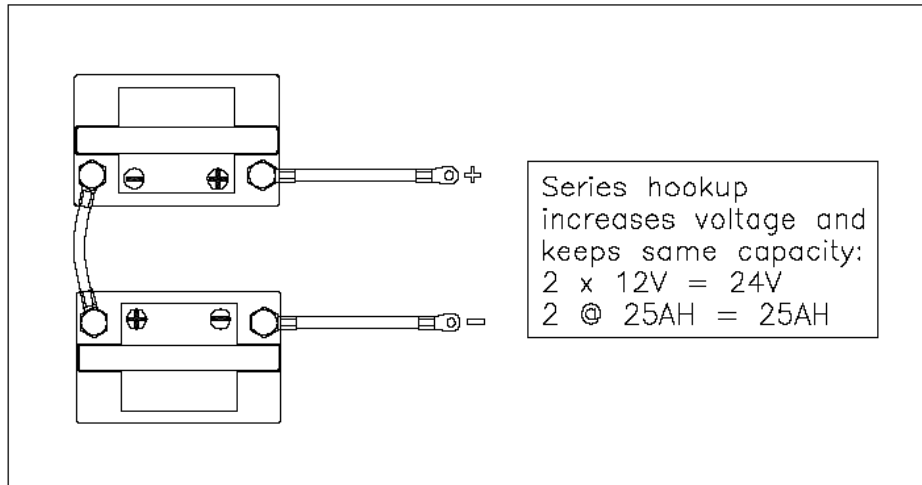


Figure 5-1. Series Connection

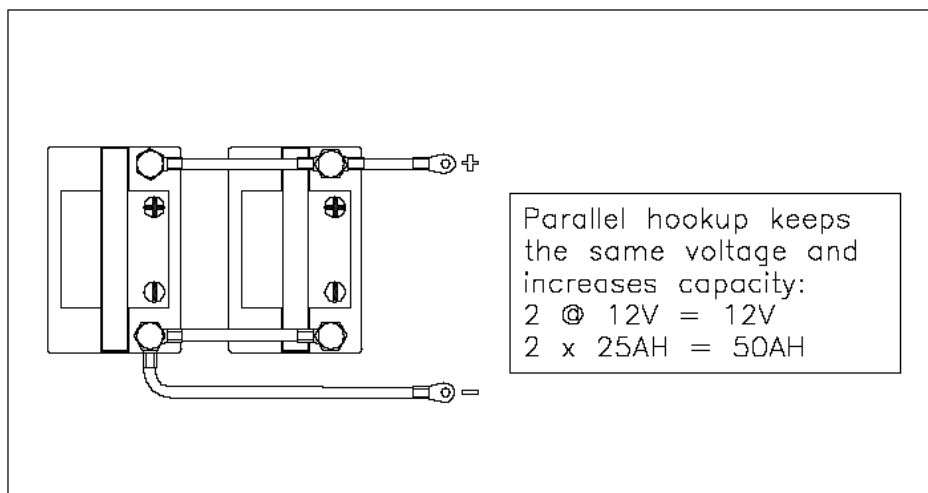


Figure 5-2. Parallel Connection

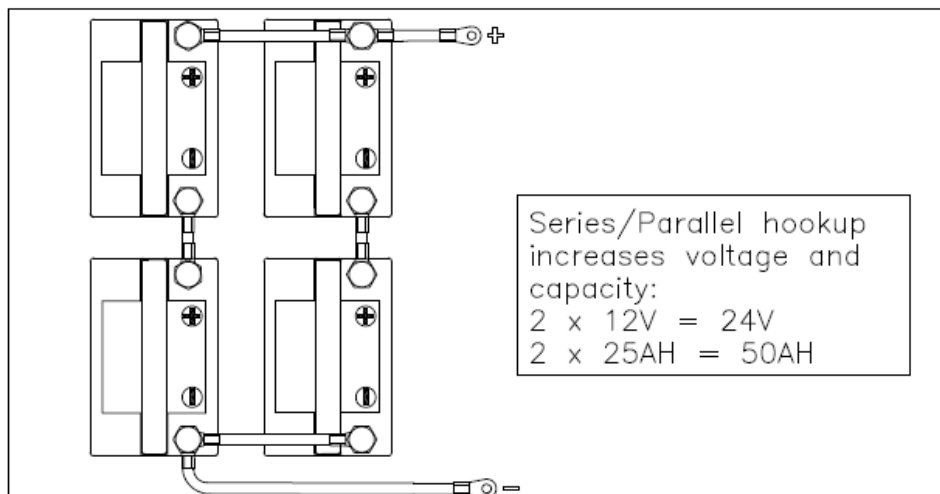


Figure 5-3. Series/Parallel Connection



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.

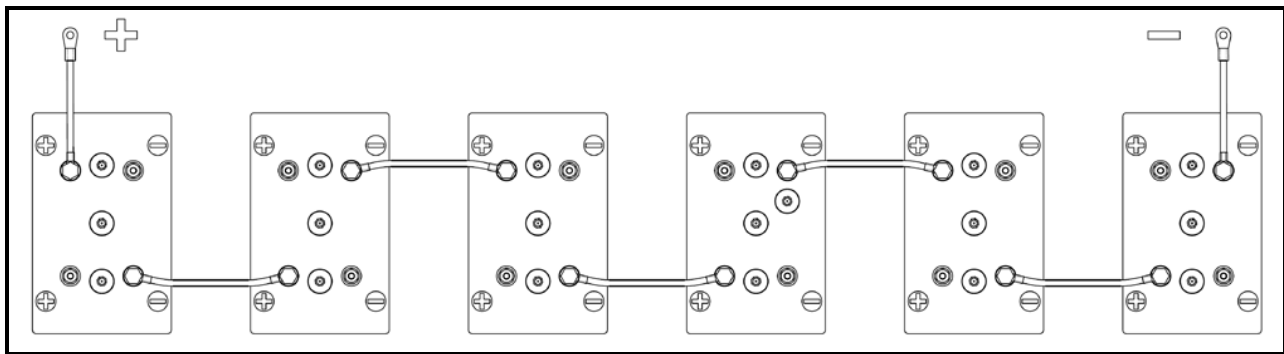


Figure 5-4. Series Connection for 4-Terminal Batteries (Low Rate Applications Only)

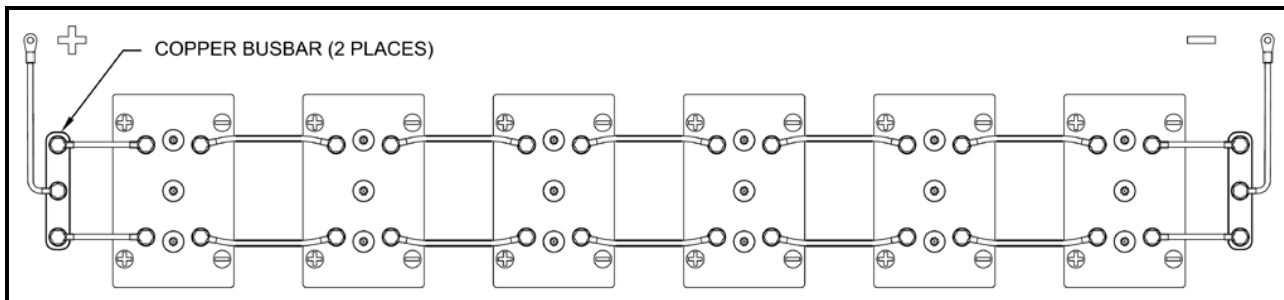


Figure 5-5. Series Connection for 4-Terminal Batteries (Low or High Rate Applications, Option A)

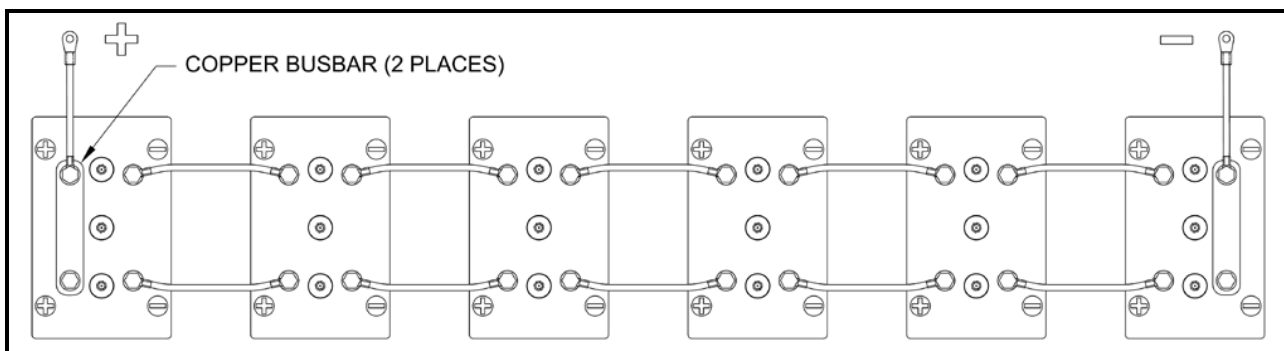


Figure 5-6. Series Connection for 4-Terminal Batteries (Low or High Rate Applications, Option B)

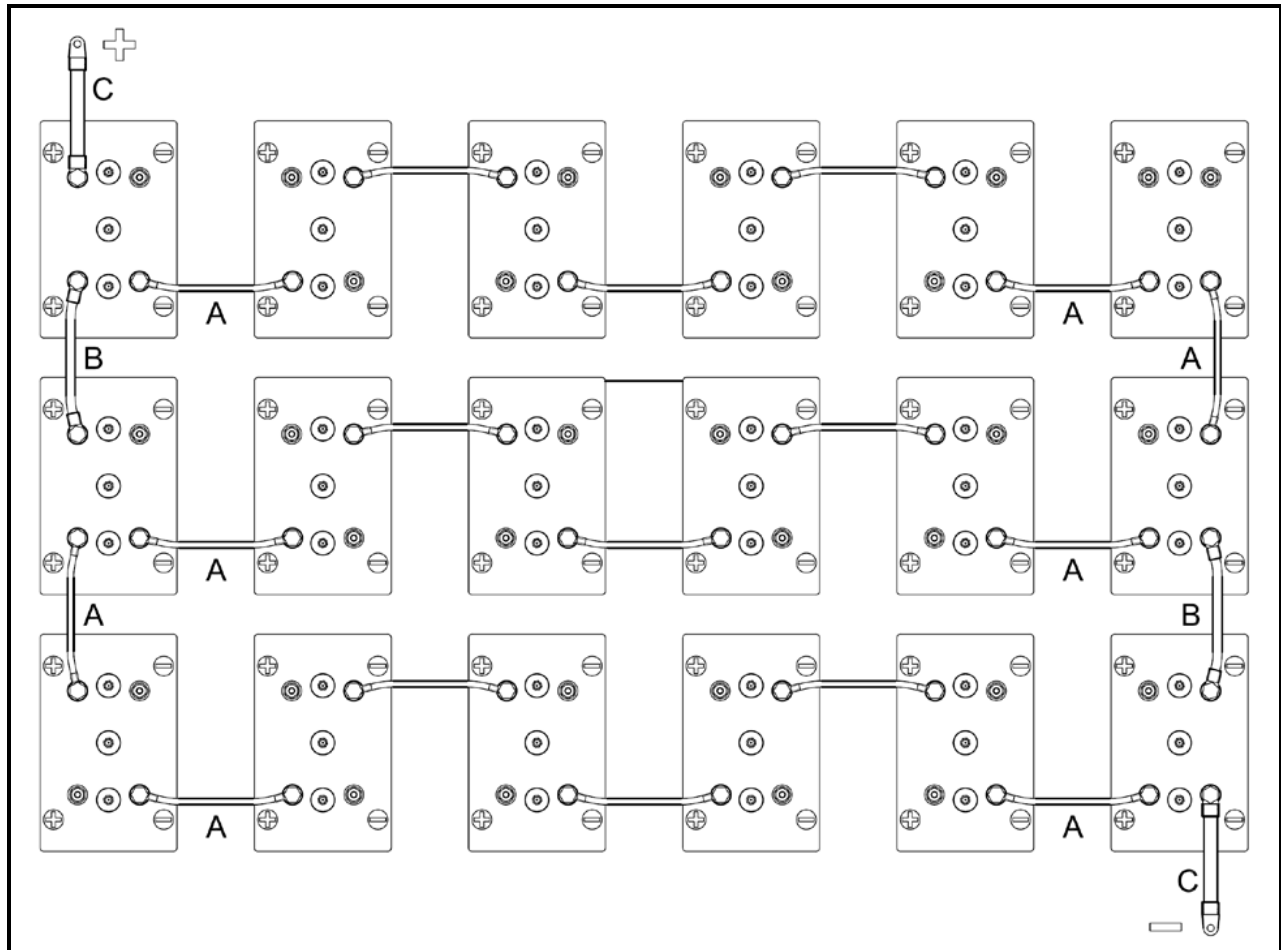


Figure 5-7. Series/Parallel Connection for 4-Terminal Batteries (Low Rate Applications Only)

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 3 times that of Cable A.

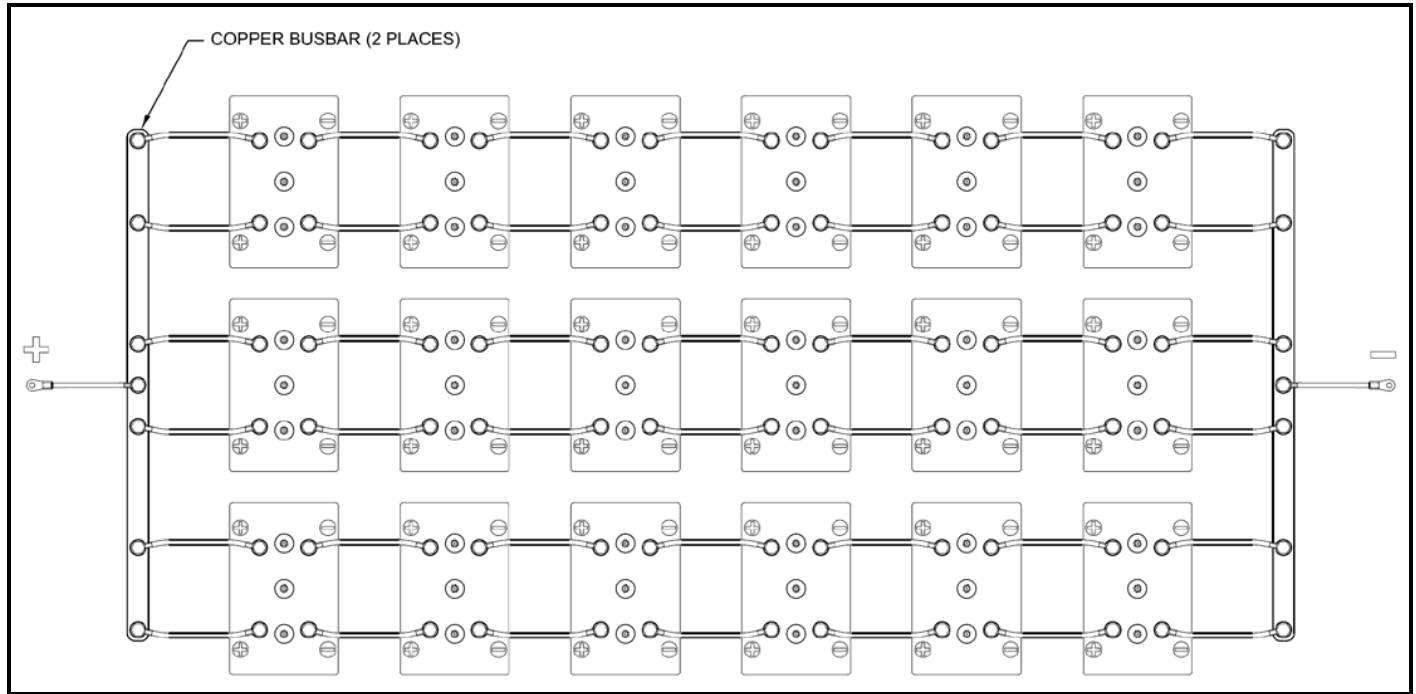


Figure 5-8. Series/Parallel Connection for 4-Terminal Batteries (Low or High Rate Applications)

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 \pm 0.1 volts (7.15 \pm 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 \pm 0.1 volts (6.65 \pm 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:

Charge Time = [(DOD/100) x Rated Capacity (Ah) ÷ Output of Charger (Amps)] + Absorb Time.

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

If a 10A charger is used, it would take:
[(40/100) x 100 ÷ 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) = $I \times T$, 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

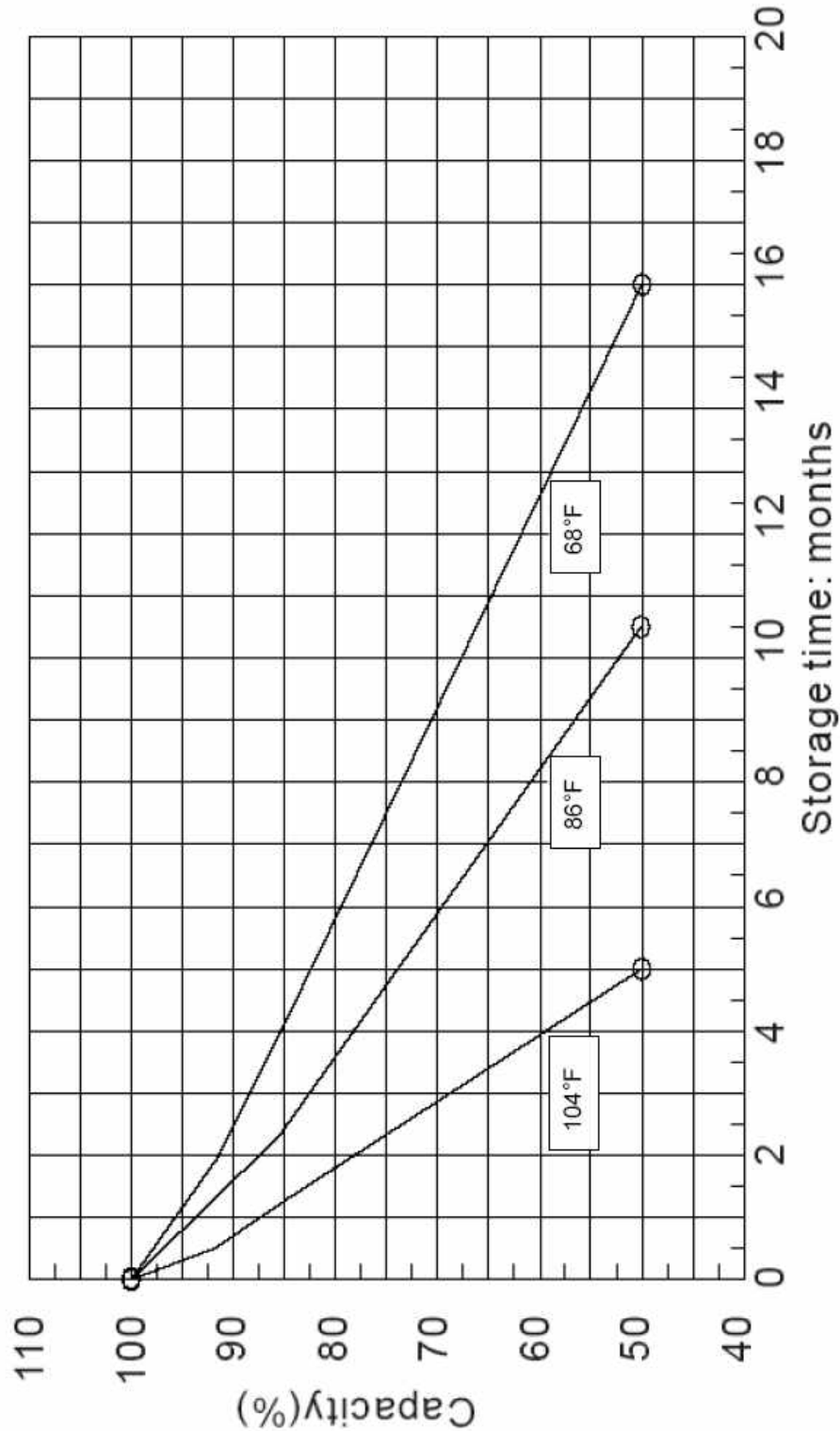
An easy method to estimate the State of Charge (SOC) of the battery is by measuring its Open Circuit Voltage (OCV). This measurement should be made after the battery has been at rest for a minimum of four hours with the battery shut off from its charging source and load. The reference temperature is 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

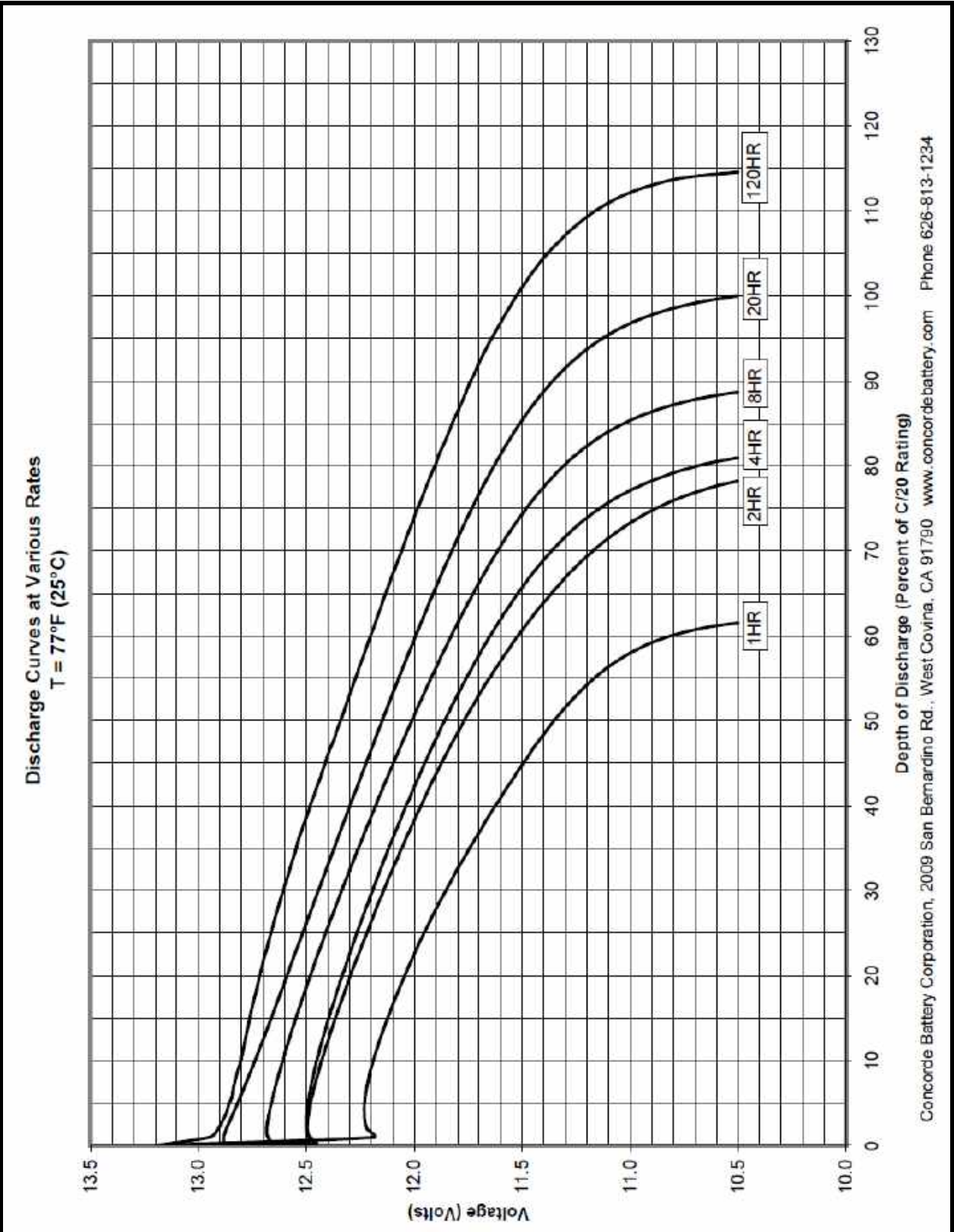
These voltage levels are applicable for aged batteries. The voltage levels for a new battery will be somewhat higher at a given state of charge. For example, a new battery typically has an OCV of 2.17 volts per cell (13.0 for a 12V battery) or higher at 100% SOC.



