Installing Your Electric QuietTorque™ 30.0 LC Motor System

List of Equipment Supplied:

1 - Motor Assembly
2 - Sheet metal covers
1 - Shaft coupler
    Standard: Industry standard 4" "Hurth/Borg Warner" flange coupler
2 - Battery Power Switches
2 - Class-T Fuse and holder
2 - Relays (also commonly called a "contactor" or "solenoid")
1 - Throttle assembly w/ key switch and attached cable (p/n 01010)
1 - Battery Monitor (display) w/ attached cable (p/n 01057 or 01059)
1 - Mounting hardware kit (p/n 01022)
    4 - L-Brackets
    4 – Mounting feet w/ ½-13 jackscrews
    8 – 3/8" x 2 1/2" lag screws
    8 – 3/8" flat washers
    8 – ½"-13 hex nuts
    8 – ½" flat washers
    8 – 5/16-18 x 7/8" hex bolts
    8 – 5/16" flat washers
    12 – 10-24 x ½" SHCS (for mounting covers)
    10 – #8 x ½" Phillips head screws (for mounting throttle assembly and display)

List of Tools Needed for Installation:

½" combination wrench (open and box end) or socket
9/16" combination wrench or socket
¾" combination wrench
1/8" hex wrench (Allen wrench)
3/16" hex wrench
#2 Phillips screwdriver
3" hole saw
1" drill or hole saw
5/16" drill
7/64" (0.109") drill
Electric drill

Unpacking:

You will have received your motor kit on a pallet. It will be wrapped with the cooling system heat exchanger and hoses filled. There will also be several small boxes. All will be wrapped with plastic wrap.

Installation Preparation:

If you are repowering, you likely have a situation where many years of oil, grease and dirt have accumulated in your engine compartment. It is strongly urged that you take the time to degrease, sand and paint the wood and fiberglass in this area. This will greatly help in getting rid of the fossil fuel smell that commonly permeates this space. It is much easier to do this when the old engine and associated hardware have been removed and before installation of the batteries and electric motor have begun.

Battery Installation:

Note: It is very important to provide sufficient ventilation in your battery compartment area. Flooded lead/acid batteries routinely give off hydrogen gas when charging. Even AGM and GEL batteries can outgas, if overcharged. Since hydrogen gas is lighter than air, always provide ventilation at the TOP of the compartment. Also, provide ventilation at the bottom to help facilitate airflow.

1. Before starting, measure up your desired spaces and make sure the batteries you will use fit. Be sure to allow some space and access above the batteries for terminal cleaning.

2. Locate all the batteries and secure in place. This is usually the most time consuming part of the installation. They at least need to be placed on a flat surface or platform and strapped down. Often, battery boxes are built to contain the batteries securely.

3. If you are using 48Vdc LiFePO4 batteries, connect them in parallel (B- to B-, B+ to B+. If you are using 6Vdc or 12Vdc batteries, connect them in series (B+ to B-) to form a 48Vdc string. If using more than two batteries in parallel install a positive and negative bus bar or binding post and bring all + connections to the B+ bus bar and all – connections to the B- bus bar.

4. IF using 6Vdc or 12Vdc (LiFePO4 or AGM) batteries you will need to create a series connected string to make your 48Vdc battery. This will consist of four batteries connected + to – for 12Vdc batteries and eight batteries connected + to – for 6Vdc batteries. Always use a wrench with plastic coated handles when tightening battery terminals. If one is not available, wrap the handle with electrical tape. Batteries can produce very high currents in a short circuit situation that will melt metal and cause serious burns.

5. Use a volt meter and verify you have the correct voltage at the (-) and (+) battery terminals. A fully charged 48V (nominal) battery bank will measure 50Vdc – 54Vdc depending on the battery chemistry.

6. Run two cables from the battery (-) to area where the motor will be installed. Current ABYC standard calls for a yellow cable jacket. 2/0 AWG cable is recommended. One will go to the B- connection of each motor controller. Also, connect a cable from the B- of one controller to the B- of the other. This insures this connection is at the same potential for each controller.

7. Install fuses as close as practical to the (+) battery terminal(s). Leave the connection to the (+) terminal of the battery disconnected for now. Use red cable for the positive side connections.