Self Discharge Characteristics



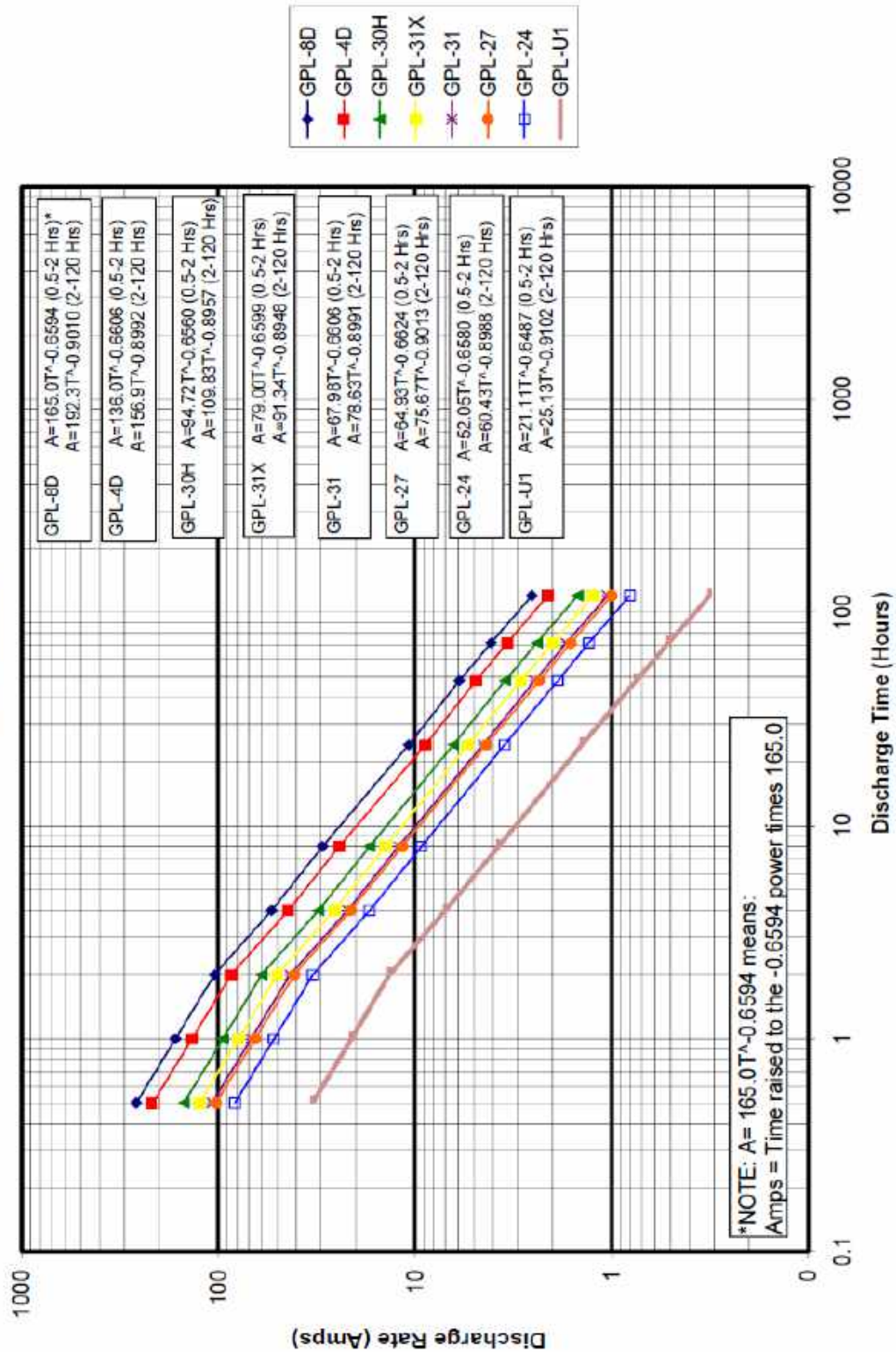
Concorde Battery Corporation, 2009 San Bernardino Rd., West Covina, CA 91790 www.concordebattery.com Phone 626-813-1234



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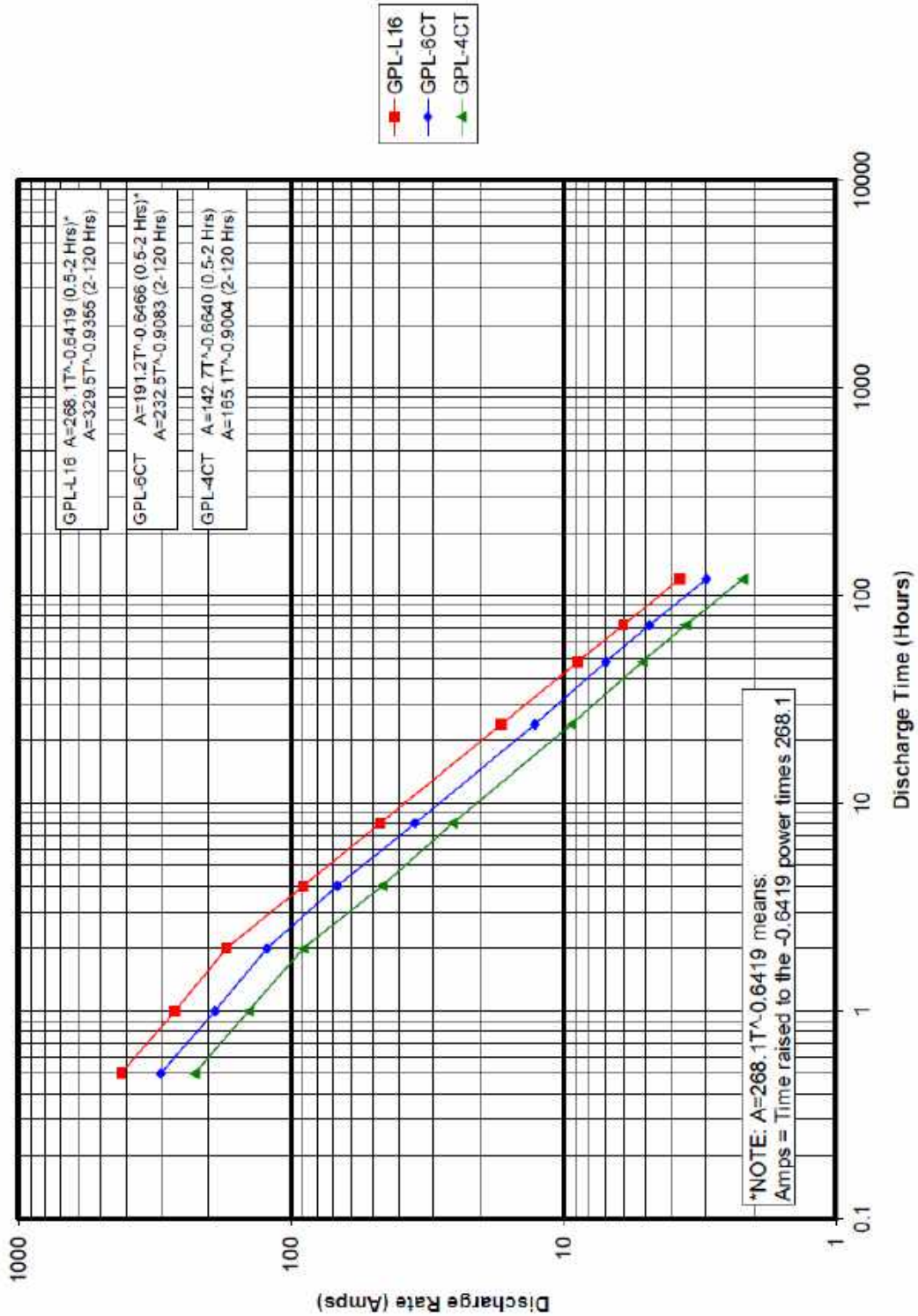
Peukert Plot for GPL Deep Cycle Batteries
12-Volt Models



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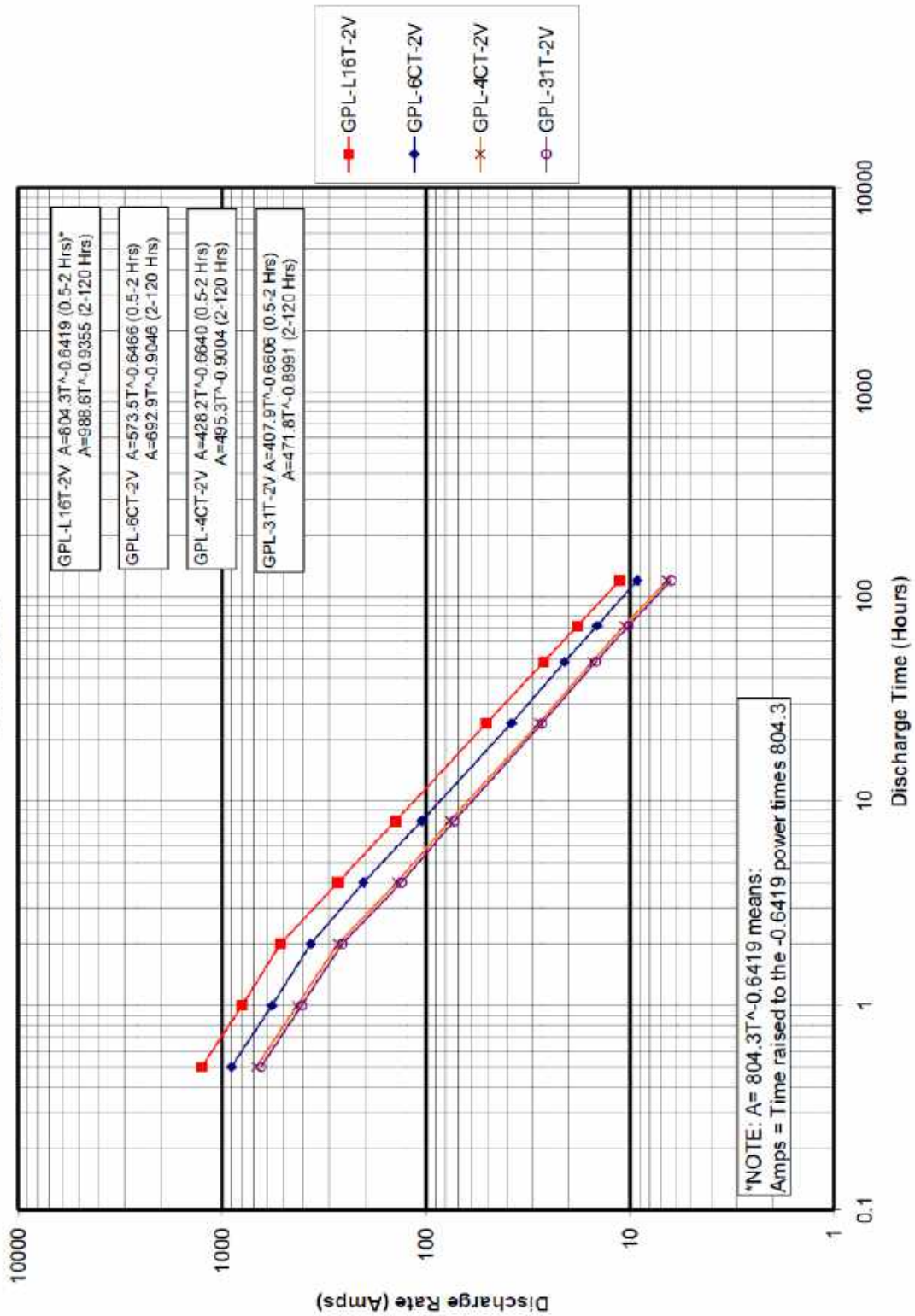
Peukert Plot for GPL Deep Cycle Batteries
6-Volt Models



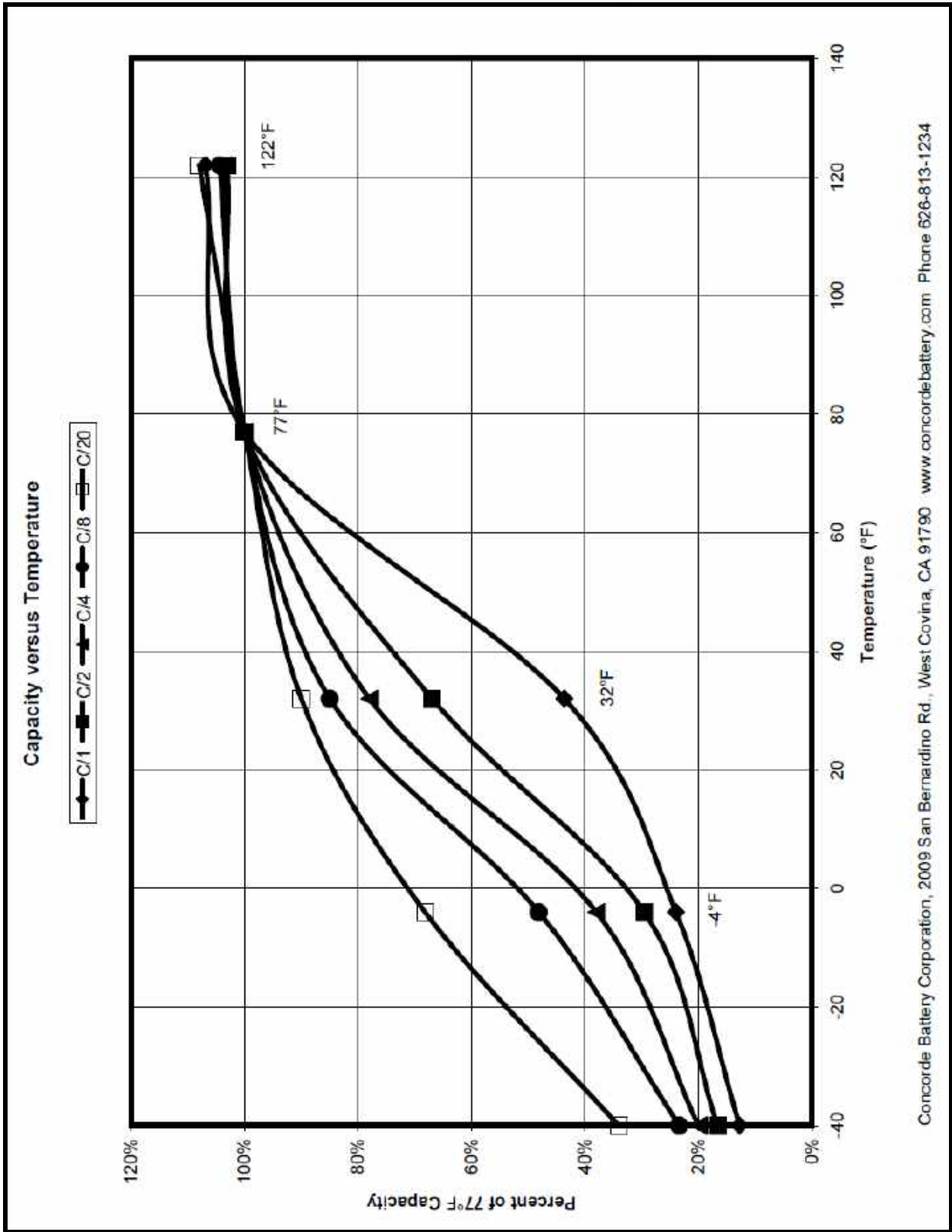
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Peukert Plot for GPL Series
2-Volt Models



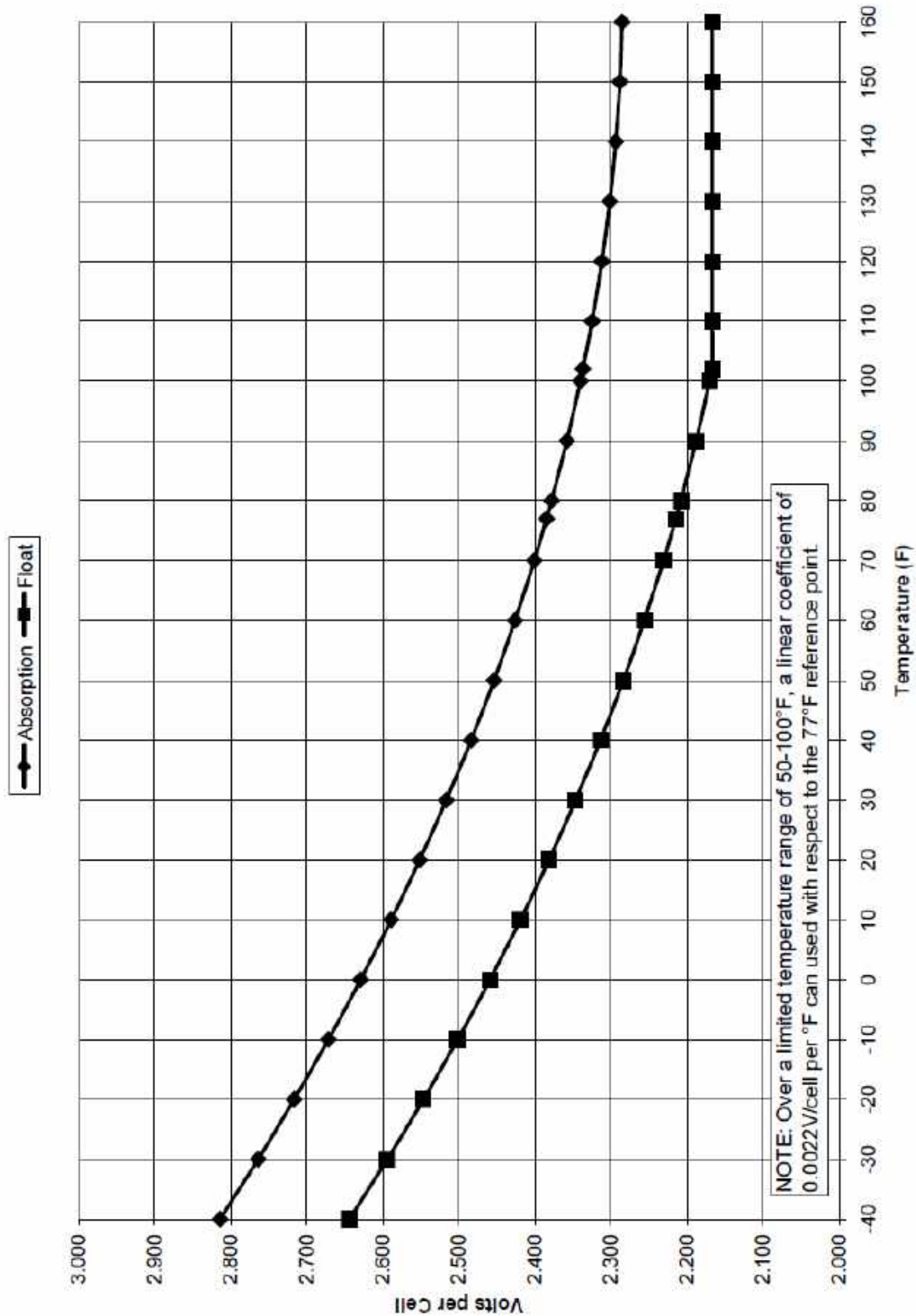
Concorde Battery Corporation, 2009 San Bernardino Rd., West Covina, CA 91790 www.concordebattery.com Phone 626-813-1234



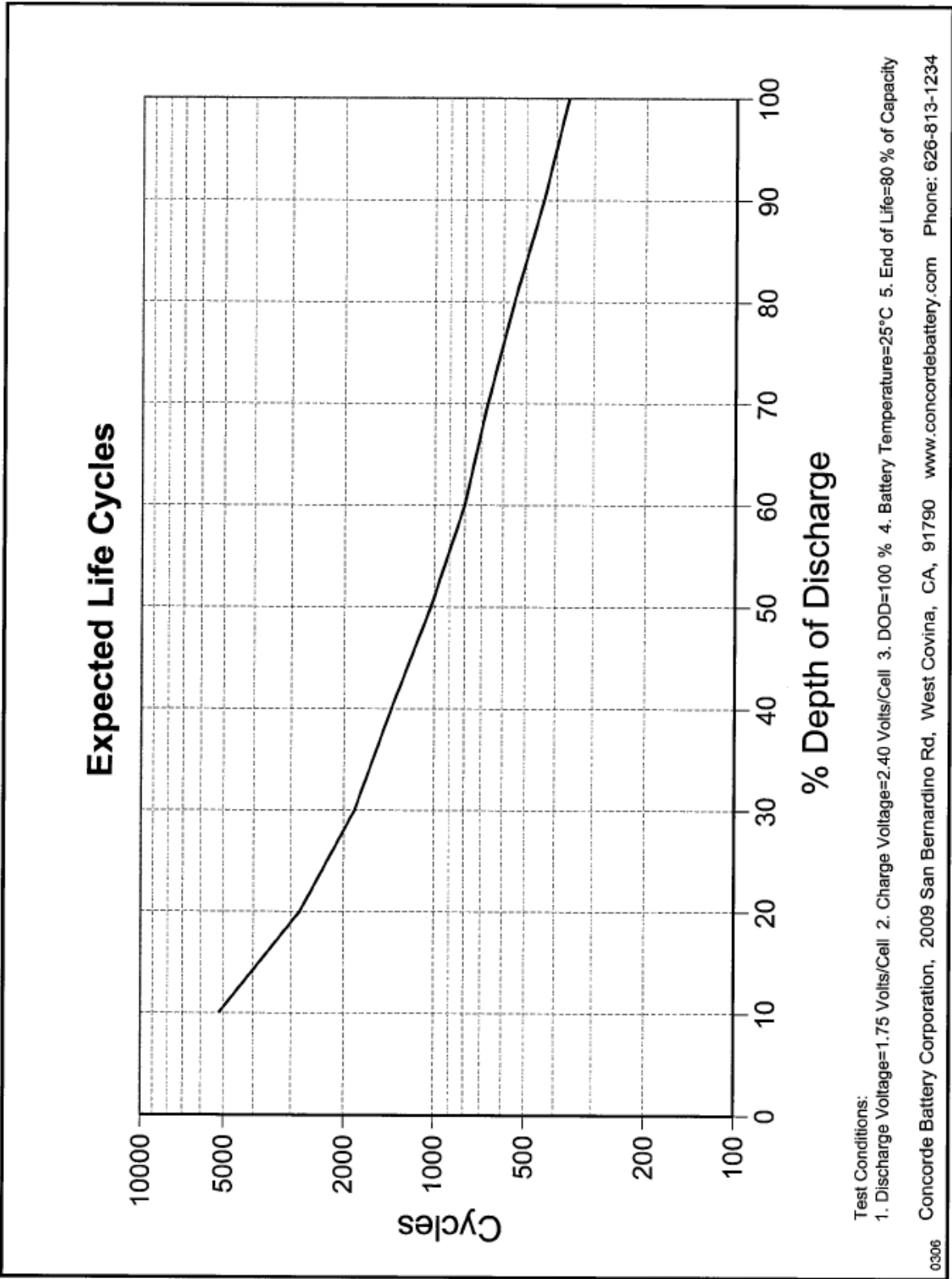
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Charge Voltage vs. Temperature



Concorde Battery Corporation, 2009 San Bernardino Rd., West Covina 91790 www.concordebattery.com Phone 626-813-1234





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.
Elkhart, IN 46516
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Toll Free 1-855-558-7862
Fax 1-574-538-2426
info@trumacorp.com
www.truma.net





Truma AquaGo® instant water heater (appliance)

Overview / Designation of parts

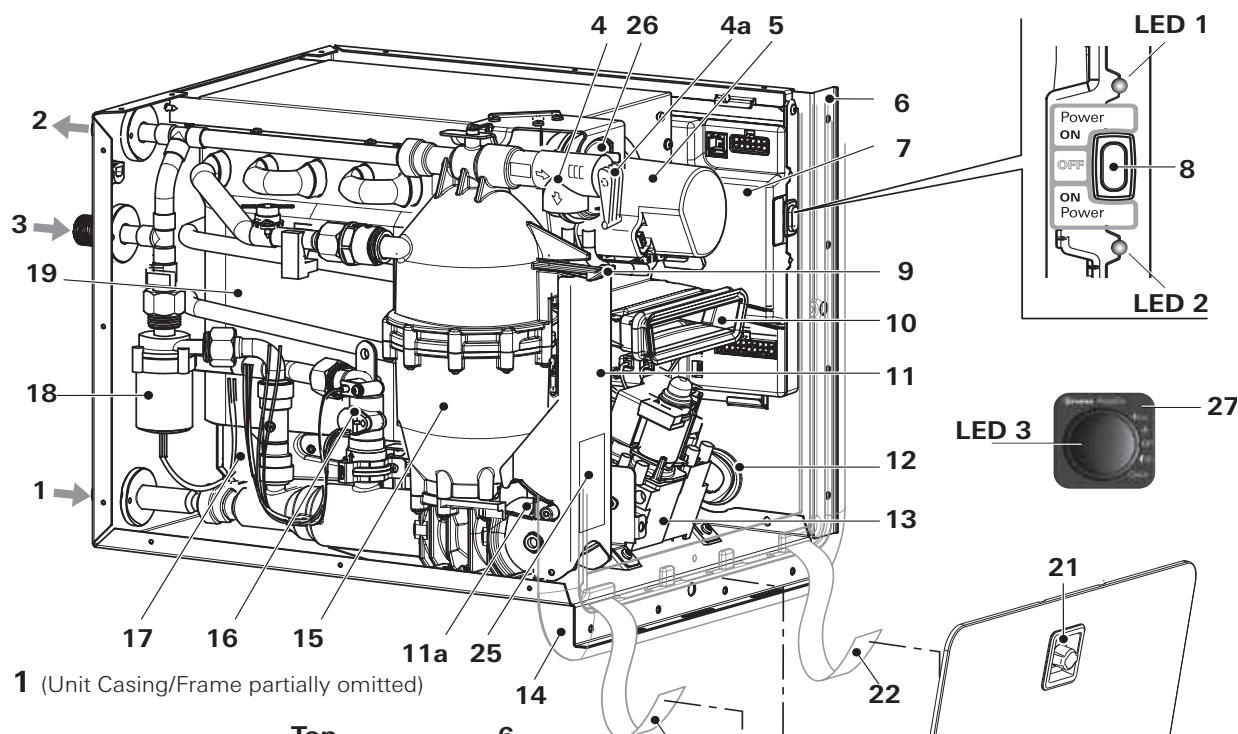


Fig. 1 (Unit Casing/Frame partially omitted)

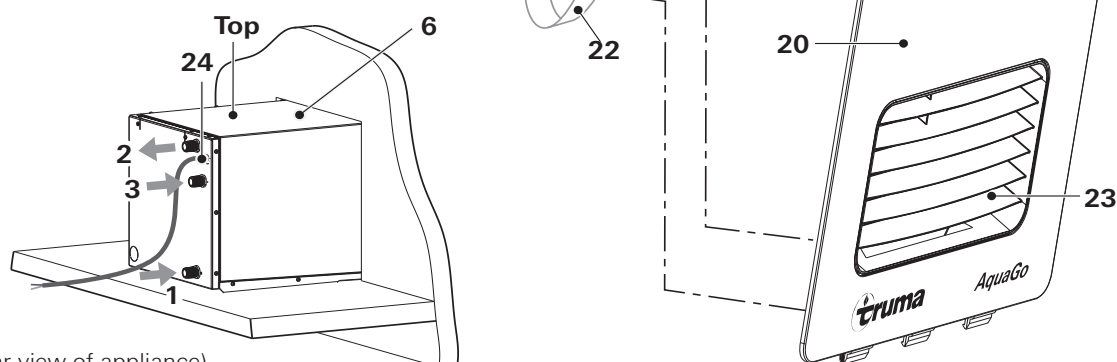


Fig. 2 (rear view of appliance)

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.



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. / Hérriques, 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.



- 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

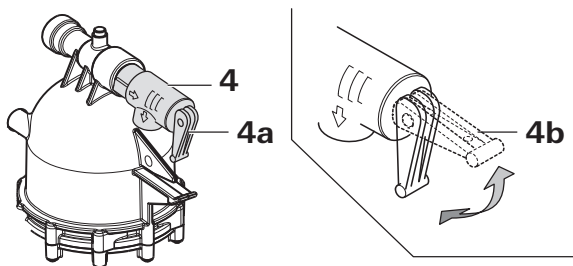


Fig. 3

- 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.

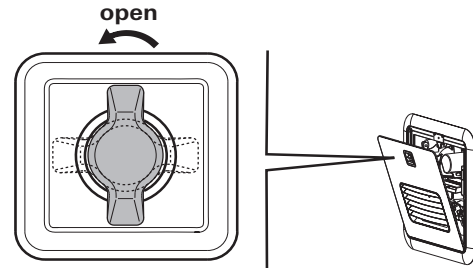


Fig. 4



- 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.

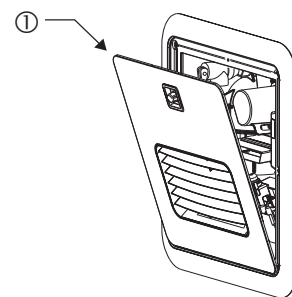


Fig. 5



Removing the access door

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

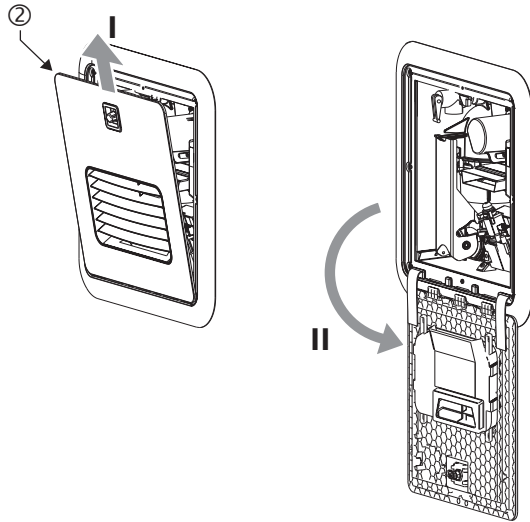


Fig. 6

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.

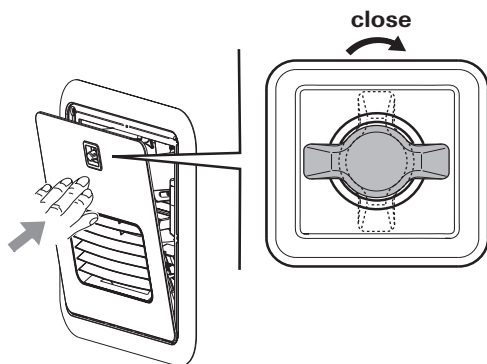


Fig. 7

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).

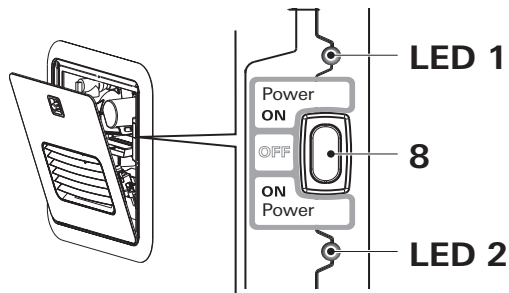


Fig. 8

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).

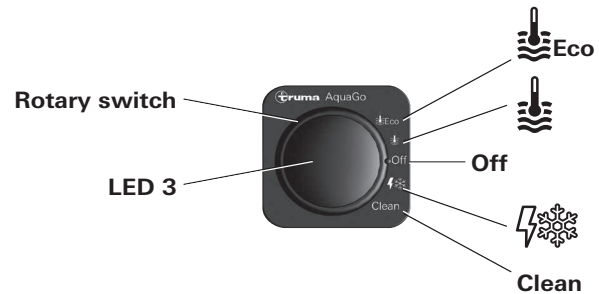


Fig. 9

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

Sign	Operating mode / Description
	ECO The appliance is now running in energy-saving mode. <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.
	COMFORT The appliance is now running in a mode that provides rapid availability of hot water. <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	Stand-by. The appliance is not running in any operating mode. <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
	ANTIFREEZE
	<p>Prevention of freezing using 12 VDC electricity:</p> <p> 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	DECALCIFICATION
	<p>Only AquaGo comfort / AquaGo comfort plus. See “Decalcification” on page 17.</p> <p> 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.

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)
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Water volume	0.35 gallons (1.3 liter)
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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)
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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

 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.



- 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.

- Open the latch with your thumb while pulling the Easy Drain Lever down as far as it will go.
- Remove the water inlet filter (or heating cartridge) as shown in Fig. 10 and rinse it with clean water.
- 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!

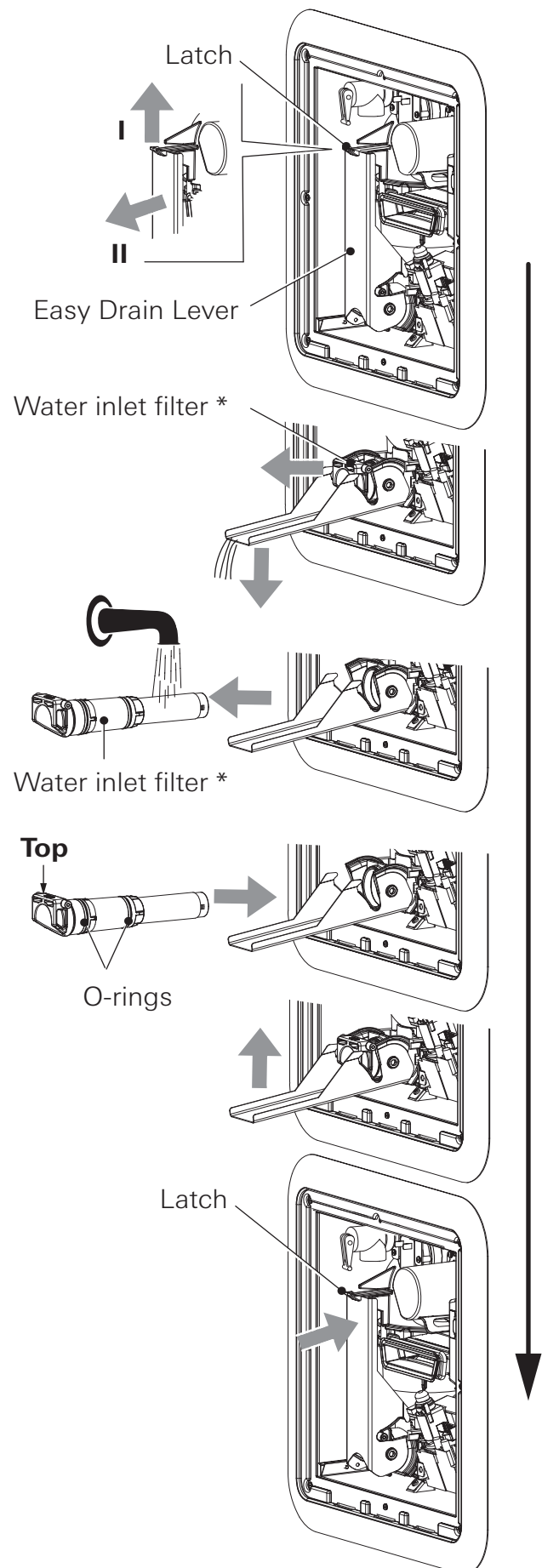
- Never put fingers between the Easy Drain Lever and water inlet filter or latch.

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.

- 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.

- 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 CaCO ₃	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).

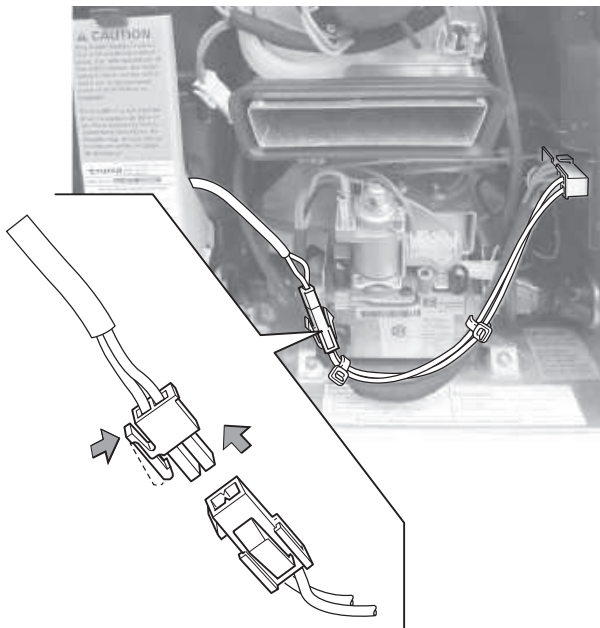


Fig. 11

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).

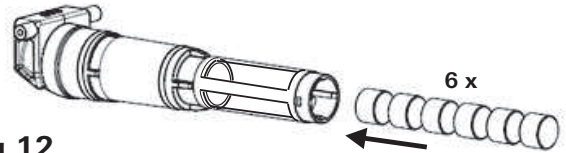


Fig.12

- 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.



- 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)

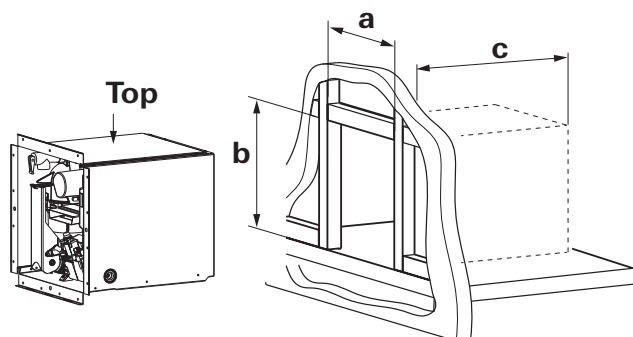


Fig. 13



- 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.

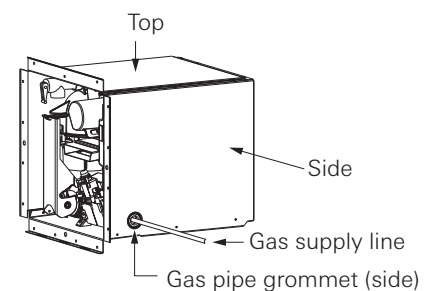


Fig. 14



– 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.

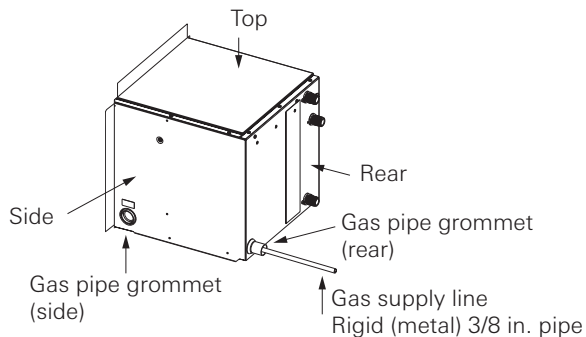


Fig. 15

- 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).

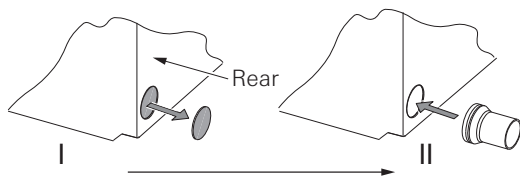


Fig. 16

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.



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).

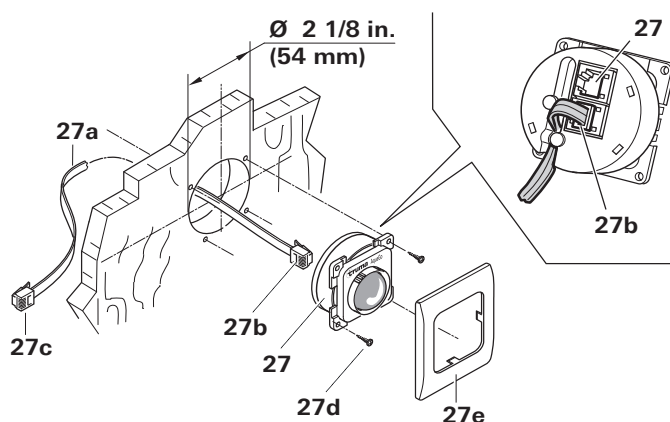


Fig. 17



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

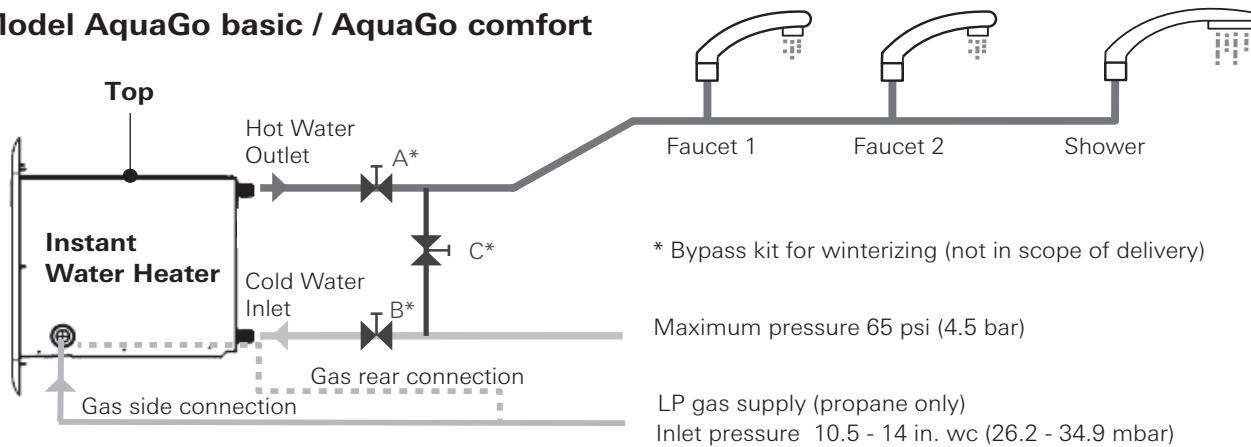


Fig. 18

Model AquaGo comfort plus

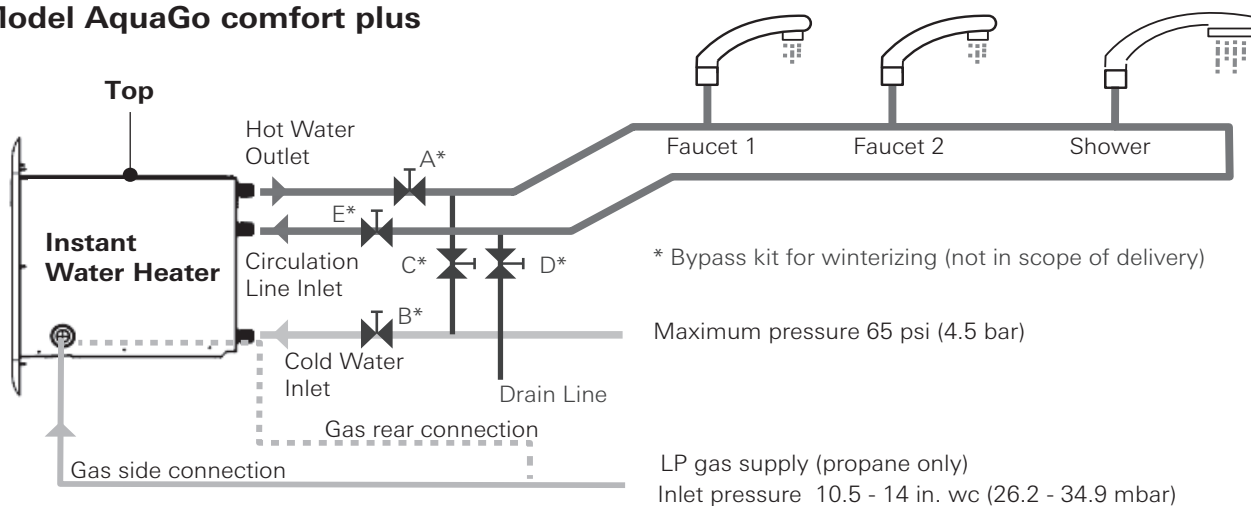


Fig. 19

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)

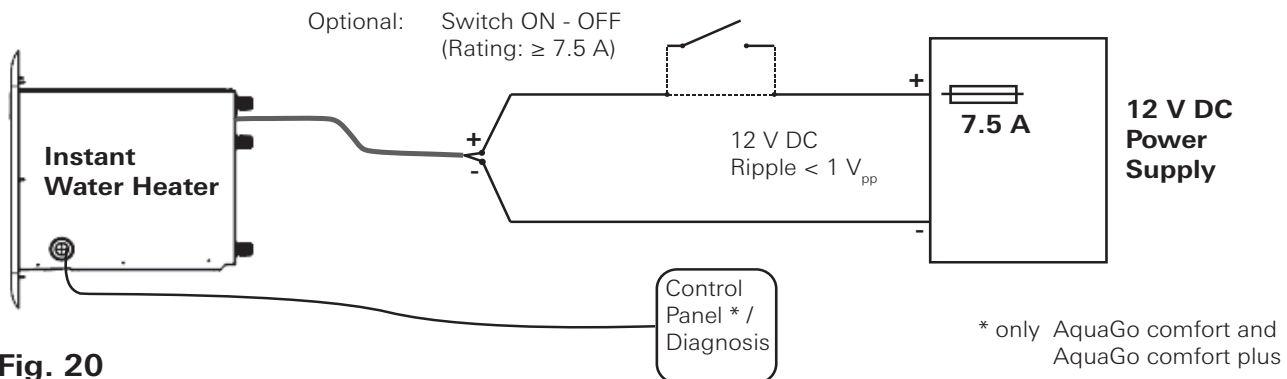


Fig. 20



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 ≈ 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.

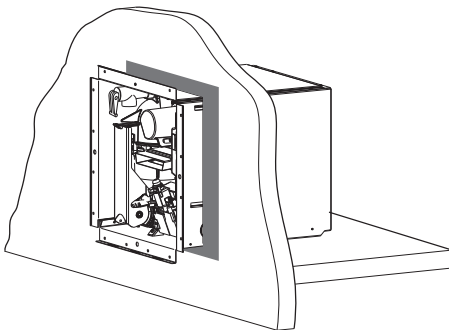


Fig. 21

- 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.

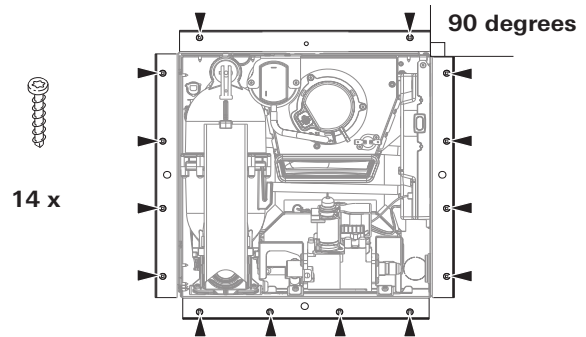


Fig. 22

- 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.

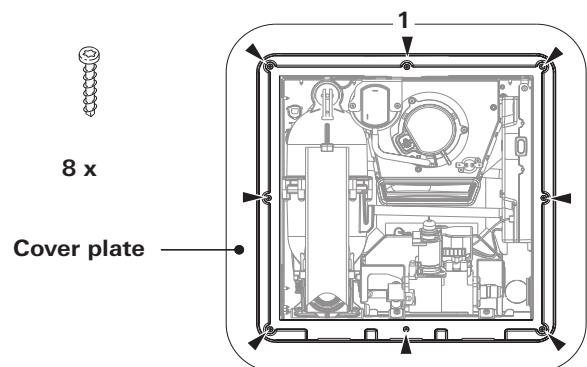


Fig. 23

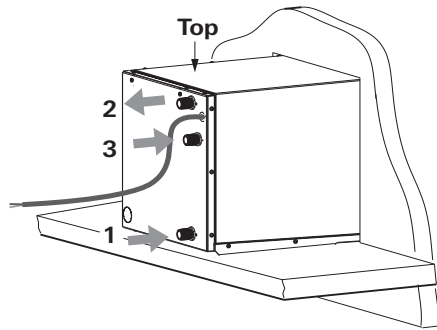


Fig. 24

- **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).

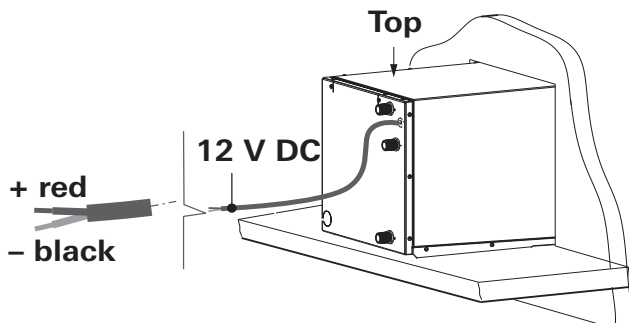


Fig. 25

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.

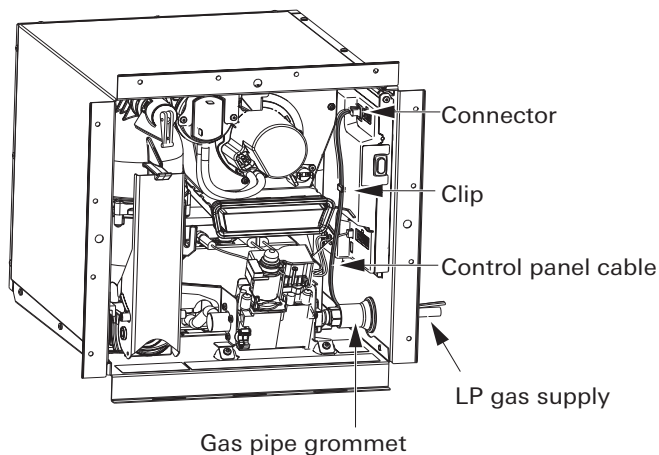
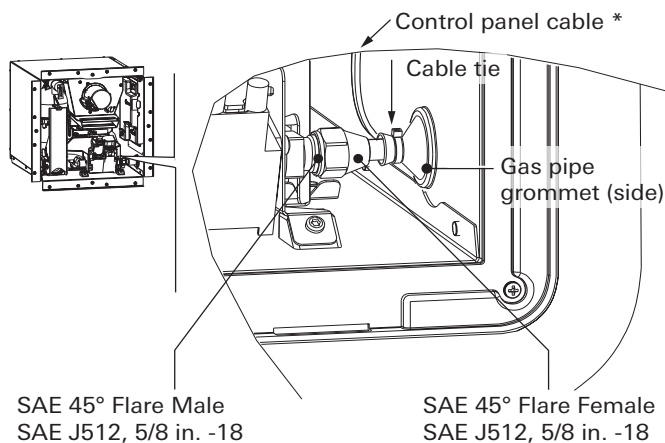


Fig. 26

- **[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.

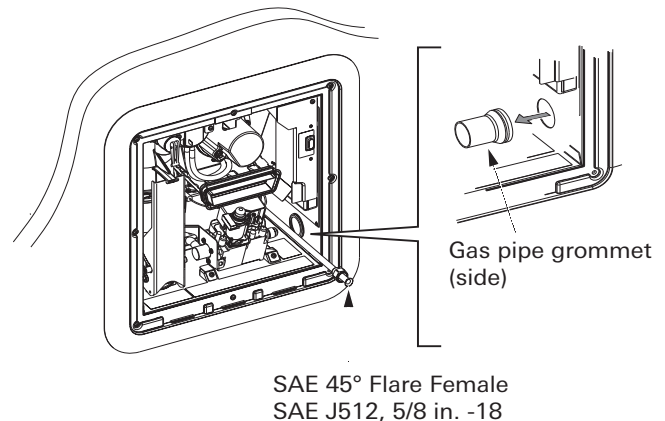


Fig. 28

- **[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)).

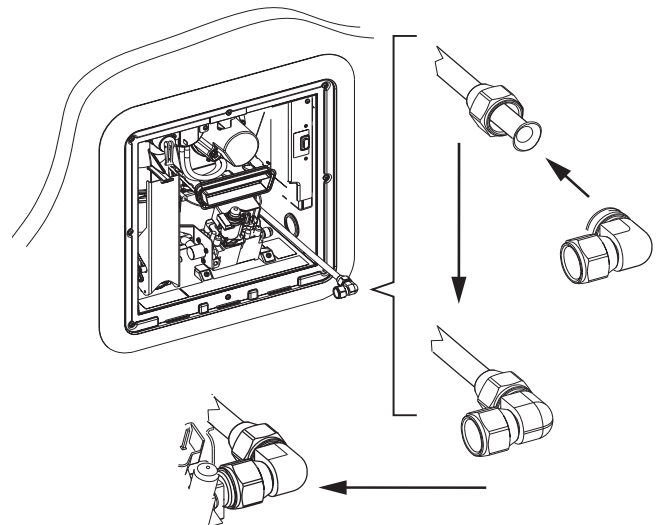


Fig. 29



- 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.

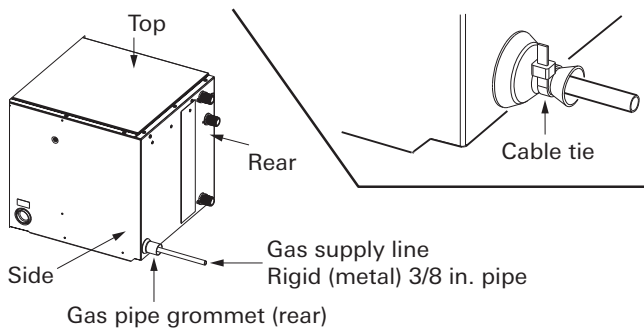


Fig. 30

- **Only AquaGo basic (without control panel):**

- Close the side hole with the plug.

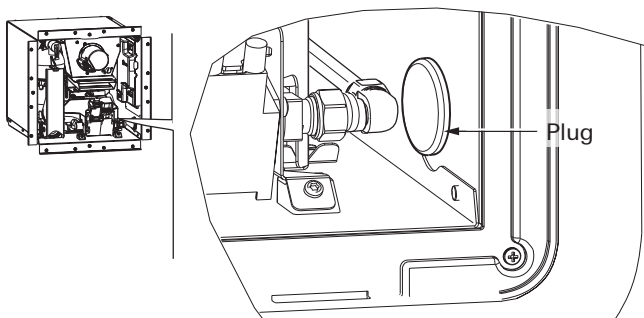


Fig. 31

- **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.

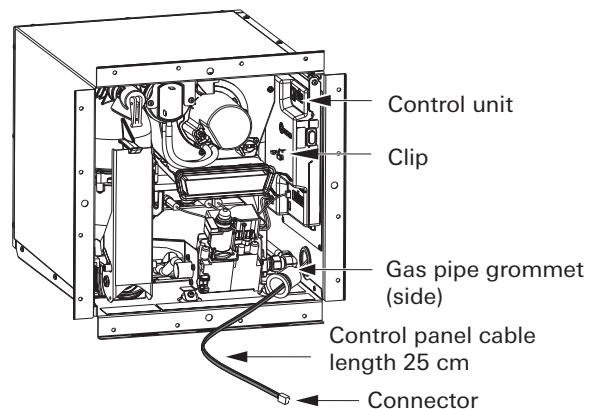


Fig. 32



- Install the side gas pipe grommet with the control panel cable in the side hole.