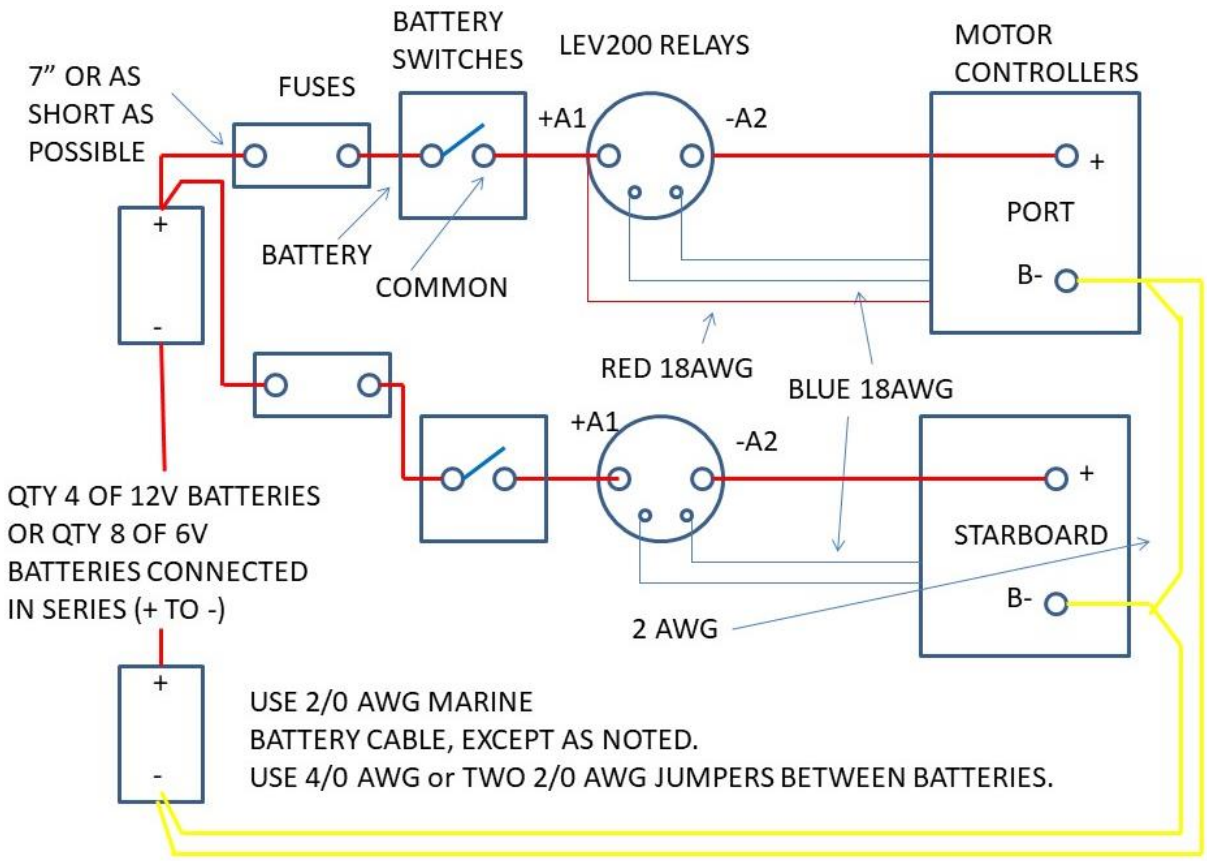
8. Install the master power switches. Make sure they are off.

9. Install the relays after the power switches. Notice there is a (+A1) polarity marking on one of the large studs. This stud should be on the battery side. Connect the cable from the master power switch and the red 18AWG wire from the port side motor controller. It should be on top of the current carrying cable. Normally, the relays are installed near the motor, but can be anywhere between the master power switch and the motor. The starboard side motor controller has only the two blue wires.

10. Connect the two blue wires to the coil connections on the relays. They are not polarity sensitive.

11. Connect a cable to the other large stud on each relay and run to the area where the motor will be installed.

12. To the greatest extent possible, route + and - cables together. This helps minimize electrical interference to your VHF radio and minimizes any risk of magnetic interference that could affect your compass. Long runs may also be twisted. Do not bundle with other wiring.