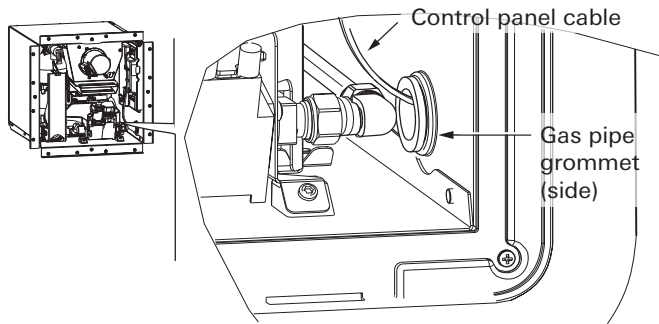


Fig. 33

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,l,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,l,s,l	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,l	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,l,s	Too low gas pressure.	Gas supply (in vehicle) to the appliance insufficient.
29	s,s,s,l,l,l,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

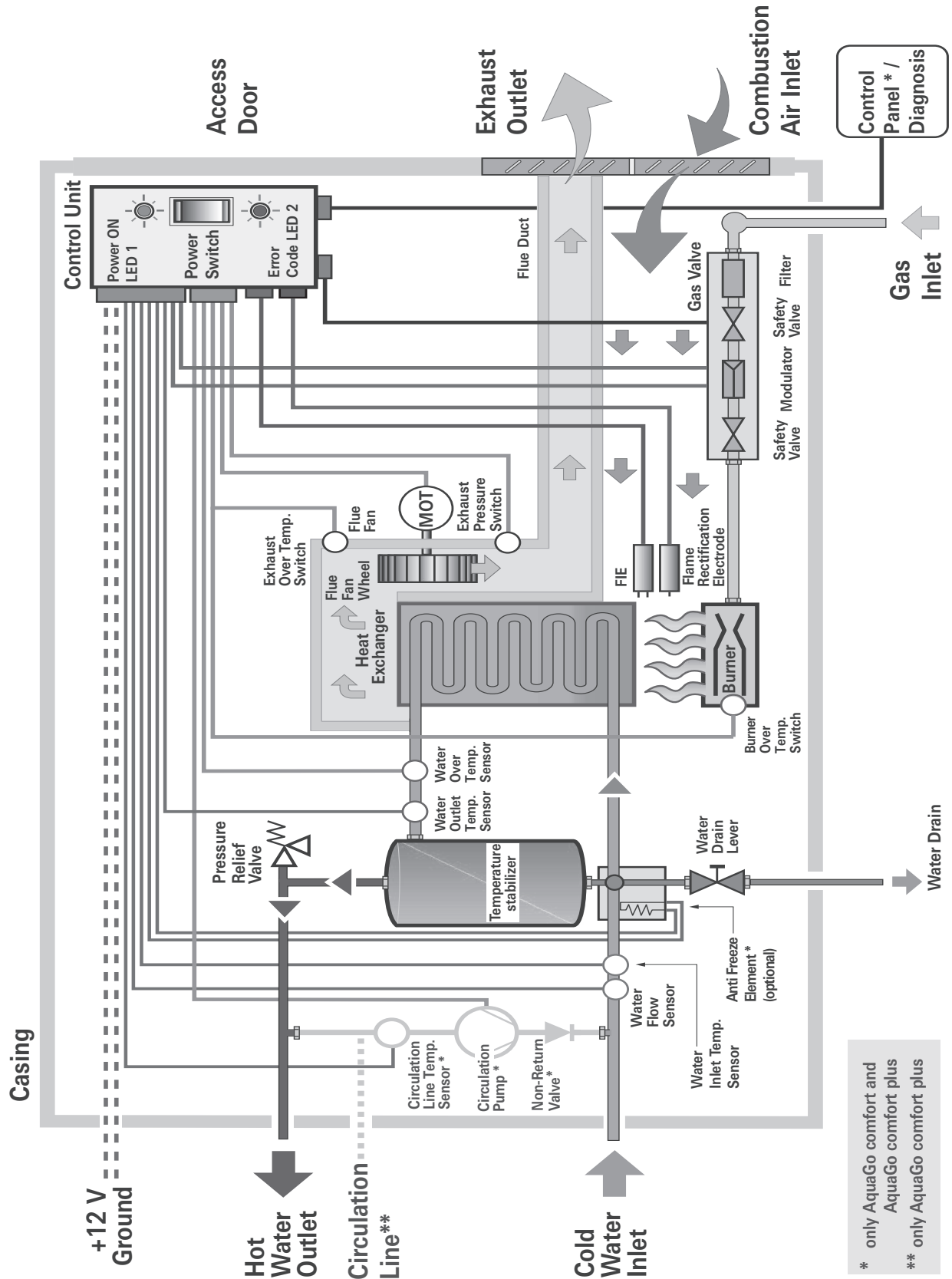


Fig. 34



APPENDIX C – Spare Parts (all models)

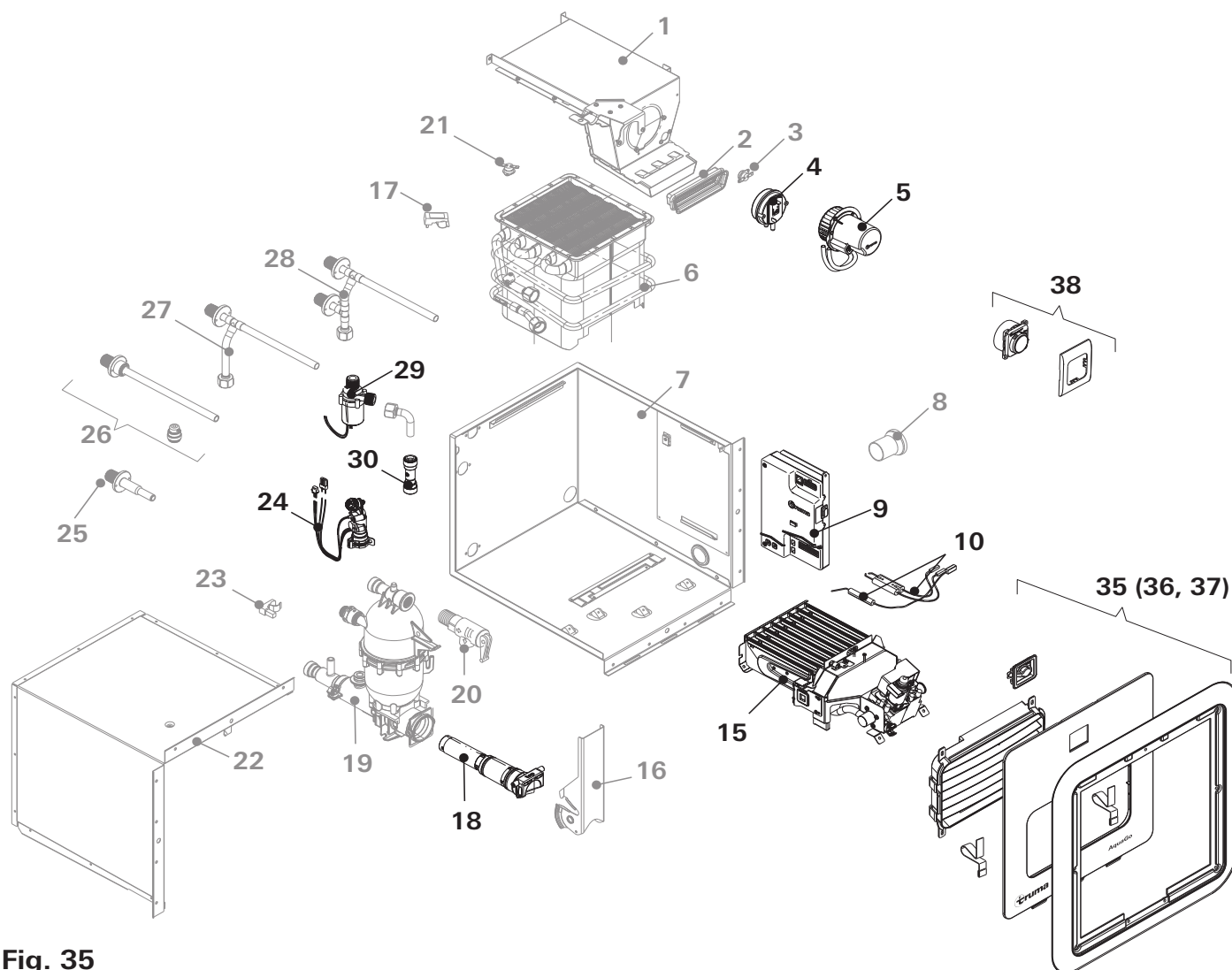


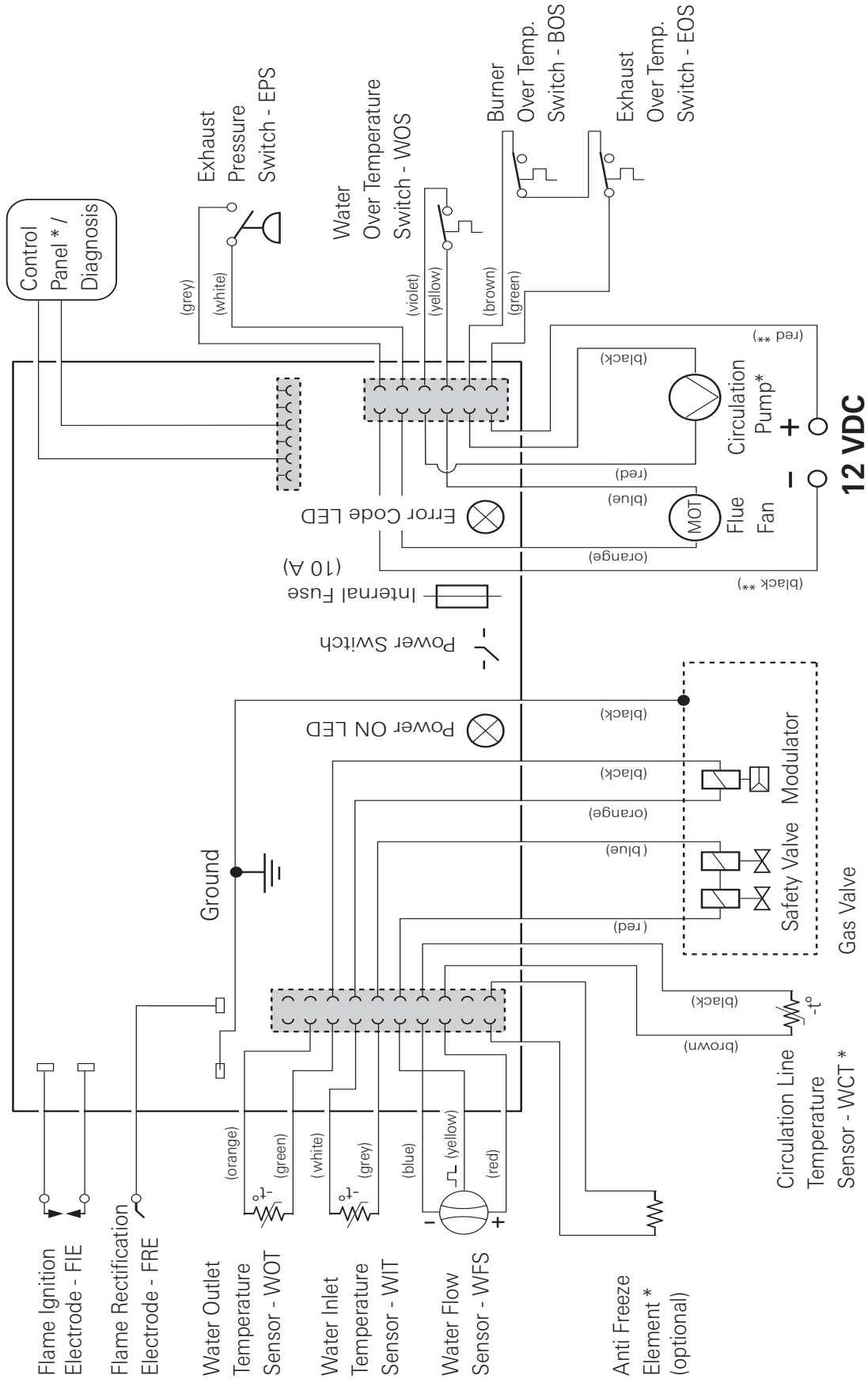
Fig. 35

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



* 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)

Fig. 36



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).



Painting a detached access door

 If necessary for masking or painting, the access door can be detached temporarily.

- Remove the four (4) screws that fix the webbing.
- 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.

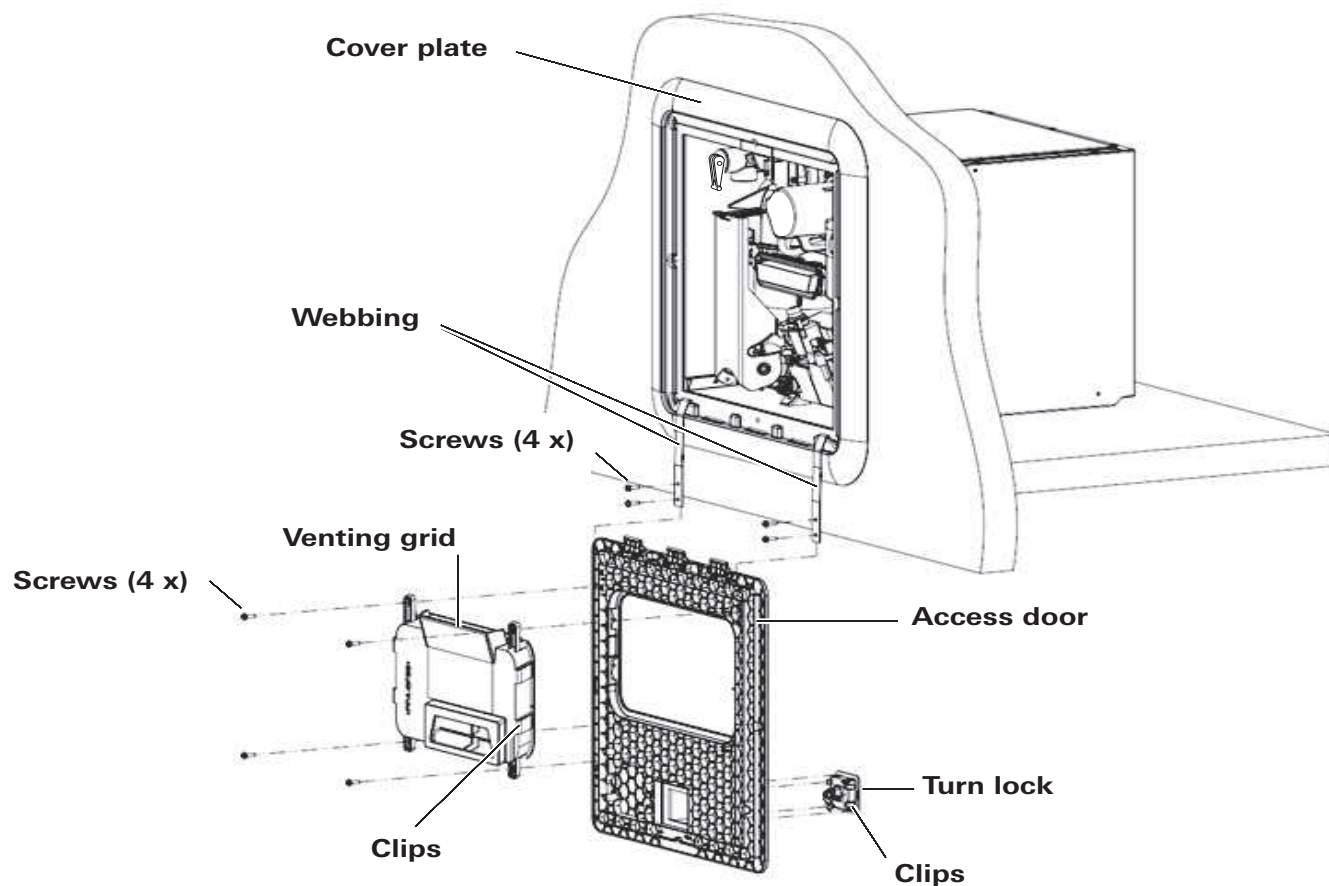


Fig. 37

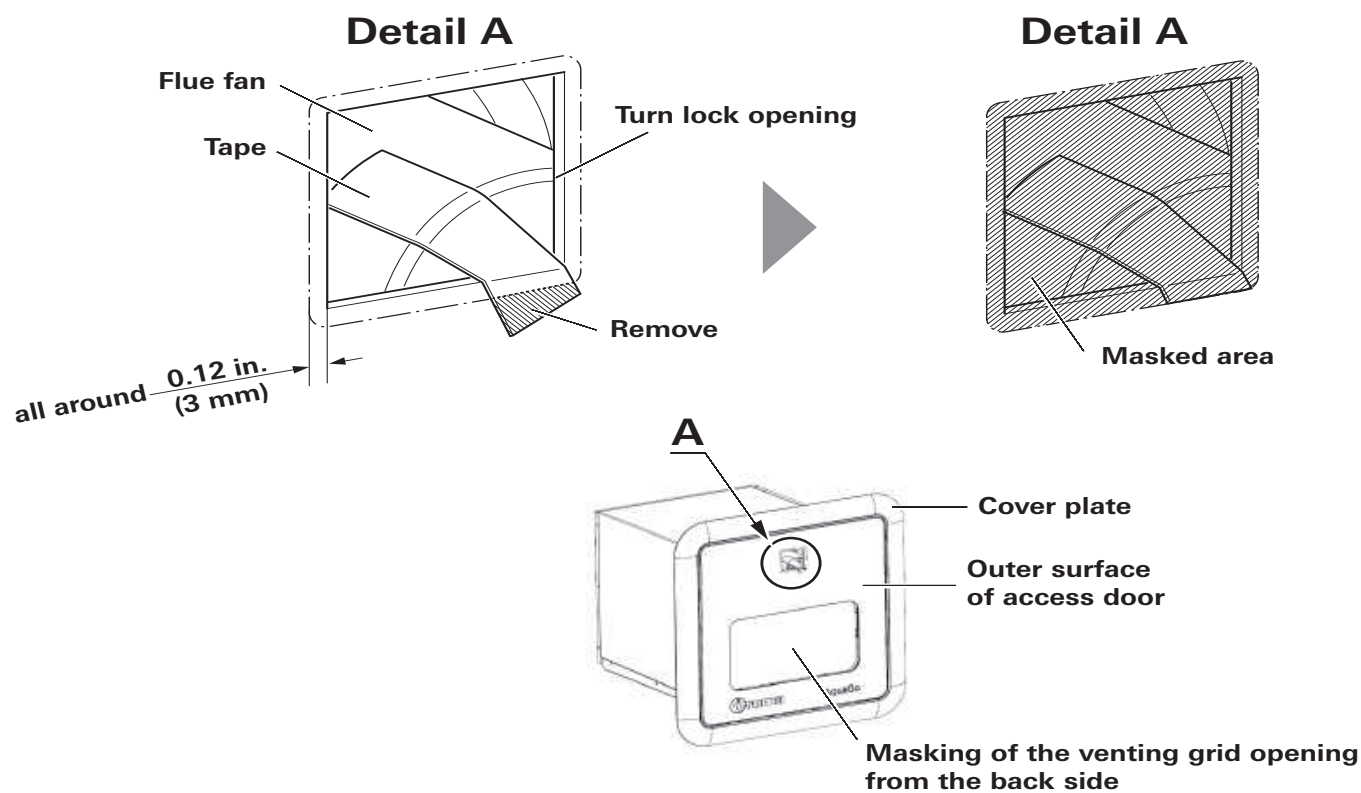


Fig. 38



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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Fax 1-574-538-2426
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www.truma.net



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.



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

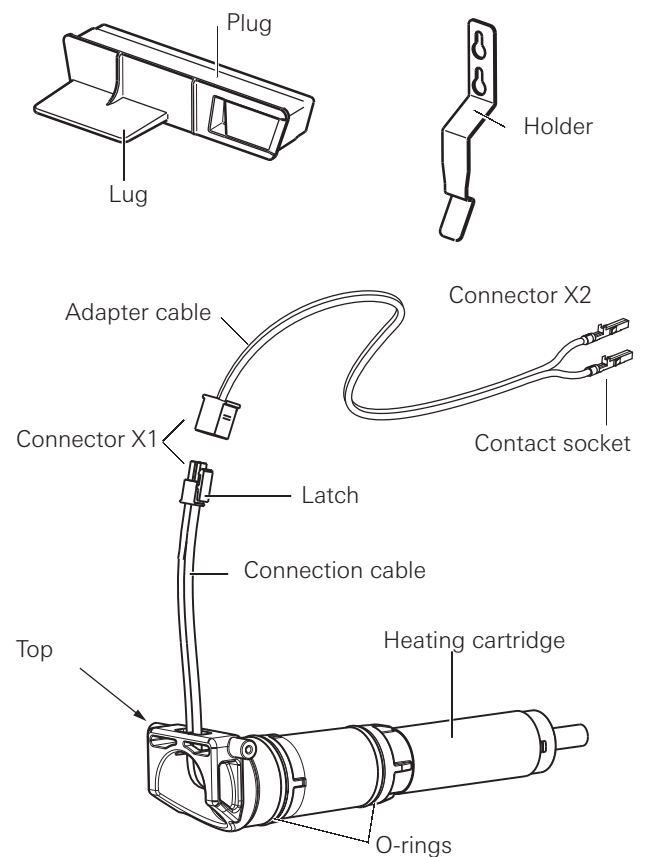


Fig. 1



Installation instructions



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.

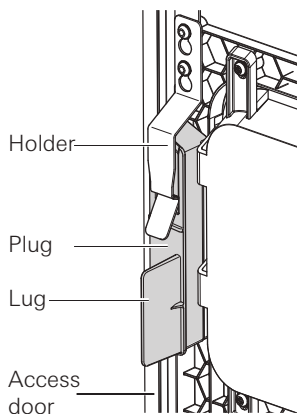


Fig. 3

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.

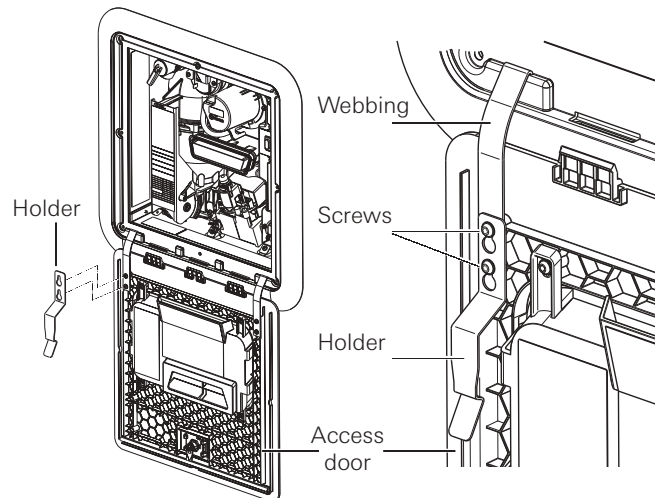


Fig. 2

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.



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.

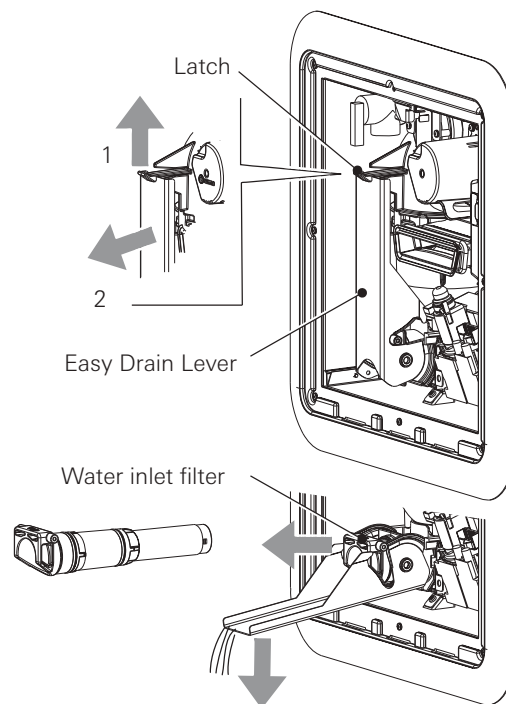


Fig. 4a

7

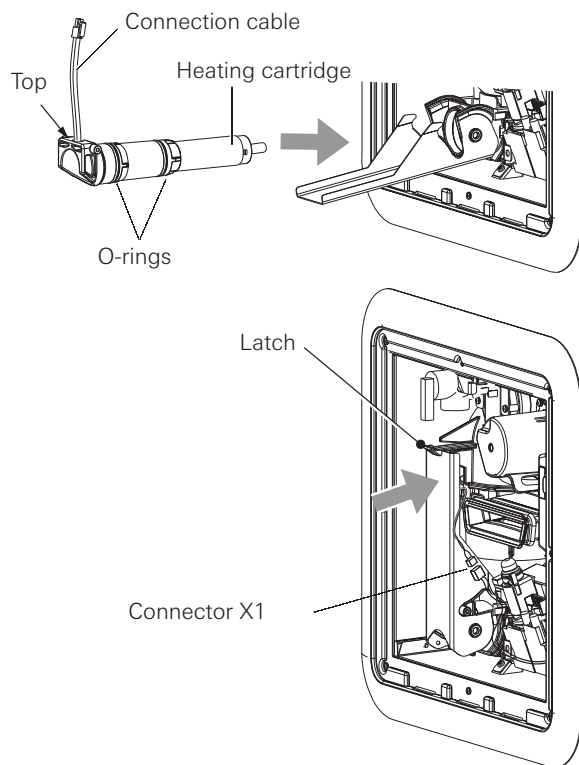


Fig. 4b

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).



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).

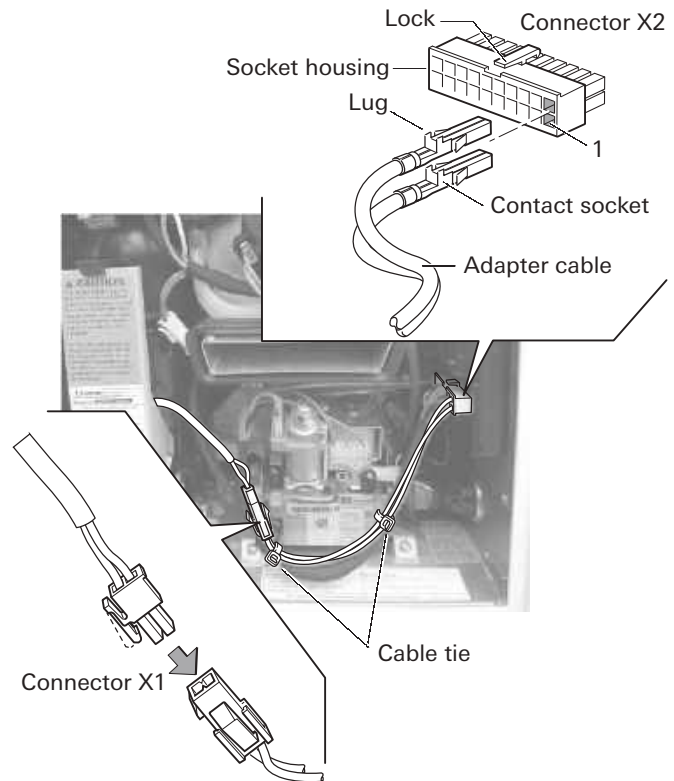


Fig. 5

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).

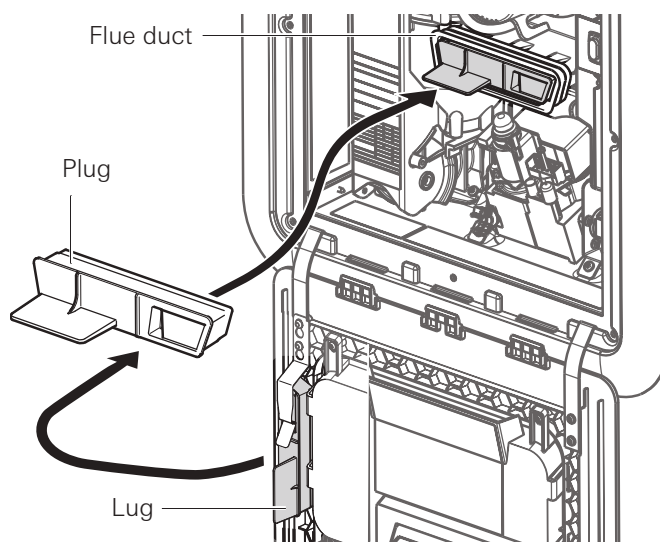


Fig. 6

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.

8. Switch ON the Truma AquaGo™ instant water heater at the POWER switch.
9. Insert and close the access door.

10. Check the position of the plug. You must be able to see the lug through the venting grid – as shown in Figure 7.

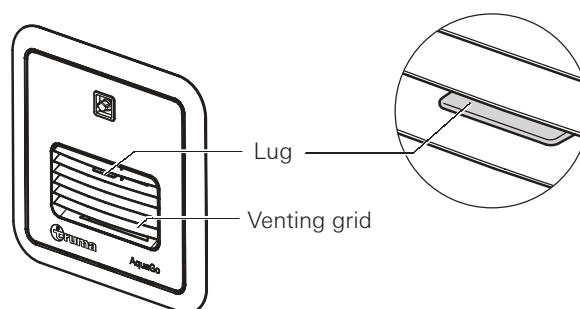


Fig. 7

11. Select operating mode ANTIFREEZE (see Figure 8).

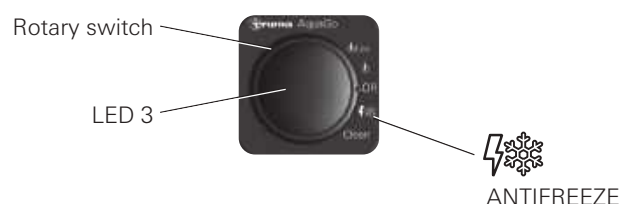


Fig. 8



- 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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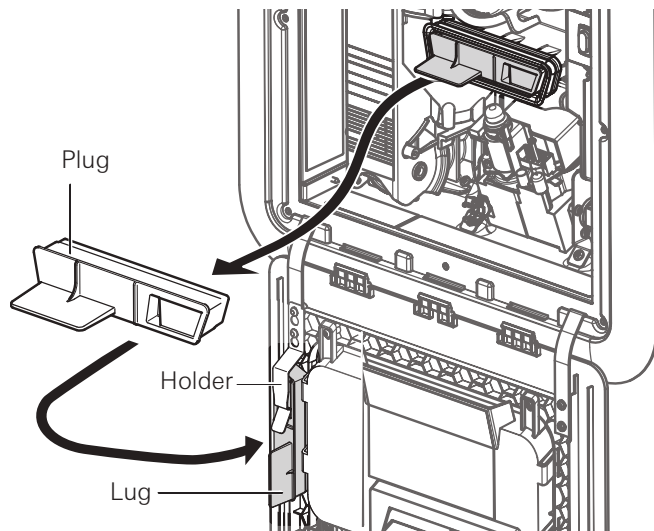


Fig. 9

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.



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).

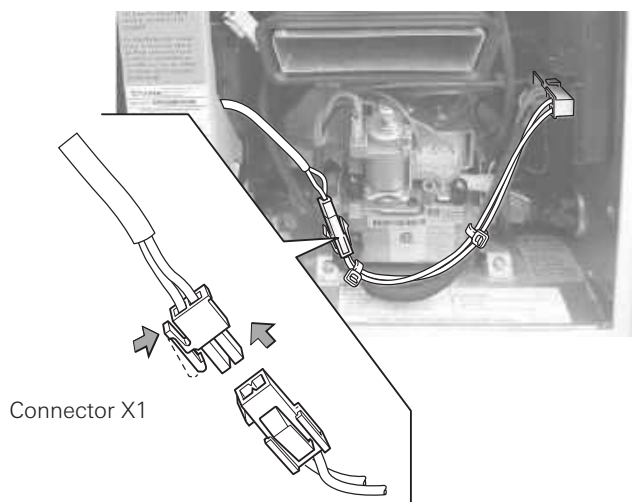


Fig. 10

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.

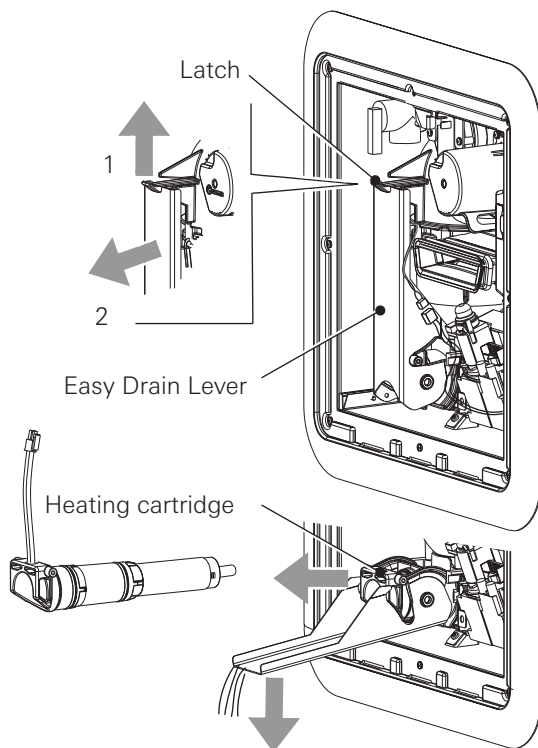


Fig. 11a

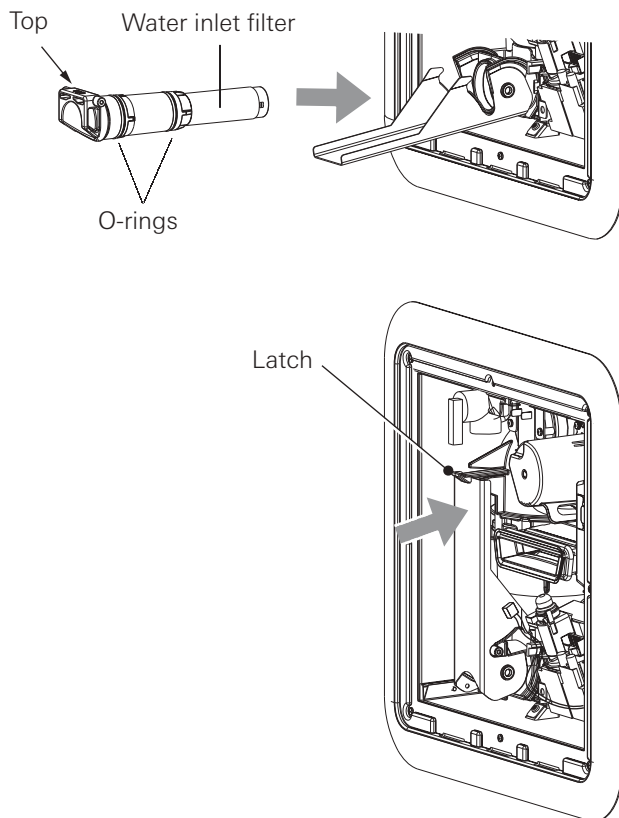


Fig. 11b



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

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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.



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



FURRION

4.3" Vision S Camera System Système 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

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.

English



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

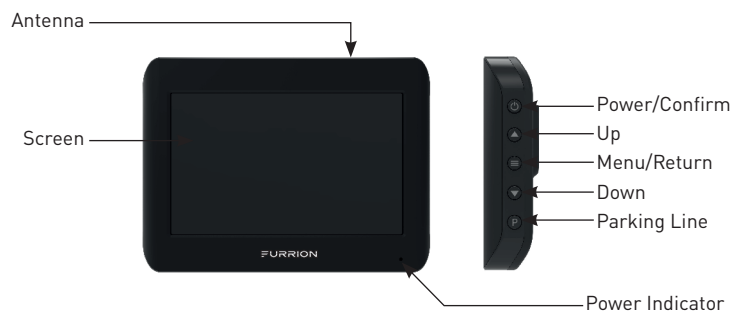
Product Description

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.

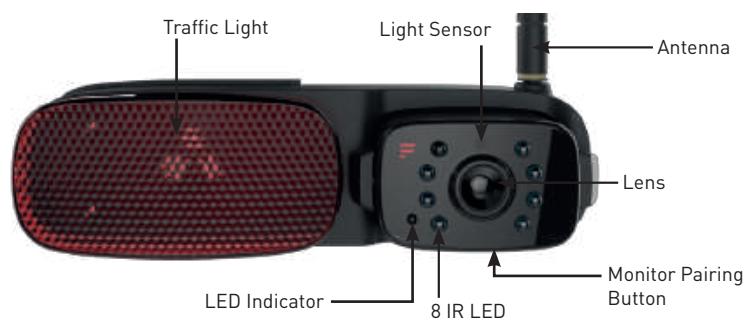
CAUTION: Do not back up your vehicle while watching the monitor screen. Always look in the direction the vehicle is traveling. Use the monitor as an aid to ensure there are no children or obstructions. The image on the monitor is not designed to show distance and may be misleading. The actual distance 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

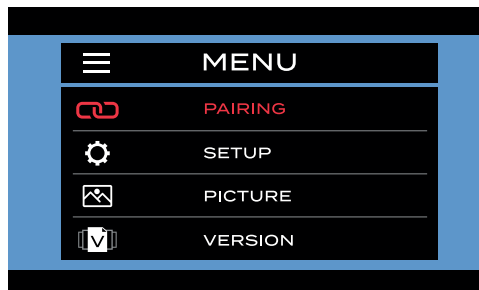
In off mode, press the  button on the right of the monitor to turn on the monitor. In on mode, press and hold the  button to activate the monitor.

There are four options that allow you to set the wireless vehicle rear observation system before operating.

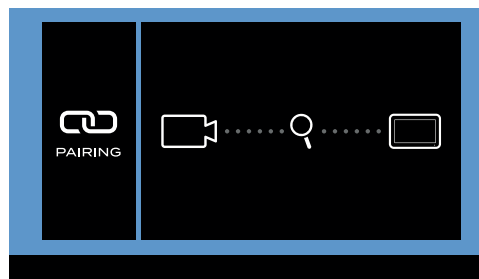
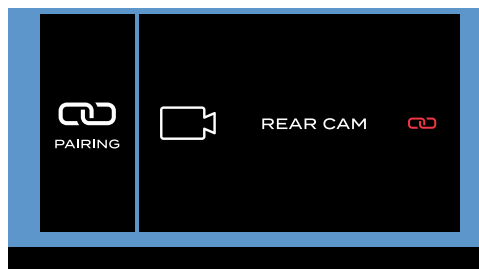


Pairing the Camera and Monitor

1. Use  or  button to highlight **PAIRING** menu, then press  to enter the next page.




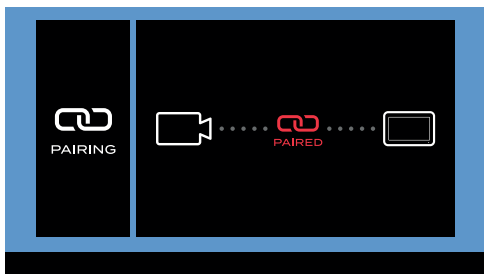
2. Press the **"MONITOR PAIRING"** button at the bottom of selected camera to pair.



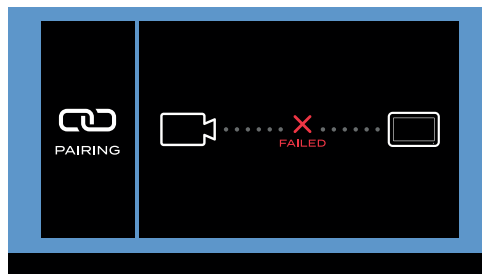


Getting Started

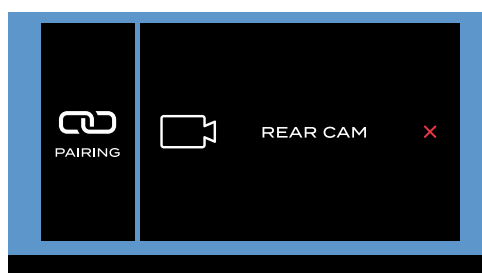
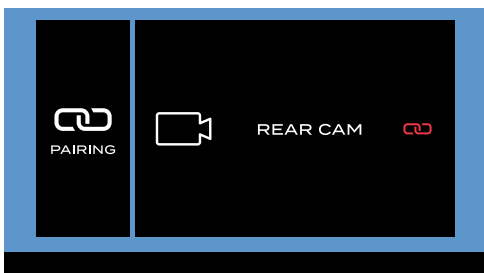
3. Once paired successfully, a red  icon will appear after the device list.



4. An **X** icon indicates pairing failed, repeat steps 2 and 3 to pair again.



English



5. Repeat steps 1 to 4 to pair the other cameras.
6. Refer to "**Camera Settings**" section for detail settings of the camera.



Installation

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)

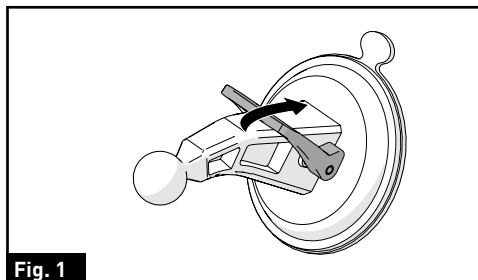


Fig. 1

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)

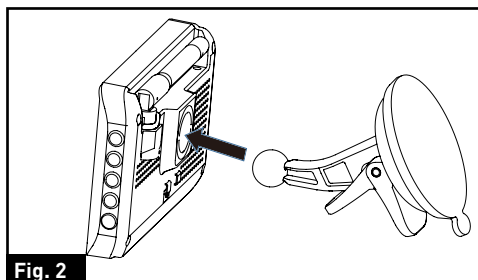


Fig. 2

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.

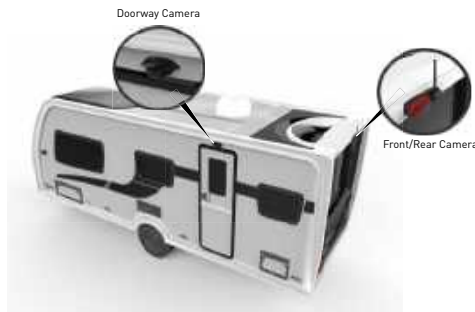
Suitable Installation Position

- 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.

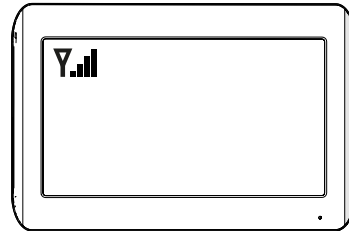


Camera Location

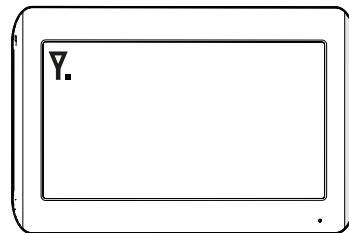
Testing

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  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)

- 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)

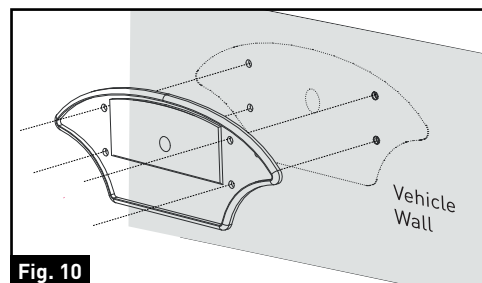


Fig. 10

- Drill a $\frac{5}{8}$ " center hole on the vehicle wall using a $\frac{5}{8}$ " hole saw. (Fig. 11)



Installation

English

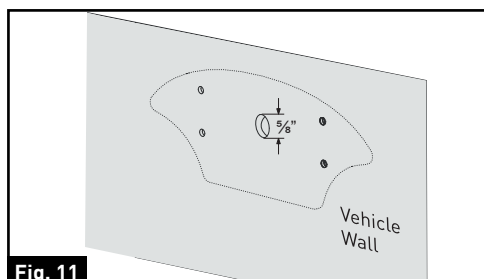


Fig. 11

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)

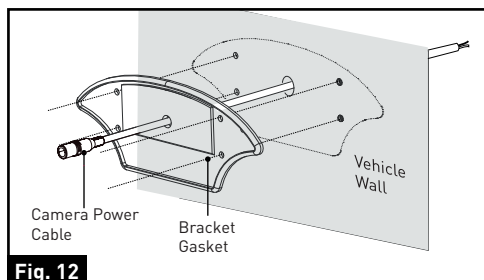


Fig. 12

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)

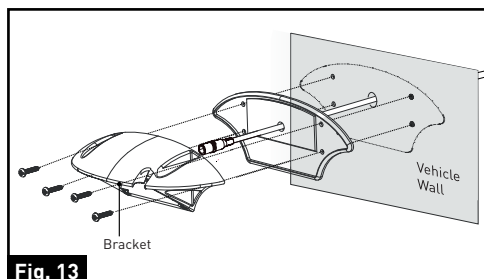


Fig. 13

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)

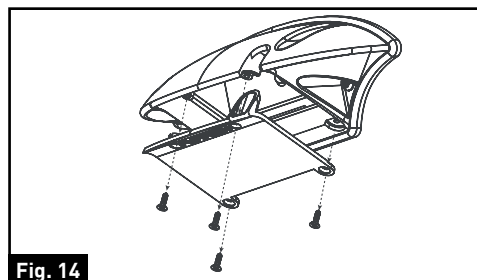


Fig. 14

7. If a doorway camera is to be installed, remove the Bracket Cover by unscrewing the four screws. (Fig. 15)

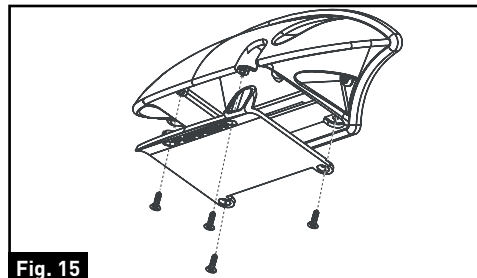


Fig. 15

8. Pull out the camera power cable, leaving approx 2 inches of slack. (Fig. 16)

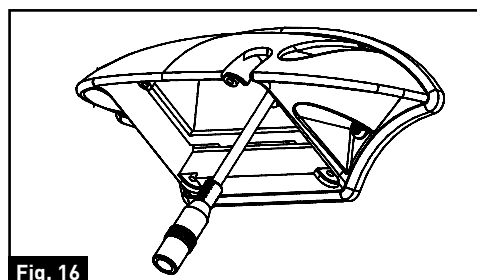


Fig. 16

9. Connect the camera power cable to the camera cable. (Fig. 17)



Installation

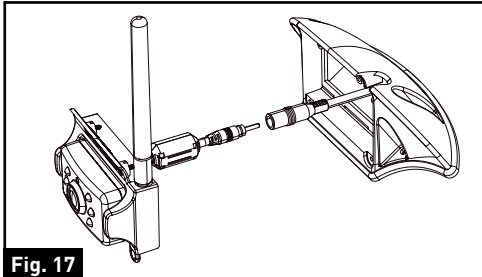


Fig. 17

10. Place the attached cables and connections into the bracket housing by first placing the cable to the right. (Fig. 18)

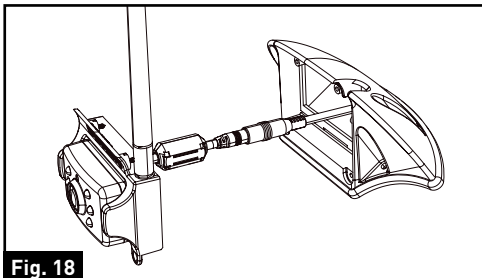


Fig. 18

11. Place the camera cable filter in the left of the bracket housing. (Fig. 19)

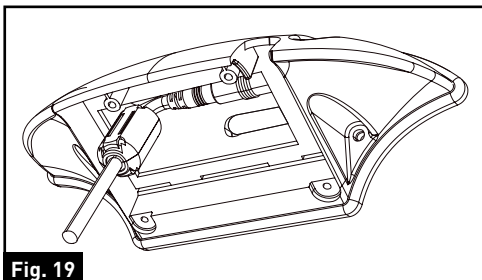


Fig. 19

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)

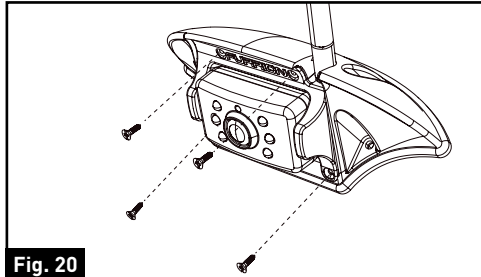


Fig. 20

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)

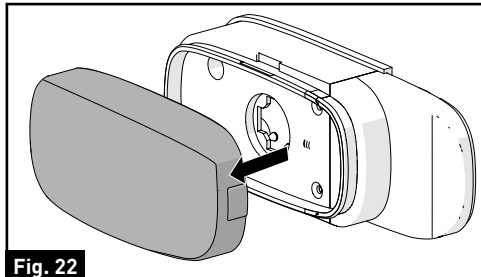


Fig. 22

3. Remove the two screws holding the decorative part using a Phillips-head screwdriver and set aside. (Fig. 23)



Installation

English

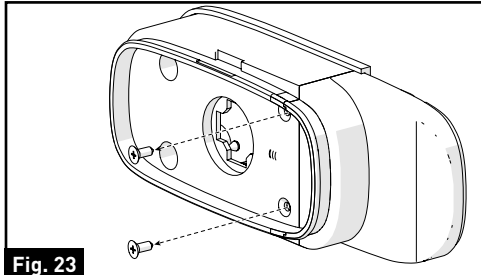


Fig. 23

4. Pull to remove the decorative part from traffic light and save in a safe place in case of future use. (Fig. 24)

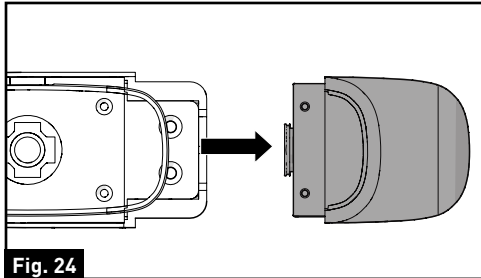


Fig. 24

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)

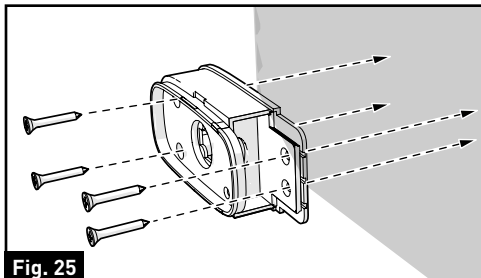


Fig. 25

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)

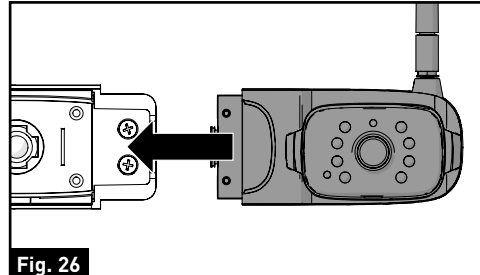


Fig. 26

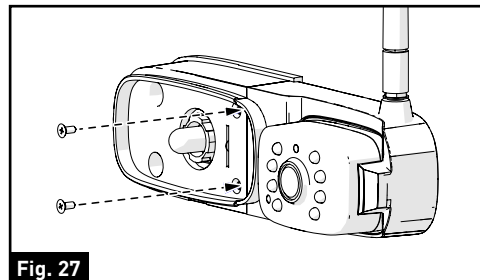


Fig. 27

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)

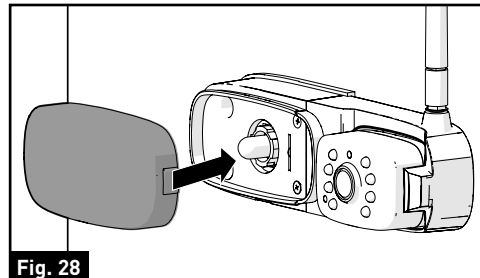


Fig. 28

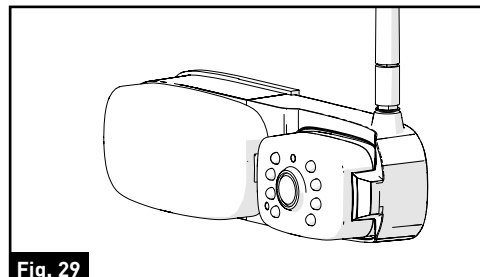


Fig. 29



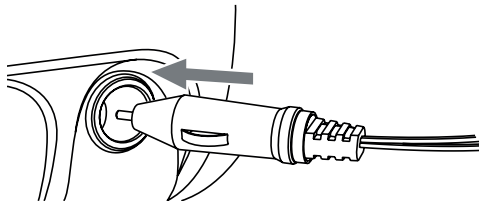
Installation

- 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

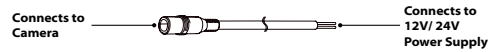
When connecting wires, ensure the circuit is isolated by disconnecting the negative terminal on the battery.

- Ensure correct polarity when wiring the cables. RED + BLACK -.
- Ensure correct polarity when wiring.
- Wire connections and terminals must be sealed and waterproof.

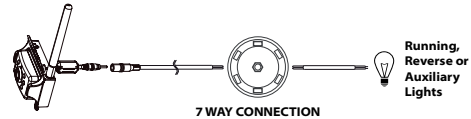
The Furrion Vision S Camera System can be connected to an electrical power source via a 7 Way Connector.

Wiring to running lights: the camera will activate when the running lights are switched on.

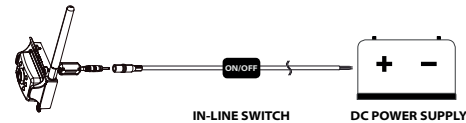
Wiring to reverse lights: the camera will activate when the vehicle engages reverse gear.



Consult the vehicle's service manual for specific wiring color code.

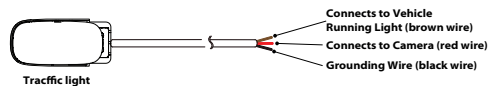


When wiring this camera directly to a 12V battery or converter in your RV, use an in-line switch on the power cable to power on or off your camera. This will enable this camera to be used when parked without a tow vehicle connected.