Throttle Installation:

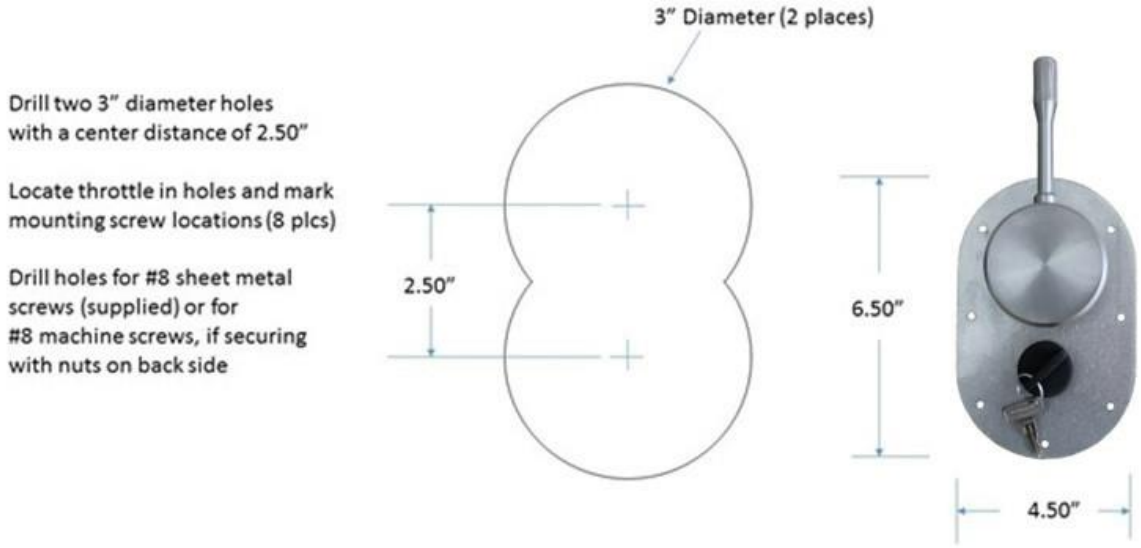
1. Locate a convenient area in the cockpit. This should be a flat surface. Often, there is already a hole where the old engine controls were. In this case a sheet aluminum plate can be cut to fit.

2. If you have the standard side mount throttle (p/n 01010), cut two 3" (80mm) holes with a 2.50" (64mm) center spacing. If you have a Glendinning top mount (p/n 01006 or 01008, or other type, follow instructions supplied with throttle unit.

3. Put throttle in place and mark the screw holes. Drill holes for the desired screws and secure in place. #8 x ½" screws are supplied. Use a sealant around the flange of the throttle quadrant to make it water tight. The screws can be sheet metal screws or machine screws and nuts. They should be stainless steel.