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

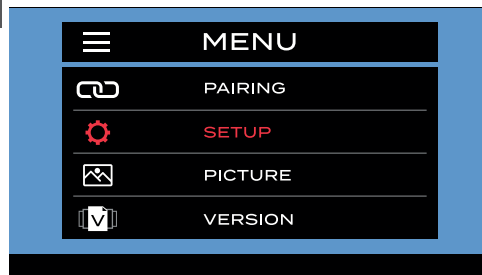


Change Settings

English

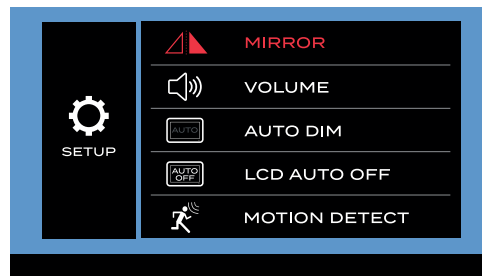
Camera Setting

Use ▲ or ▼ button to highlight **SETUP** menu, then press ⏻ to enter the next page or press ≡ button to return to the previous page.

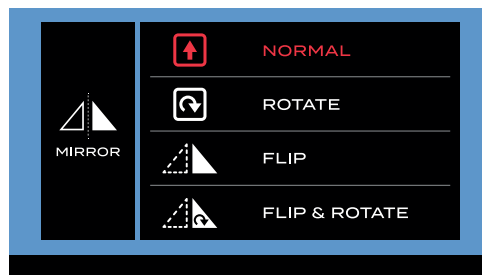


MIRROR SETTING

1. Use ▲ or ▼ button to highlight **MIRROR** menu, then press ⏻ to enter.

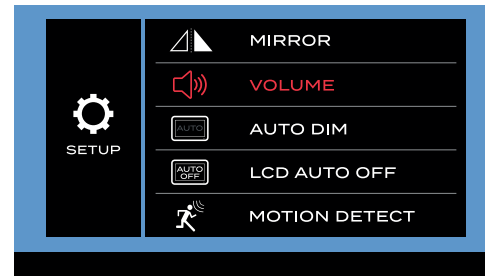


2. Press ▲ or ▼ button to set the camera image as **NORMAL** (0o), **ROTATE** (90o), **FLIP** (180o) or **FLIP & ROTATE** (270o). Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



VOLUME SETTING

1. Use ▲ or ▼ button to highlight **VOLUME** menu, then press ⏻ to enter.

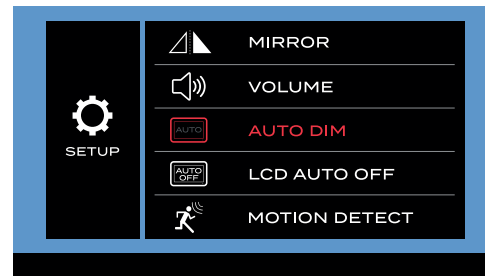


2. Press ▲ to increase the volume or press ▼ to decrease.



AUTO DIM SETTING

1. Use ▲ or ▼ button to highlight **AUTO DIM** menu, then press ⏻ to enter.

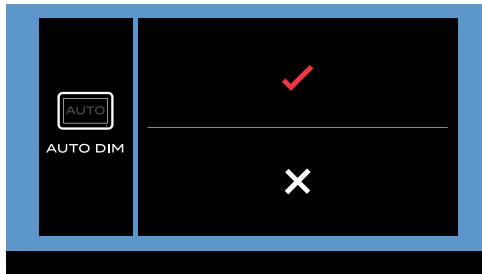


2. Use ▲ or ▼ button to select ✓ or ✗. Press ⏻ to confirm your selection or press ≡ button to return to the previous page. Press ✓ or ✗ to enable or disable



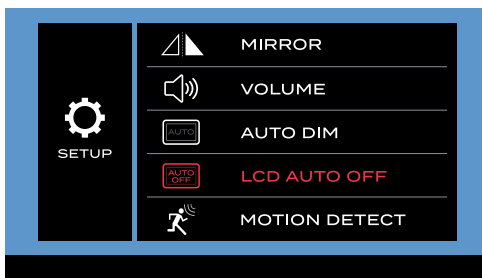
Change Settings

the light detective function.



LCD AUTO OFF SETTING

1. Use ▲ or ▼ button to highlight **LCD AUTO OFF** menu, then press ⏻ to enter.



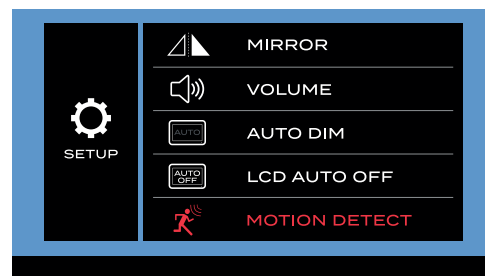
2. Press ▲ or ▼ button to set the LCD auto off time as **10 SEC, 20 SEC, 30 SEC** or **X** (off). Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



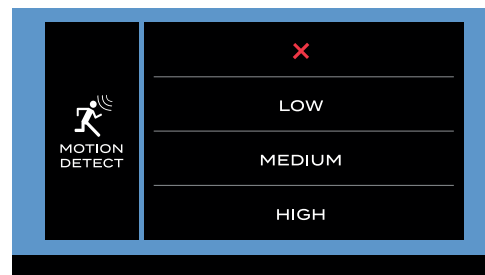
MOTION DETECT SETTING

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

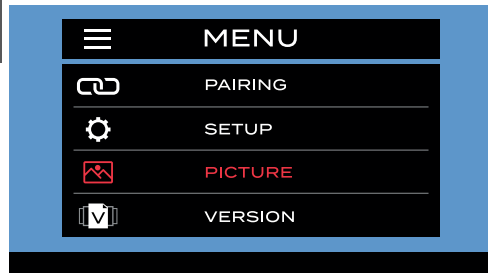


Change Settings

English

Picture Setting

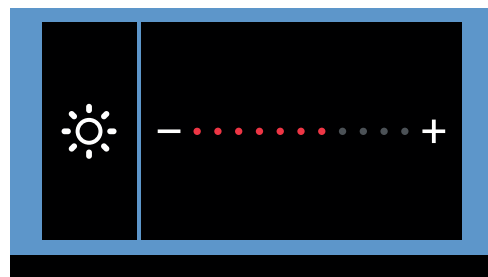
1. Use ▲ or ▼ button to highlight **LCD AUTO OFF** menu, then press ⏻ to enter.



2. Use ▲ or ▼ button to highlight **BRIGHTNESS, CONTRAST** or **COLOR** menu, then press ⏻ to enter.

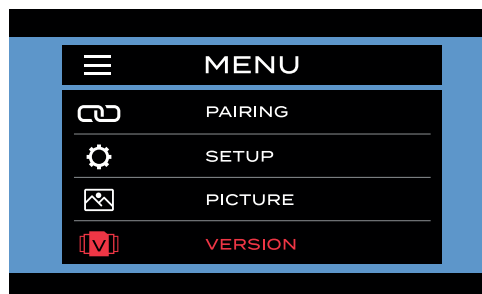


3. Press ▲ or ▼ to change the **BRIGHTNESS, CONTRAST** or **COLOR** setting. Press ⏻ to confirm your selection or press ≡ button to return to the previous page.



Software Version

Use ▲ or ▼ button to highlight **VERSION** menu, then press ⏻ to enter and view the current software version.

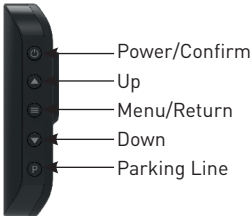







Operation

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



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.

English



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.

20

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



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

English

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.



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

- 52567 Independence Ct., Elkhart, IN 46514, USA ● Toll free: 1-888-354-5792
- Email: support@furrion.com

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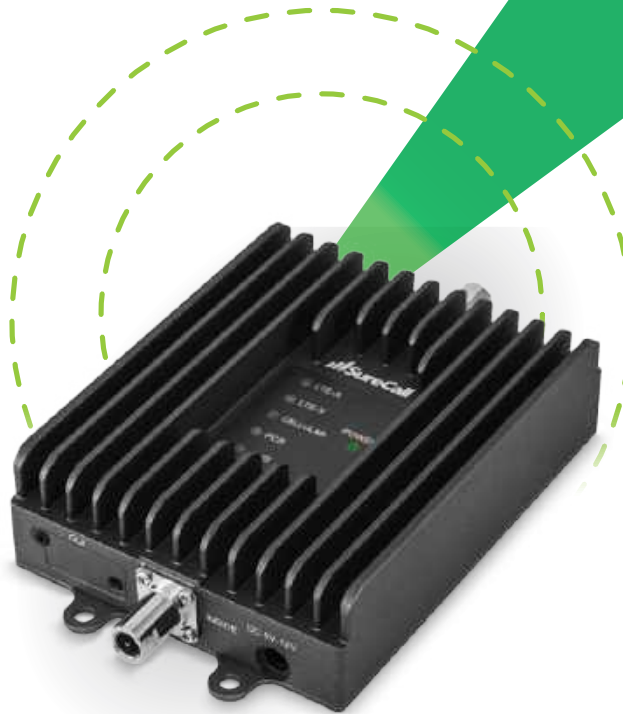
IM-FCM00002 V4.0



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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Step 2. Install the Signal Booster	6
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Antenna Kitting Information	9
Consumer Guidelines	10
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How It Works

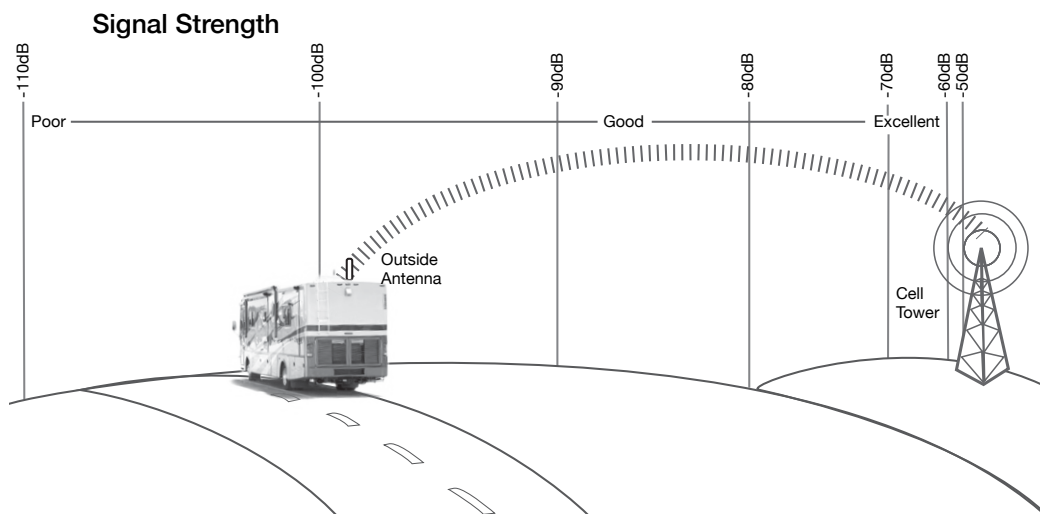
How It Works

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



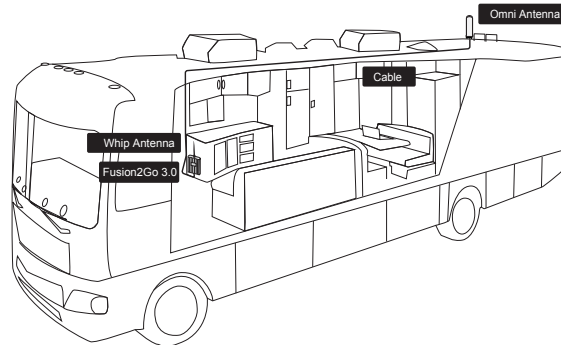
Installation

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.

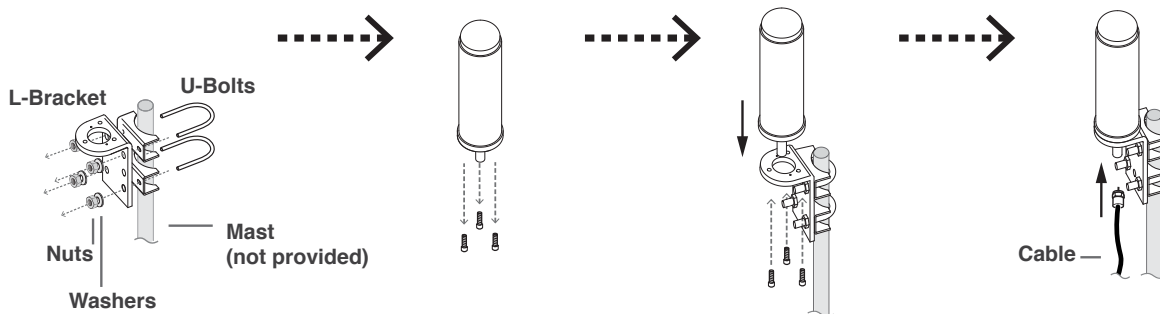
The provided antenna is omni-directional, which receives and sends signals in a 360° radius. Mount the antenna at the highest possible elevation and in an upright position.

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.

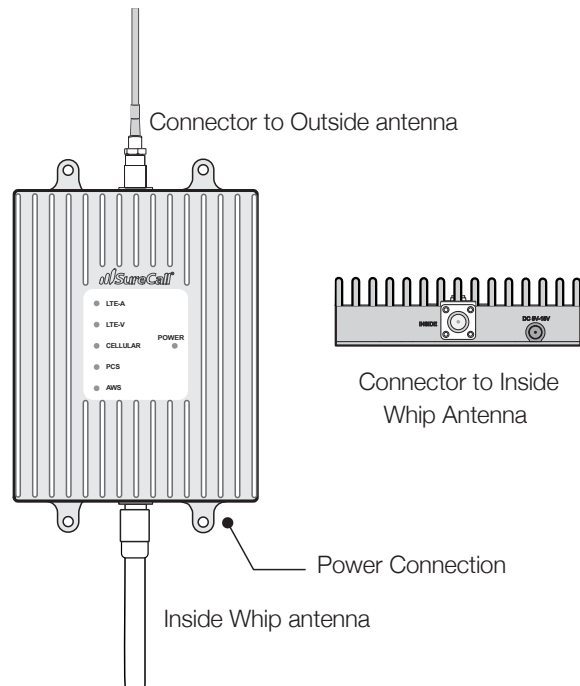




Installation

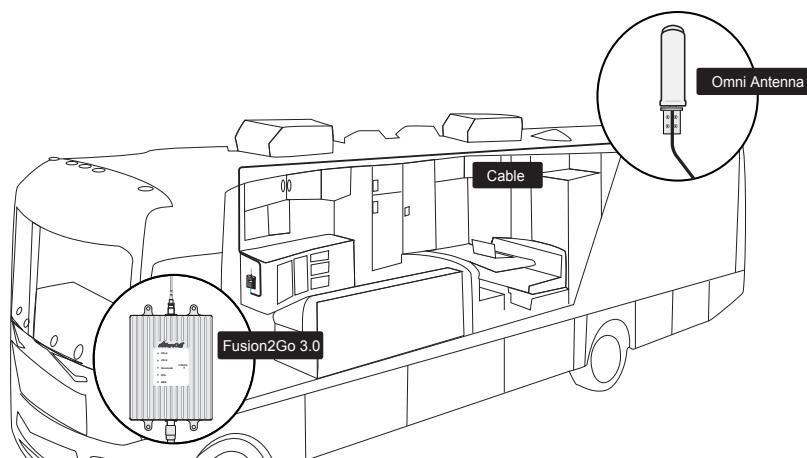
Step 2. Install the Signal Booster

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 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.





Installation

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 $+158^{\circ}$ 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/attsigbooster.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.

48346 Milmont Drive
Fremont, California 94538, USA
888.365.6283
www.surecall.com

SureCall has made a good faith effort to ensure the accuracy of the information in this document and disclaims the implied warranties of merchantability and fitness for a particular purpose and makes no express warranties, except as may be stated in its written agreement with and for its customers. SureCall shall not be held liable to anyone for any indirect, special or consequential damages due to omissions or errors. The information and specifications in this document are subject to change without notice.

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SureCall
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Fremont, CA 94538 USA
www.SureCall.com | 888.365.6283 | support@surecall.com



Models: RVTV-B2 (Black)
RVTV-W2 (White)

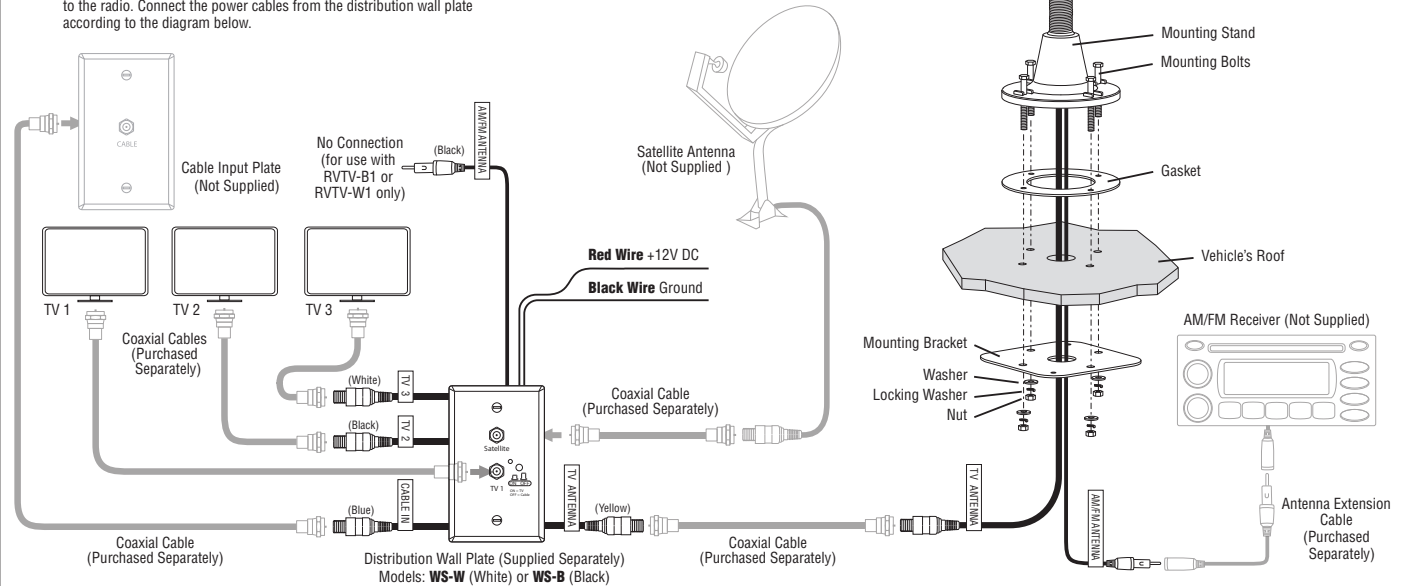
Installation Instructions

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: 110dB μ V
Impedance: 75 Ω
Power supply: DC 12V



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Compton, CA 90220

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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)



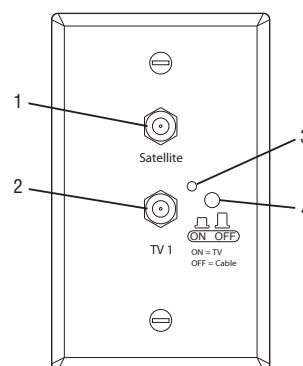
Operating Instructions

Distribution Wall Plate Features

Features:

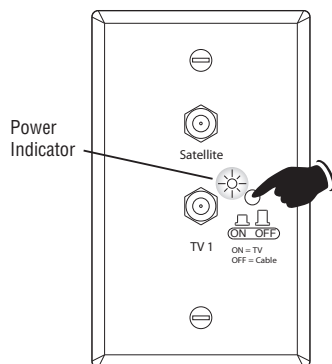
- Compatible with HDTV.
- Built-in high gain and low noise amplifier, shielded for minimum interference.
- Omnidirectional antenna receives VHF, UHF and AM/FM signal from every point regardless of the direction you are traveling.
- Amplifier with SMD technology and micro-electronics ensures excellent 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

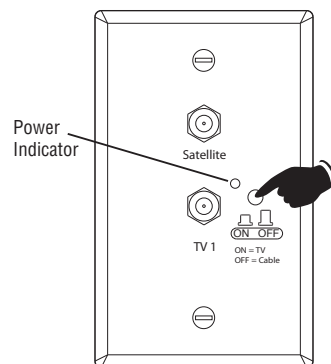
To receive TV antenna reception press the On/Off switch so the power indicator is lit.



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.



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For Technical Assistance, please call (800) 638-3600



Omnidirectional Digital HDTV Over-the-Air Antenna



Installation and Operating Instructions

**OA1000 • OA1000-OE • OA1010-OE (White)
OA1001 • OA1001-OE • OA1011-OE (Black)**

Thank you for choosing a KING Antenna!

The KING OmniPro is an omnidirectional antenna.
It's *always* pointed in the right direction!

OPERATION

- 1 Turn on your TV.
Turn on the power injector.***



*You must have a properly installed KING wall mount power injector to operate the KING OmniPro.

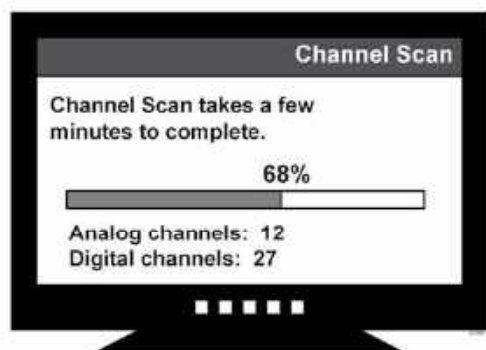
KING Wall Mount Power Injector for models:

OA1000 • OA1001 (supplied with this product)
OA1000-OE • OA1001-OE (ordered separately)
OA1010-OE • OA1011-OE (ordered separately)

**See your TV or converter box owner's manual for instructions on performing a channel scan.

Installation instructions start on next page.

- 2 Perform a channel scan.****



Sample screen: number of channels will vary

- 3 Start watching TV!**



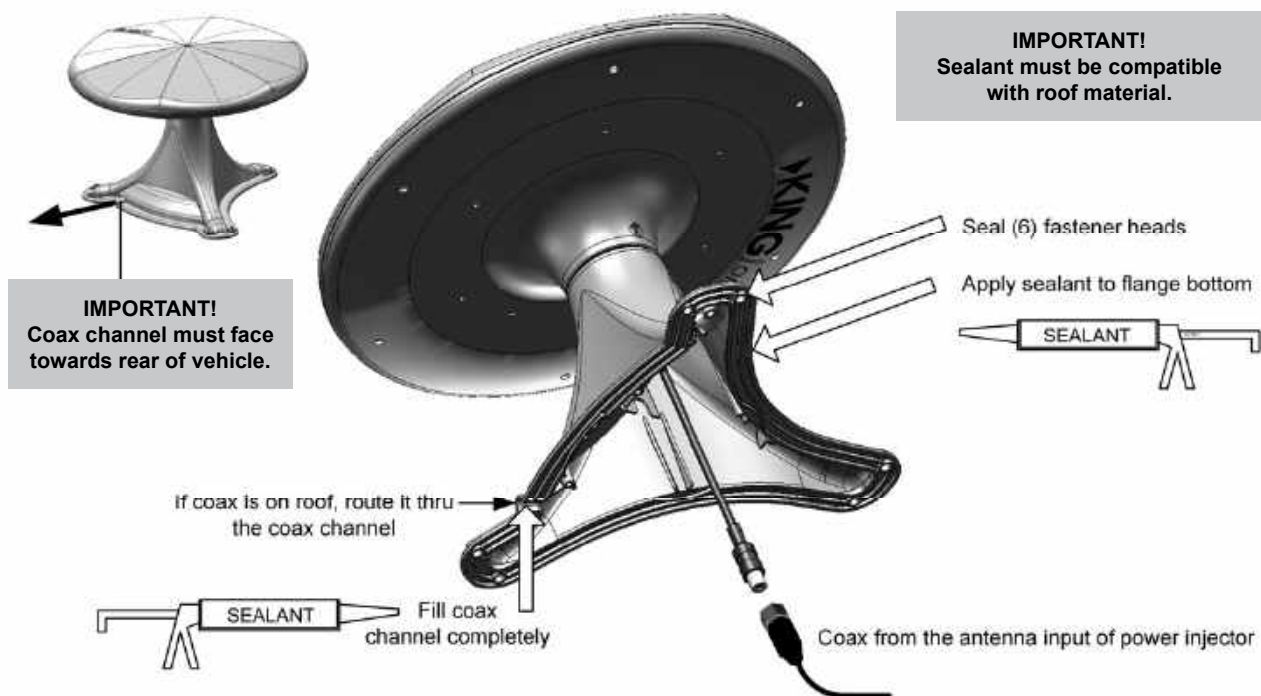


ANTENNA INSTALLATION

IMPORTANT! The installer is responsible for determining and supplying the most appropriate fasteners to secure the antenna to the roof, and for weatherproofing all holes with roof-compatible sealant.

All holes and fastener heads must be sealed so they are completely waterproof.

1. Select an area on the roof for the base mount keeping in mind the following **IMPORTANT POINTS**:
 - a) The antenna must be mounted with the coax channel towards the rear of the vehicle.
 - b) The center of the roof hole must be at least 20" away from any object taller than 8" to provide clearance for the antenna head. The center of the roof hole must also be at least 8" from the edge of the roof.
2. Connect the coax from the power injector's antenna input to the coax cable in the base mount. (The coax may come up thru the roof or enter thru the coax channel.)
3. Apply sealant to the base mount, and fill the coax channel with sealant. Place the base mount in position.
4. Fasten the base mount to the roof. Make sure the base mount is sealed all the way around. Make sure the coax channel and fastener heads are sealed as well.

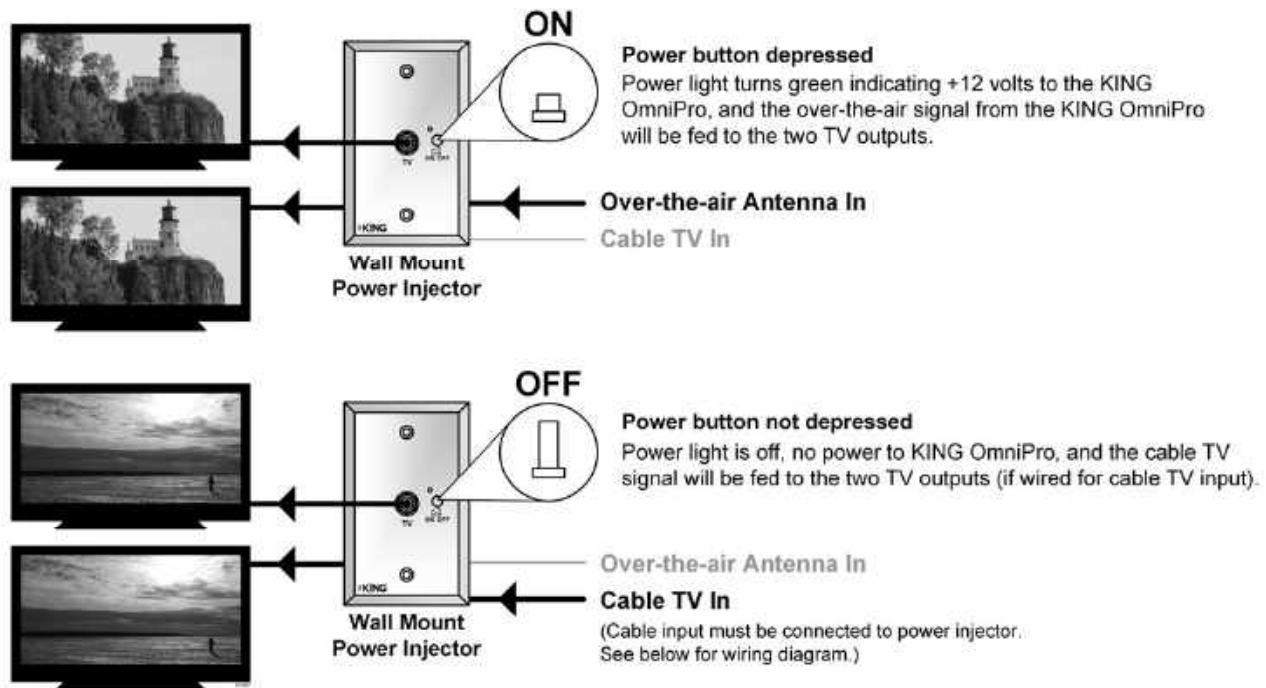


SPECIFICATIONS

SPECIFICATIONS	
Dimensions:	9" H x 13" W x 13" L
Weight:	2.2 lbs.
Frequency:	VHF (54-216 MHz)
Bands:	UHF (470-698 MHz)
	FM (87.9-107.9 MHz)
	AM (530-1700 KHz) (OA1010-OE • OA1011-OE only)
Power requirement:	+12 Volt / 100 mA
Power supplied by:	KING Power Injector OA1000 • OA1001 (supplied with this product) OA1000-OE • OA1001-OE (ordered separately) OA1010-OE • OA1011-OE (ordered separately)
Enclosure/Mount:	ASA-Automotive grade



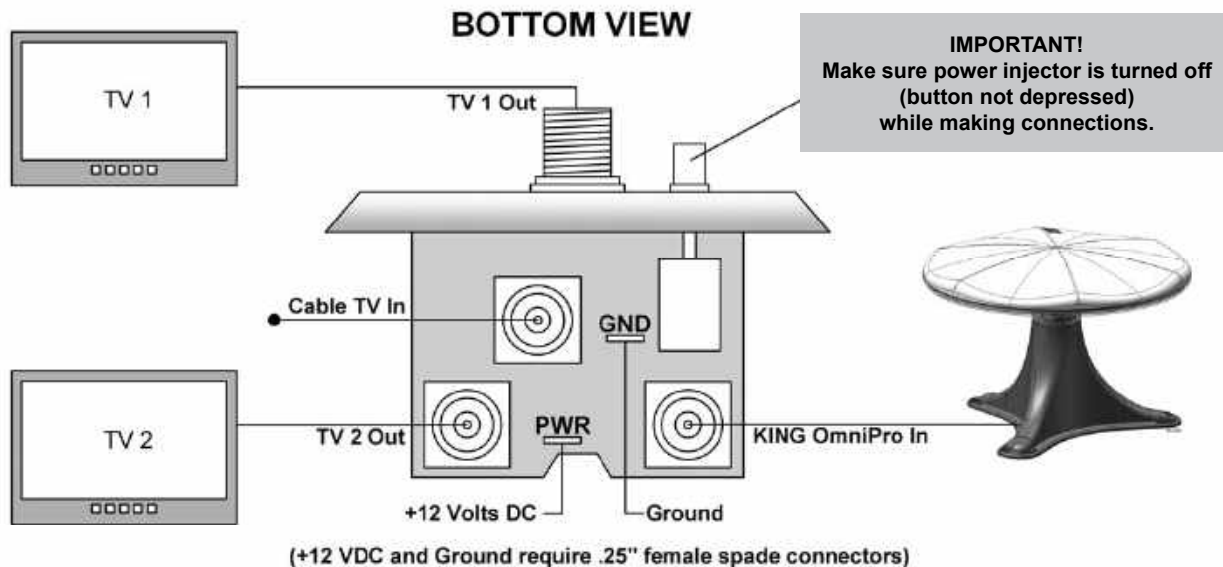
ABOUT THE POWER INJECTOR



POWER INJECTOR INSTALLATION

Keep in mind the following when installing the Wall Mount Power Injector:

- Can be mounted in most standard electrical boxes.
- Requires a +12 Volt DC power source. (Inadequate voltage may cause the green LED to not illuminate and the unit to not function properly.)
- Requires .25" female spade connectors for power and ground connections.
- Has an internal fuse rated @ 400 mA max. If tripped, the fuse will reset when the circuit cools.
- Is not an amplifier. No devices other than those shown below should be connected (unless approved by KING).





LIMITED WARRANTY

IMPORTANT! Do not powerwash any part of the KING OmniPro antenna head or base mount.

KING OmniPro Over-the-Air Antenna Systems (models OA1000 & OA1001, OA1000-OE & OA1001-OE, OA1010-OE & OA1011-OE), are thoroughly inspected and tested before leaving the factory, and are covered by the following limited warranty from the date of original purchase:

- Two-year parts warranty: The customer is not responsible for the cost of replacement parts if the original part is determined to be defective under the terms of the warranty. The customer is responsible for the cost of replacement parts after two years.
- One-year labor warranty: The customer is not responsible for labor costs to repair unit if labor is performed within the labor warranty period. The customer is responsible for all labor costs after one year.

Only KING and certified dealers may perform warranty evaluations and repairs. Depending upon the problem, KING may authorize a dealer to perform the necessary repairs. Any warranty labor outside of that performed at the factory is not covered unless 1) the product has been installed by an authorized dealer/installer or OEM manufacturer and 2) the dealer/installer receives prior authorization to perform the repair.

A certified dealer must not perform any repair without first contacting KING for a Service Order Number. KING will advise the dealer on how to proceed with any repairs.

Should any trouble develop during the warranty period, contact KING at (952) 345-8147. You must contact KING before the warranty period expires. The customer must supply proof of purchase (such as a dated sales receipt) when requesting warranty service. If the customer cannot supply proof of purchase, warranty period shall start 30 days after date of manufacture.

If it is determined that the unit needs to be returned to KING, customer must return COMPLETE product, freight prepaid, to:

KING, 11200 Hampshire Avenue South, Bloomington, MN 55438-2453.

If inspection shows the trouble is caused by defective workmanship or material, KING will repair (or at its option, replace) without charge.

When returning product, KING will supply an RMA number (Return Merchandise Authorization). This number must be clearly written on the box. Failure to clearly write RMA number on box may result in delays in processing claim. Along with product, customer should include in the box: his/her name, address, daytime phone number, proof of purchase and description of the problem.

This warranty does not cover installation and external wiring, or remanufactured units. This warranty does not cover damage caused by the use of an accessory other than a KING accessory designed for the product. This warranty is not transferable from the original owner.

KING cannot be held responsible for changes in the expanding and changing digital and analog communications market that cause the product to no longer operate correctly.

This warranty also does not apply where:

- The product has been abused, misused, improperly installed or improperly maintained.
- The product has been used with an accessory other than a KING accessory designed for the product.
- Repairs have been made or attempted by others that are not certified by KING to do such repairs.
- Repairs are required because of normal wear and tear.
- Alterations have been made to the product.
- The product or any associated component has been opened without authorization or disassembled to any degree.
- Damage has been caused by powerwashing.
- Circumstances beyond the control of KING cause the product to no longer operate correctly.
- Customer is not the original owner.

In no event shall KING be liable for any indirect, incidental, or consequential damages from the sale or use of the product. This disclaimer applies both during and after the term of this warranty.

KING disclaims liability for any implied warranties, including implied warranties of "merchantability" and "fitness for a specific purpose," after the term of this warranty.

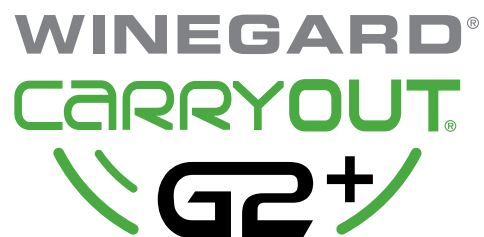
This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.



11200 Hampshire Avenue South, Bloomington, MN 55438
PH 952.922.6889 || FAX 952.922.8424 || kingconnect.com

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Instruction Manual



DO NOT RETURN ANTENNA TO PLACE OF PURCHASE



POWER INSERTER



See page 2 for setup instructions

2452360



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"



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°)

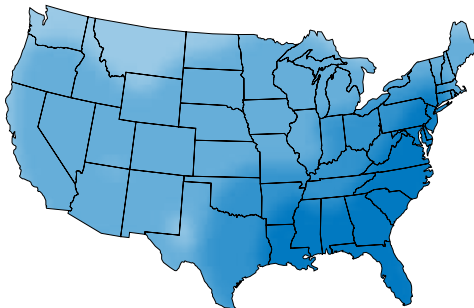
DISH (Western Arc): 110°, 119°, 129°

Bell TV: 91° or 82°

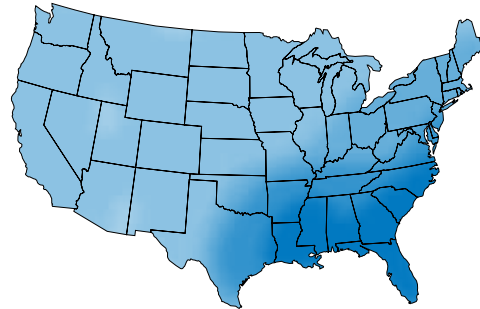
Refer to maps* to determine coverage in areas of the U.S.

Good	Signal Strength	Best
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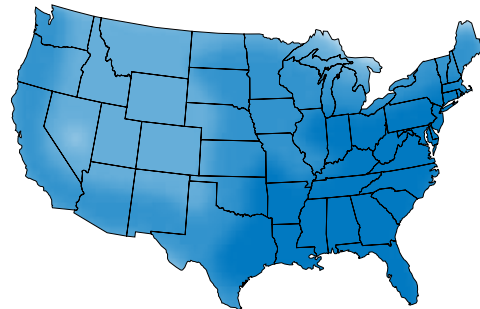
DIRECTV Sat. 101°



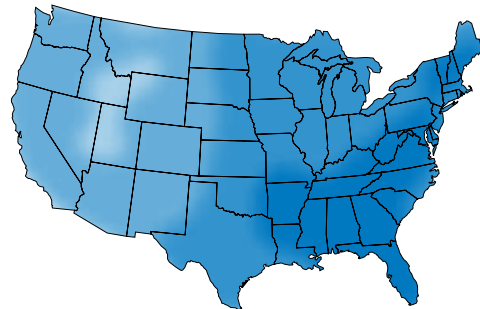
DIRECTV Sat. 119°



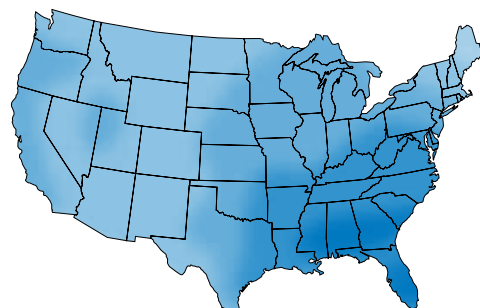
DISH Sat. 110°



DISH Sat. 119°



DISH Sat. 129°





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.

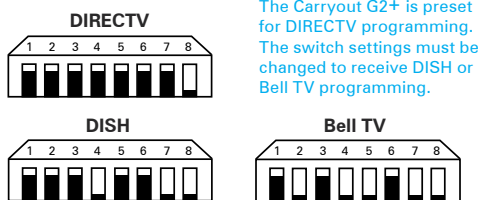
1. Switch Settings

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 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



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

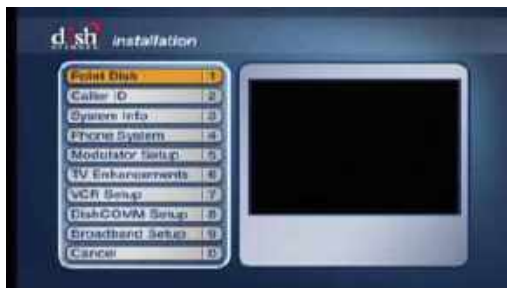
2. Press **Menu** on your remote. Select option 6, **System Setup**.



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





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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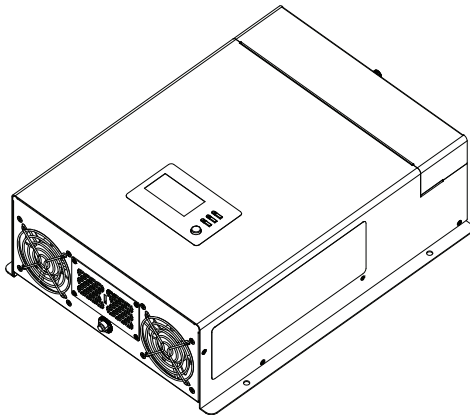
DISH is a registered trademark of DISH Network L.L.C. DIRECTV is a registered trademark of DIRECTV, LLC. Bell TV is a registered trademark of Bell Canada, Inc.

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[™]
A MISSION CRITICAL ELECTRONICS BRAND



Owner's Guide

Freedom XC PRO Inverter/Charger

Freedom XC PRO 2000 **818-2010**
Freedom XC PRO 3000 **818-3010**

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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 ITS 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 ENTIRELY 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/>.

Document Number: 975-0799-01-01

Rev C

Date: November 2019

Product Name and Part Number

Freedom XC PRO 2000 (818-2010)

Freedom XC PRO 3000 (818-3010)

Contact Information

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Email: customerservice@xantrex.com,
<http://www.xantrex.com/power-products-support/>

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**.

975-0799-01-01

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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.

975-0799-01-01

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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.

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Freedom XC PRO Owner's Guide



⚠ 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

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.

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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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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)

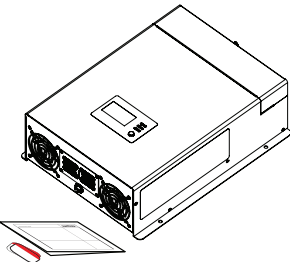


Figure 1 What's In The Box

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.



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.	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.
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.	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.
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.		

Materials List

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Load Management	<p>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.</p> <ul style="list-style-type: none">■ 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

<p>This section identifies the default settings and the hardware features of the Freedom XC PRO Inverter/Charger.</p> <p>This section includes:</p> <p>Default Settings 8</p> <p>AC/DC and GFCI Panel 10</p> <p>Display Panel 12</p> <p>Side Panel 13</p>	
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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

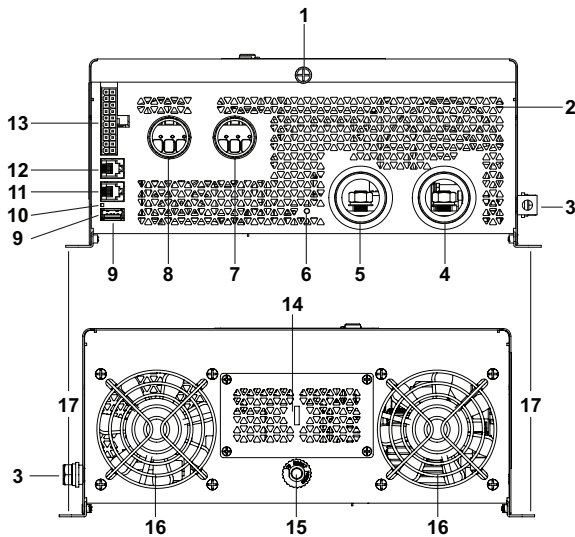


Figure 2 AC/DC and GFCI Panel

⚠ 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.



Display Panel

Display Panel

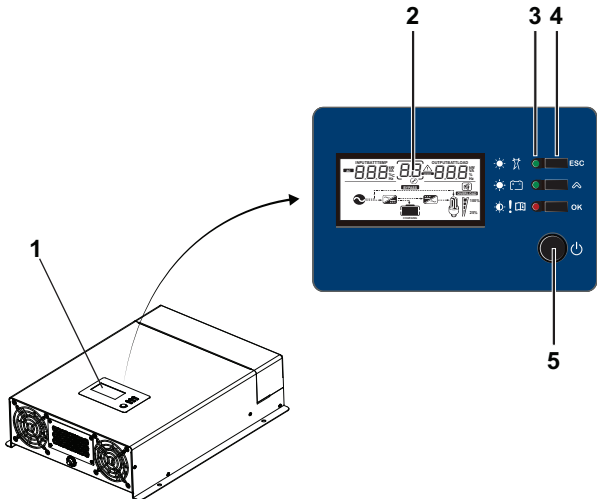


Figure 3 Display Panel

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</i> on page 52 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

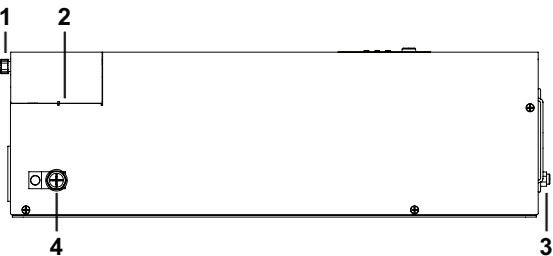


Figure 4 Side Panel

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
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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 (33CFR 183, 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 (½" or 13mm socket wrench)
- AC cable (that is, two-conductor-plus-ground cable), sized appropriately for load and application
- ½" (or ¾") 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

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.



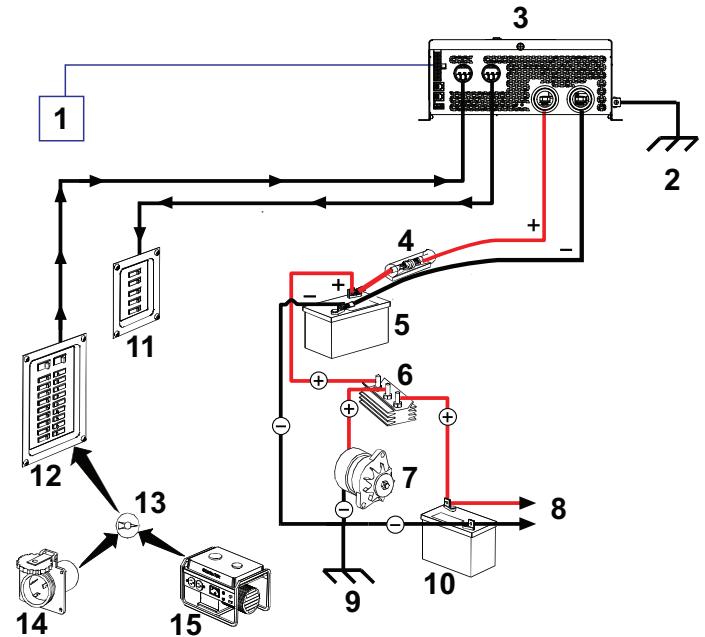
Step 1: Designing the Installation

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

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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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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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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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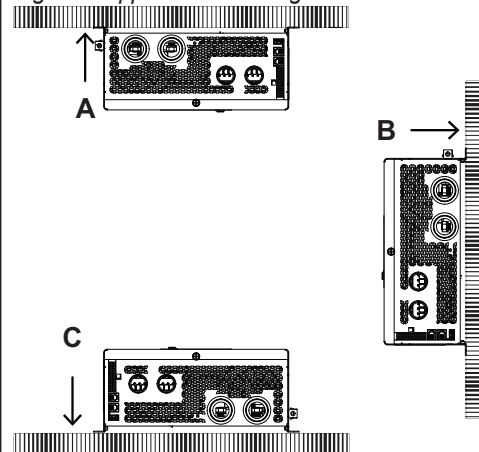
Basic Installation Procedures

Step 3: Mounting the Unit

To mount the Freedom XC PRO:

- 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.
- 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:
 - 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 6 Approved Mounting Orientations



- Mark the desired number of mounting holes on the wall by placing the unit on the wall.
- Pilot-drill the mounting holes.
- 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 1/4"-20 machine screws.

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Connecting the Equipment Ground

⚠ WARNING

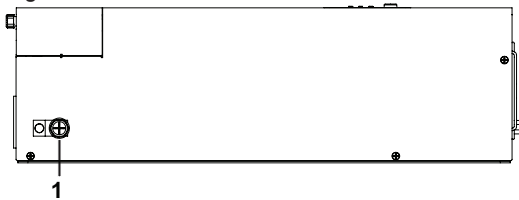
ELECTRIC SHOCK HAZARD

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



1 DC grounding lug

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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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 ½" trade-size hole (or ¾" 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

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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 ½" trade-size strain relief clamps. If larger cables and strain relief clamps are needed, remove the ¾" 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

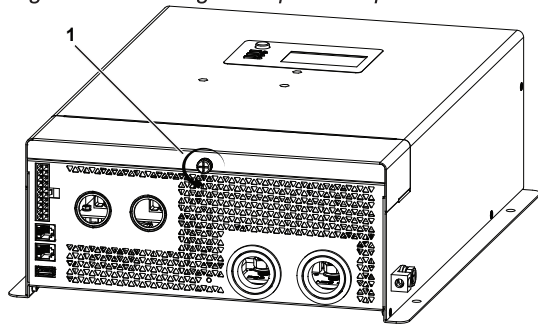
ELECTRIC SHOCK HAZARD

Use a screwdriver to loosen the captive nut panel screw.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



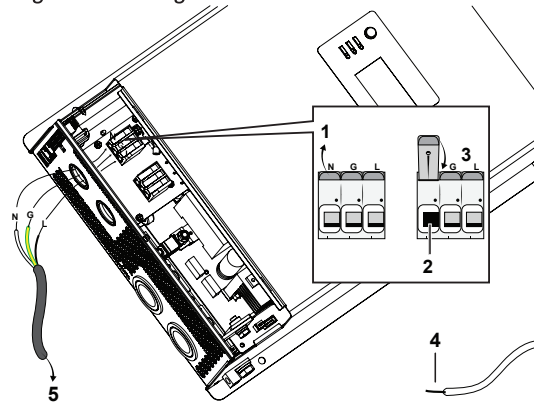
Figure 8 Loosening the captive nut panel screw



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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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.

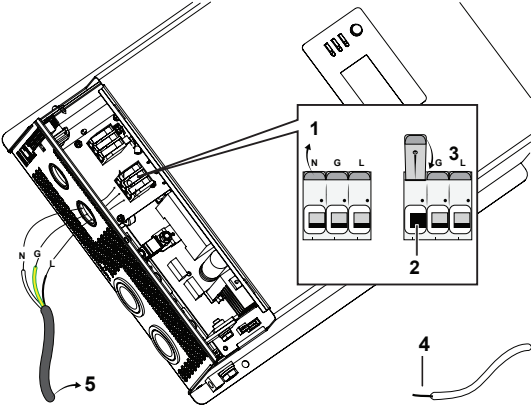
Failure to follow these instructions can result in equipment damage.

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:

1. Ensure AC and DC power sources are turned off, if not already done from *AC Output Connections on page 33*.

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2. Install the required circuit breaker in the inverter/charger distribution panel receiving AC power from the inverter/charger.
3. 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.

4. 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).
5. Install a ½" (or ¾") strain relief clamp on the AC output hole.
6. Route the wires through the strain relief clamp (not shown in the figure)
7. Connect each AC wire into its corresponding terminal on the no-tool cage clamp terminal block.
 - a. Lift the terminal lever (as shown on the figure).
 - b. Insert the wire fully into the open slot.
 - c. Lower the terminal lever to secure the wire in the slot.
8. 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.

11. Connect the other end of the wires to a circuit breaker in AC distribution panel providing AC power to the loads.



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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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.

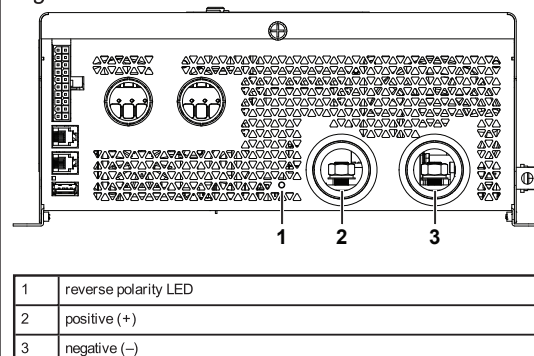
Failure to follow these instructions can result in death, serious injury, or equipment damage.

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





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 $\frac{1}{2}$ " (13 mm) to $\frac{3}{4}$ " (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 $\frac{1}{2}$ " (13 mm) to $\frac{3}{4}$ " (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.

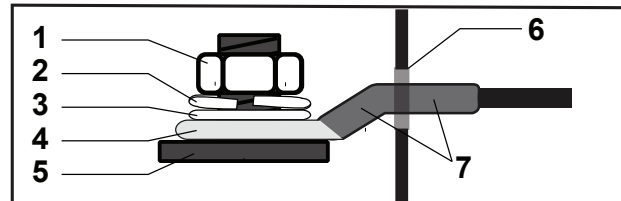
NOTICE

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.

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⚠ 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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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.

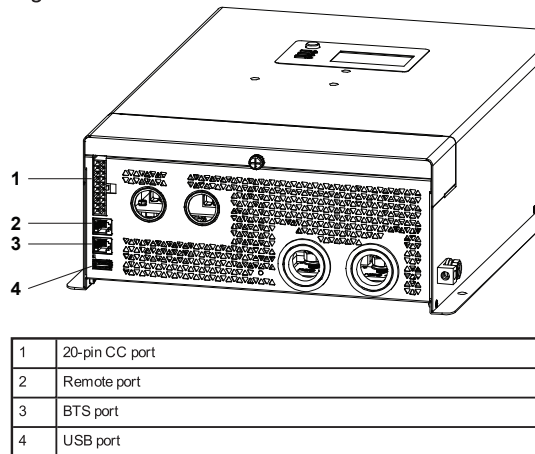
Regulatory references

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



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.

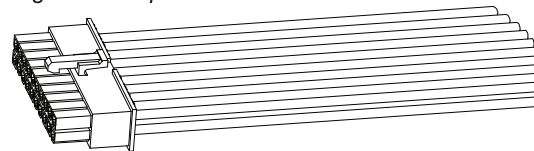
Failure to follow these instructions can result in equipment damage.