4. Run the cable(s) to the area where the electric engine will be installed and secure in place.

Throttle Mounting Template



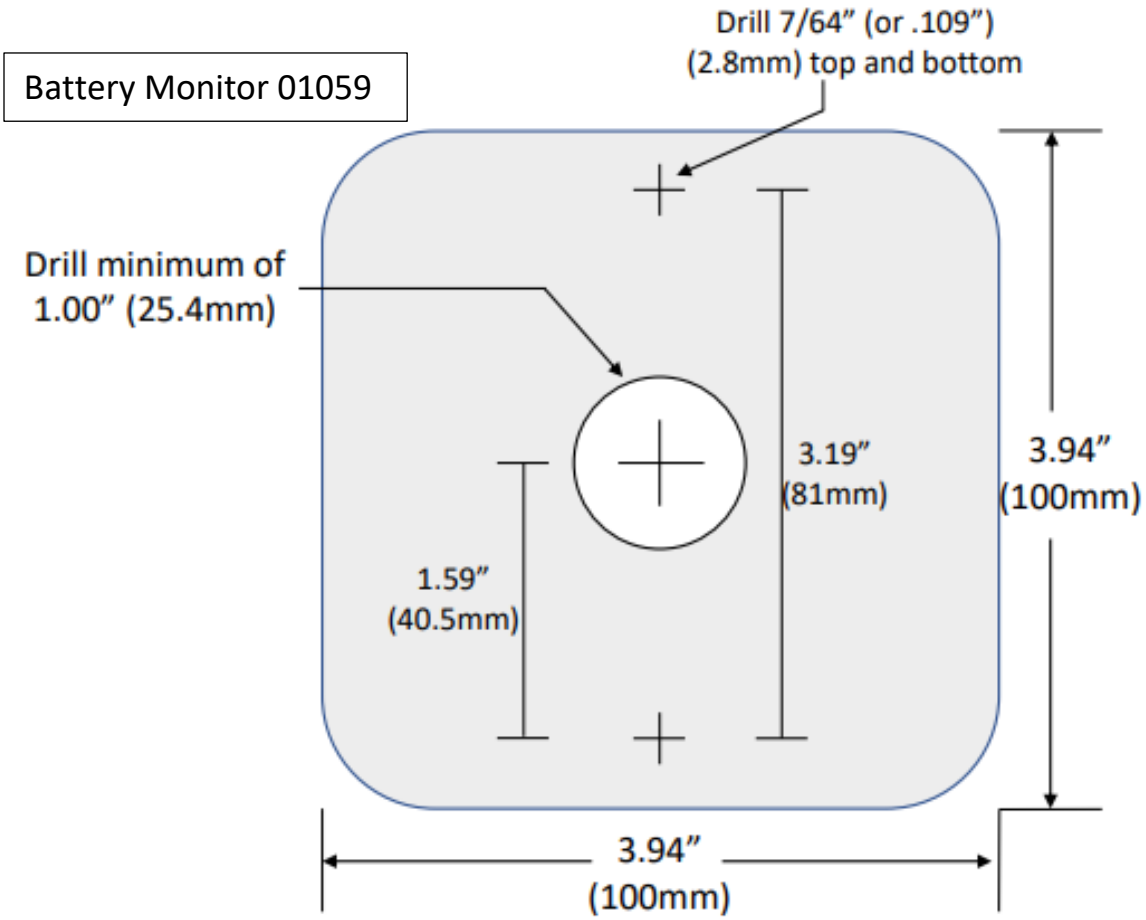
Battery Monitor Installation:

1. Find a location in the cockpit to install the Battery Monitor. This should be a flat surface with good visibility from the normal steering position.

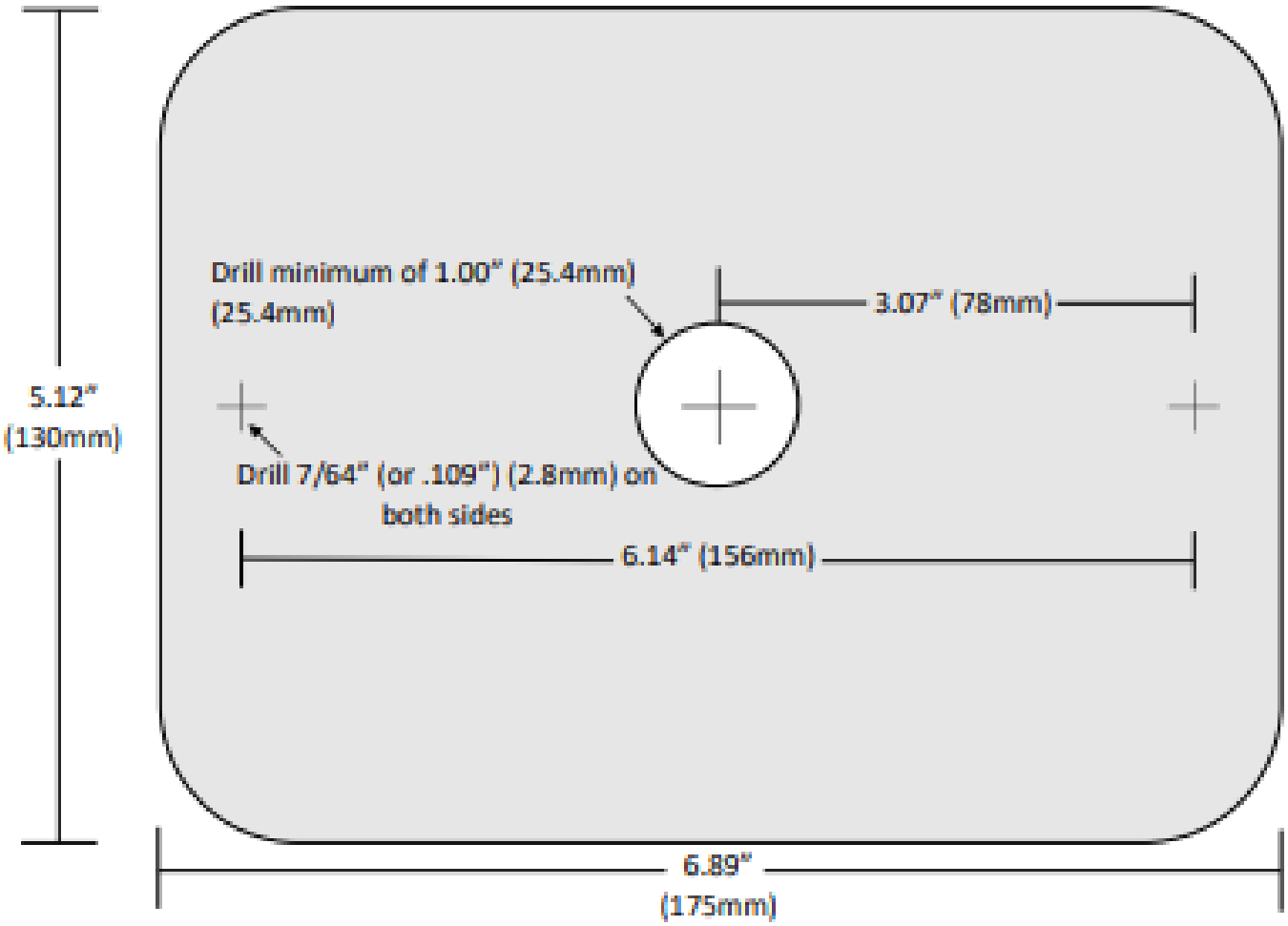
2. Use the figures below depending on your battery monitor to determine hole placement for mounting.