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



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Basic Installation Procedures

Figure 15 20-pin Communications Harness Pinouts

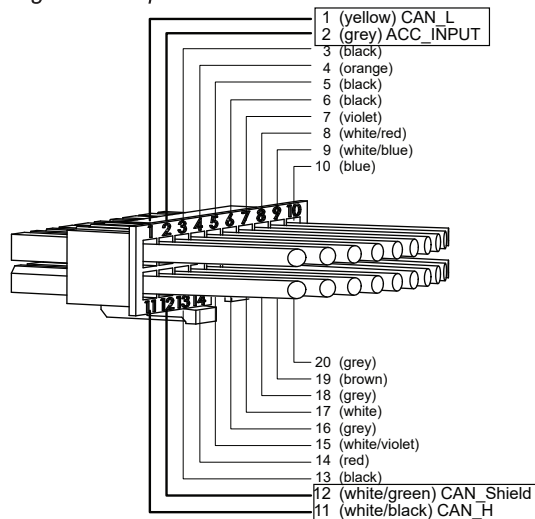
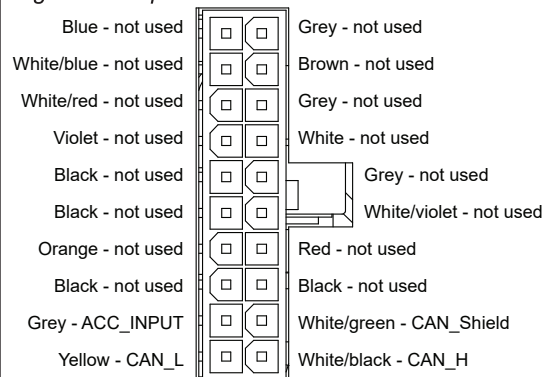


Figure 16 20-pin CCPort Pinouts



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

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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 (AEO)	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.
-------------------------------	--

Ignition Lock-out (LOE)	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.

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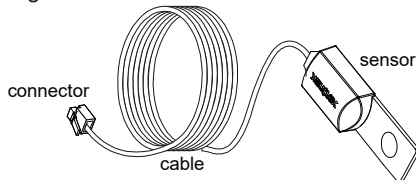
Basic Installation Procedures

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

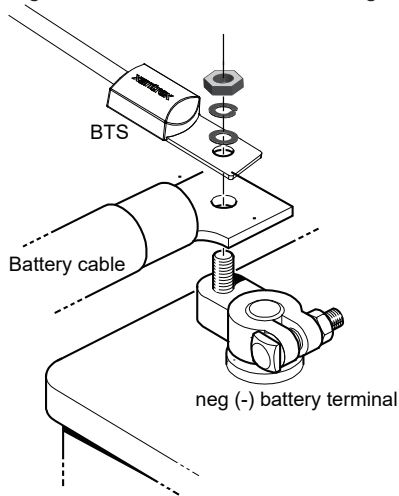
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loose connection can cause excessive heating. Always follow your battery manufacturer's torque specifications.

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

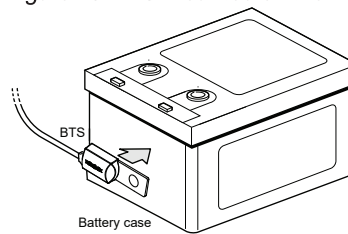
ELECTRICAL SHOCK AND BURN HAZARD

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



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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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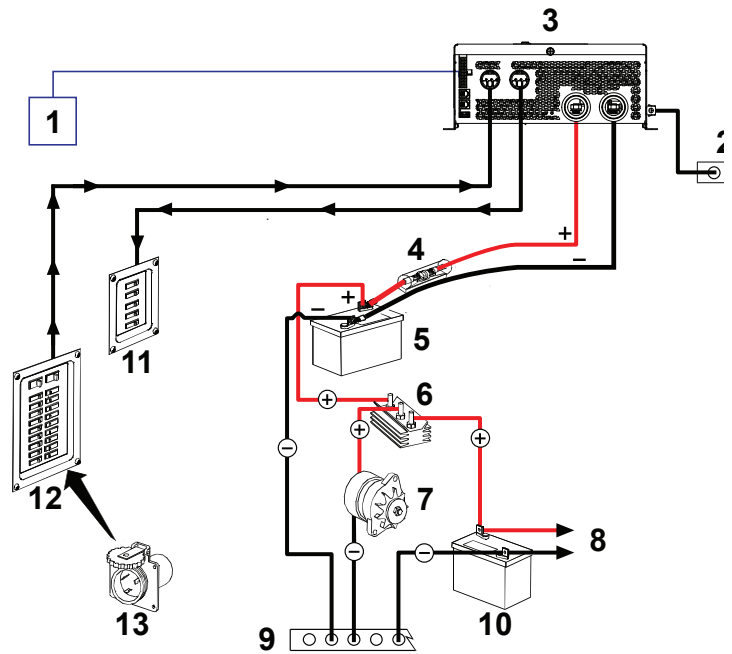


Marine Installation

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

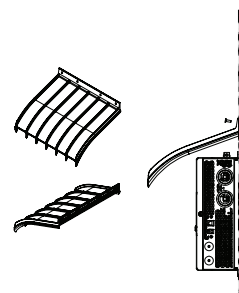
ELECTRICAL SHOCK HAZARD

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.

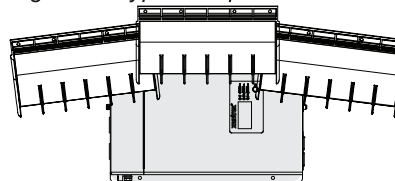
Figure 21 Drip shields



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.

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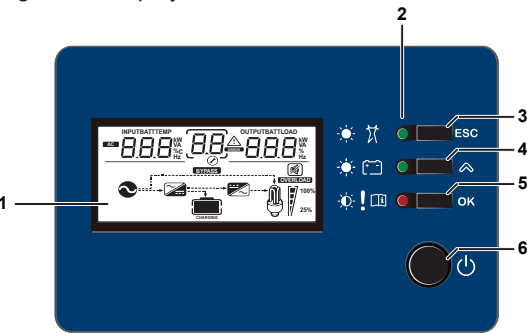
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Freedom XC PRO Display Panel

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.



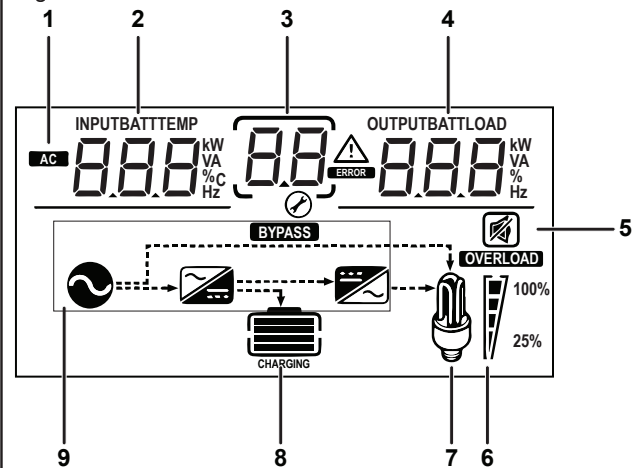
Function Buttons

Button	Definition
ESC	Return to default screen or exit setting mode
	Next screen or next selection Press and hold for three seconds to go back one step
OK	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	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%.
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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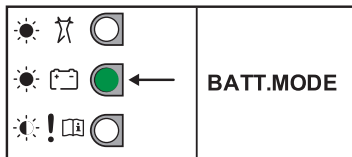


Operating in Battery Mode

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 (AEC^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.

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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.

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Operating in Grid Mode

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).

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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:

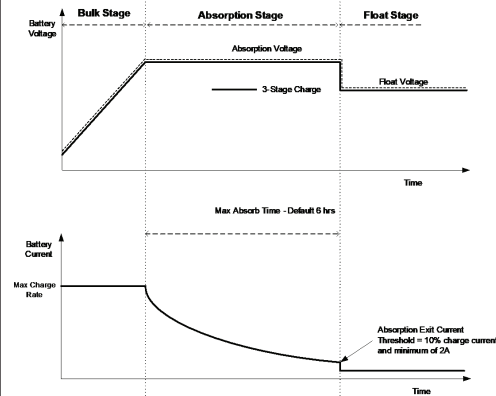
- Bulk
- Absorption
- Float

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.

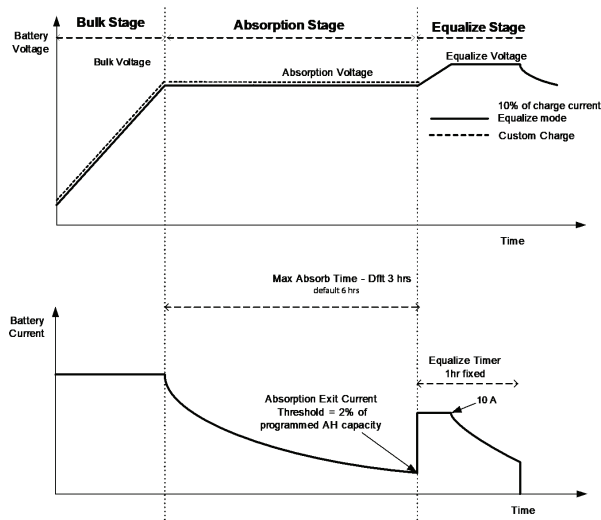
Equalization duration is fixed at one hour.

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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.

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.



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 <i>E01</i> . After LBCO Shutdown delay timer runs out, the unit shuts down inverter output. The buzzer stops beeping and the LCD screen shows error code <i>E01</i> .
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 <i>E02</i> 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.

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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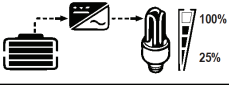
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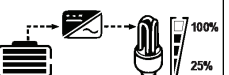
Viewing Information During Battery Mode

Viewing Information During Battery Mode

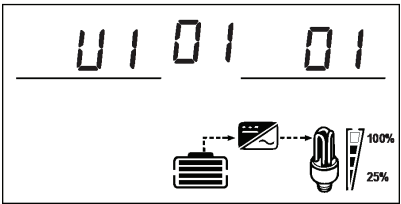
The LCD screen displays information related to battery mode operation.

- 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.	<div><div>BATT125VLOAD120kW</div><div></div><div>battery voltage = 12.5V, AC load = 1.2kW</div></div>


Info and Setting	LCD Screen
Screen 2 of 4 - AC Output Voltage/Frequency	<div><div>AC120VLOAD600Hz</div><div></div><div>output voltage = 120V, output frequency= 60Hz</div></div>
Screen 3 of 4 - AC Input Voltage/Frequency Screen shows up when utility AC is connected.	<div><div>INPUTAC120VLOAD600Hz</div><div></div><div>input voltage = 120V, input frequency = 60Hz</div></div>

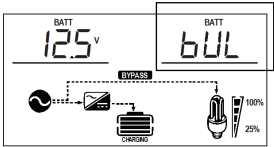
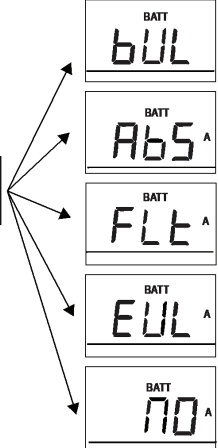


Info and Setting	LCD Screen
Screen 4 of 4 - Firmware version	 Firmware version = U1 1.01

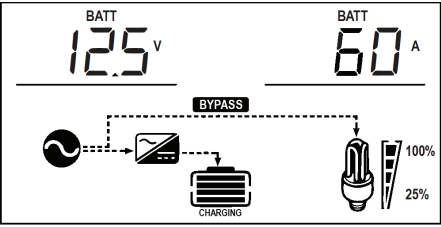
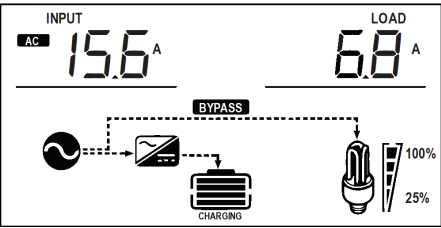
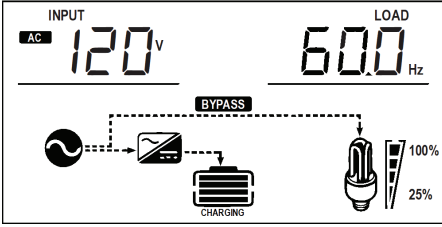
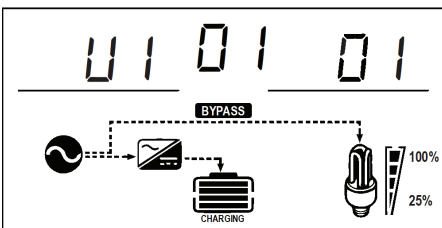
Viewing Information During Battery Mode

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.	  battery voltage = 12.5V, charging stages = bulk, absorption, float, equalization, and no charging



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>
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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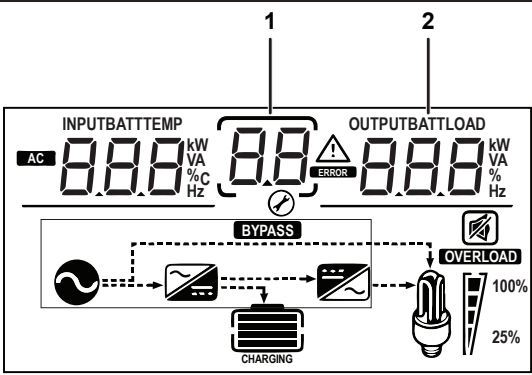
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Adjusting Feature Settings in Configuration Mode

Adjusting Feature Settings in Configuration Mode



The **OK**, Scroll , and **ESC** buttons can be used to cycle through the various feature settings:

- Press and hold the **OK** button for three seconds to enter the feature settings mode.
- Press the Scroll  button to move through the different feature settings. Press and hold for three seconds to go back one step.



1	setting number is displayed here
2	setting value is displayed here

To change the default value to a different value:

- Press and hold the **OK** button for three seconds to enter the feature settings mode.
- Press the Scroll  button to move through the different feature settings. Press and hold for three seconds to go back one step.
- Press the **OK** button to select a setting number and change its value.
- Press the Scroll  button to change the value until you reach the desired value.
- Press the **OK** button to confirm the change.
- Repeat the previous steps to set other feature settings.
- Press the **ESC** button to exit the feature settings mode.



Settings

Setting Name	Setting Number	Default Value	Range of Values	Description
Inverter Ignition Control	01	OFF	OFF LOt At0	See <i>Description of Ignition Control Features</i> 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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Freedom XC PRO Owner's Guide



Setting Name	Setting Number	Default Value	Range of Values	Description
Transfer Mode	11	<i>A_{PL}</i>	<i>A_{PL}</i> (appliance) <i>U_{P5}</i> (UPS)	Selecting <i>A_{PL}</i> - appliance sets the transfer time from line to battery to 20 ms. Selecting <i>U_{P5}</i> (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	<i>̄A_{RE}</i>	<i>A_{EO}</i> (auto-restart) <i>̄A_{RE}</i> (manual restart)	The inverter shuts down when there is an over temperature, overload, and short circuit condition. Selecting <i>A_{EO}</i> (auto-restart) will allow the inverter/charger to recover automatically from a shutdown up to three times maximum. Selecting <i>̄A_{RE}</i> (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	<i>b_{ON}</i>	<i>b_{ON}</i> (Audible) <i>b_{OF}</i> (Mute)	The alarm beeps once every 5 s.
Battery Type	20	<i>F_{Ld}</i>	<i>F_{Ld}</i> (Flooded), <i>A₉̄</i> (AGM), <i>9EL</i> Gel <i>U_{SE}</i> (Custom) <i>L_{FP}</i> (LiFePO ₄)	The use of <i>L_{FP}</i> (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	<i>H_{OT}</i>	<i>C_{LD}</i> (Cold) <i>w-̄</i> (Warm) <i>H_{OT}</i> (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	<i>OFF</i>	<i>OFF</i> (OFF) <i>A_{EO}</i> (Auto-ON)	See <i>Description of Ignition Control Features on page 43</i> .
Equalize Charging for Flooded Battery	27	<i>d_I 5</i>	<i>E_{NA}</i> (enable) <i>d_I 5</i> (disable)	This setting is only available when Flooded battery type is selected. It allows only one hour of equalize charging once.




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 (asis) 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 Unit80

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.
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:
 - Whether any extreme ambient conditions existed at the time (temperature, vibrations, moisture, etc.)
 - 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.



Warning Messages

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.

Warning Messages

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 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/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.

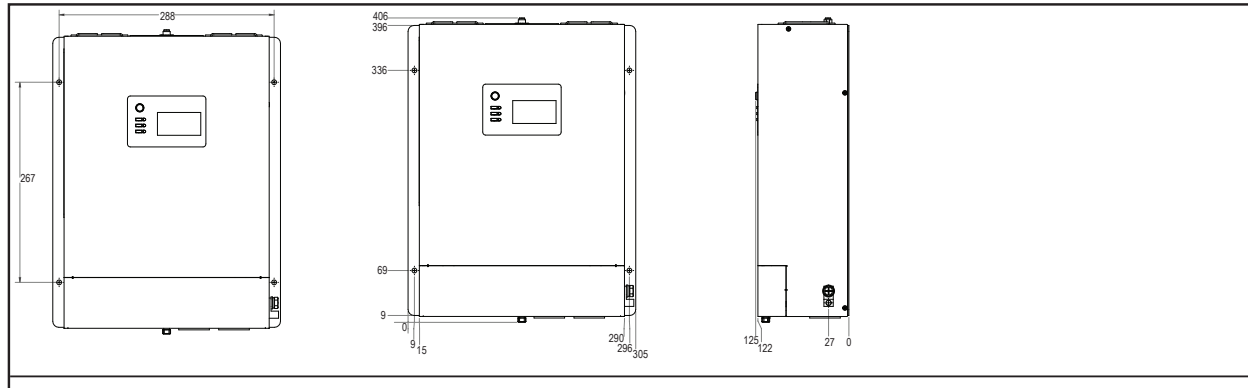


Physical Specifications

Table 16 Physical specifications

	Freedom XC PRO 2000	Freedom XC PRO 3000
L × W × H	16.0" × 12.0" × 4.9" (406mm × 305mm × 125mm)	16.0" × 12.0" × 4.9" (406mm × 305mm × 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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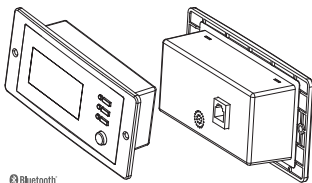
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XANTREX INVERTER REMOTE

Freedom X Remote Panel User Guide
PN: 808-0817 / 808-0817-02

<http://www.xantrex.com>



Bluetooth
808-0817-02 only

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 SPECIALLY AGREED TO IN WRITING, SELLER (A) MAKES NO WARRANTY AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN ITS 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 ENTERED 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: ZA00L-FXRP-BT / IC: 23407-FXRPBT

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

Status LED Indicators

Function buttons

LCD screen

Function Buttons

- ESC** return to default screen or exit setting mode
- Scroll** next screen or next selection
- OK** to enter the setting mode or to confirm the setting
- Power** turns the inverter unit on or standby

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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PN: 808-0817 / 808-0817-02

<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.

1 **2** **3**

4 **5**

NOTE: Screen 3 appears only when AC qualification is pending.

NOTE: Screen 2 appears only in Freedom XC units. Greyed out icons also appear only in Freedom XC units.

5 Viewing Information During Grid Mode

Press scroll [↗] to move to the next screen. Press [ESC] to return to the home screen 1.

1 **2** **3**

4 **5**

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.

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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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)* with a compatible smart device* 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.

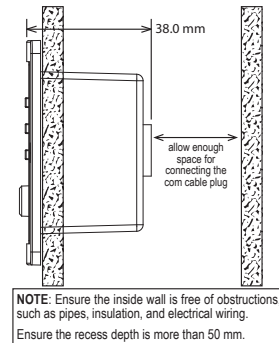
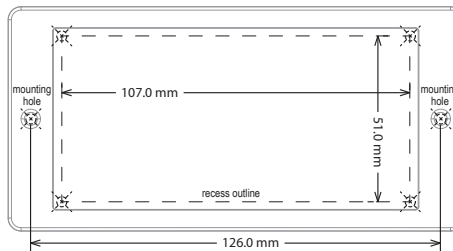
a List of compatible Freedom X/XC units:
817-1000, 817-2000, 817-2000-21, 817-3000,
817-1050, 817-2050, 818-2010, 818-3010, 806-1212
b Compatible smart devices:
Phone: iPad running iOS 8 or higher
Android phone or tablet running 4.0 or higher with Bluetooth
Low Energy capability

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



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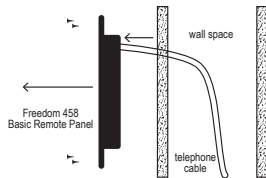
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B

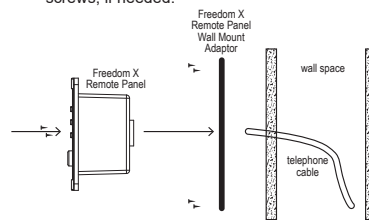
Installing the Freedom X Remote Panel with a Wall Mount Adaptor

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.

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ZAMP CHARGE CONTROLLER



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

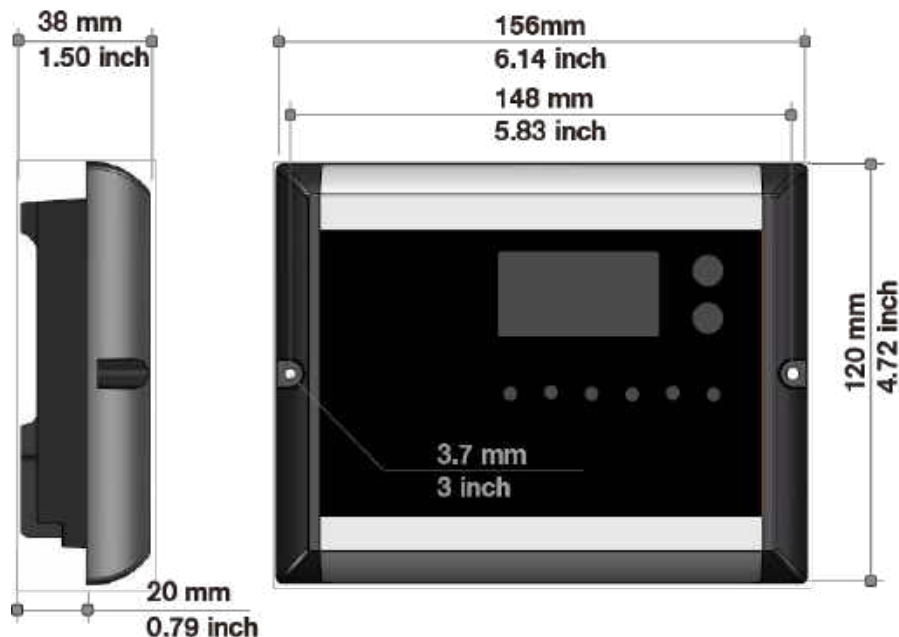
The Solar Controller has two mounting options.

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.



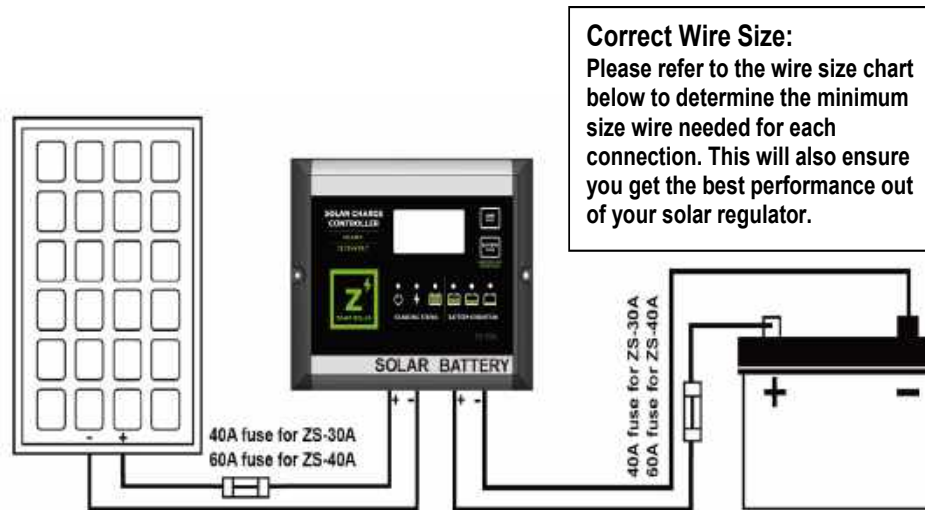


WIRING CONNECTIONS

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



v



A

Rated voltage and current test



°C

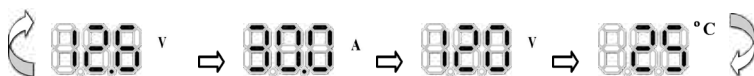
External battery temperature sensor test (if connected)



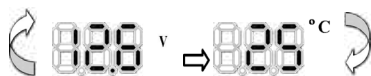
Indicates the solar panel connected.

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%.

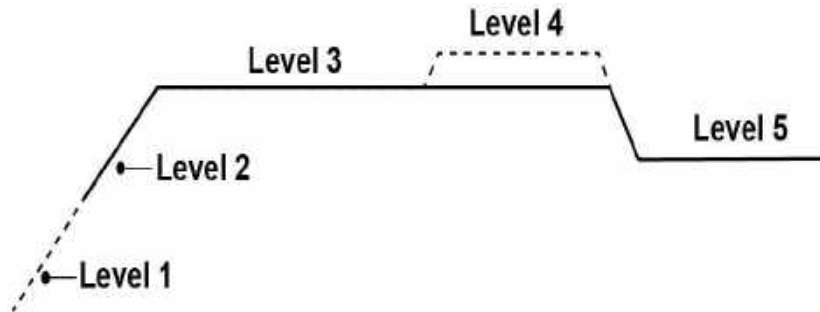


The LCD also can be treated as an independent voltage meter or thermometer.
A voltage less than 11.5V Volts indicates that the battery is discharged and requires re-charging.

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



ABNORMAL OPERATION MODE

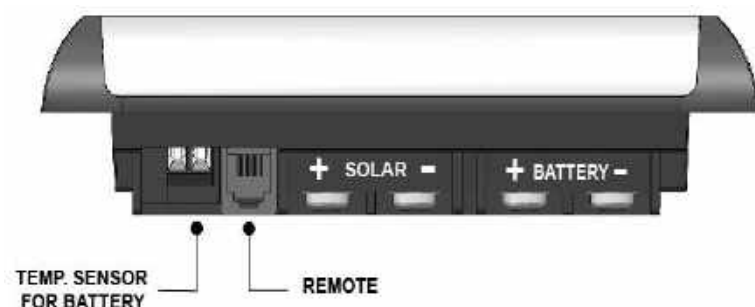
Solar panel abnormal mode	LCD display	LED indication	LCD backlight
Solar panel weak		 Flash	ON
Solar panel reverse connection		 Flash	Flash
Solar panel over voltage (> 26.5V)		 Flash	Flash

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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