3. Drill the appropriate holes.

4. Run the cable to the engine area and secure.



Battery Monitor 01057



Electric Engine Installation:

1. If the boat is out of the water, it is advised to remove the shaft and check it for straightness and signs of corrosion. Also, renew the stuffing box packing and, if necessary, the cutlass bearing.

2. If the existing shaft coupler is a Hurth/Borg Warner 4” flange, and is in good condition, leave it in place. Otherwise, remove the old coupling flange, clean the end of the shaft with an abrasive pad or fine sandpaper. If the boat is in the water, be very careful not to push it out. File off any burrs caused by the old coupling, etc.

   Note: A wheel puller or a reciprocating saw (Sawzall) or angle grinder with a cutoff wheel may be needed to remove an old coupler. If cutting with a saw or cutoff wheel, cut lengthwise being careful not to cut into the shaft.

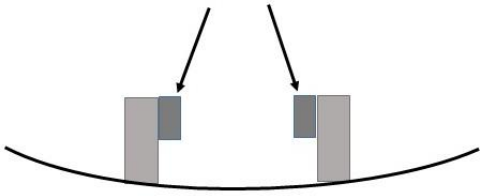
3. If the boat is in the water, tighten a hose clamp around the shaft to prevent it from being pushed out through the stuffing box accidentally.

4. If the aft end of the existing engine stringers extend to within 7” (17.8cm) of the forward end of the propeller shaft, you should have adequate shaft length.

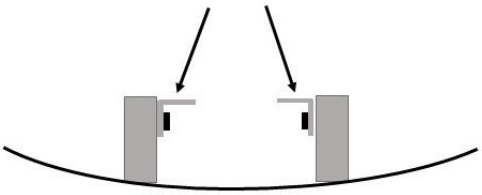
5. If the space between the engine stringers is at least 10.5” (26.7cm) AND the mounting feet can be mounted on 12.5” (31.7cm) – 16” (40.6cm) centers, you can proceed without modification of the engine beds.

6. If over 16” (40.6cm)” (36.8cm), sister in and glass over hardwood boards thick enough to bring the space between the stringers down to 16” (40.6cm) or less. Alternately, bolt painted steel, stainless steel or aluminum L-brackets to the inside of each of the engine stringers to narrow the space between them.

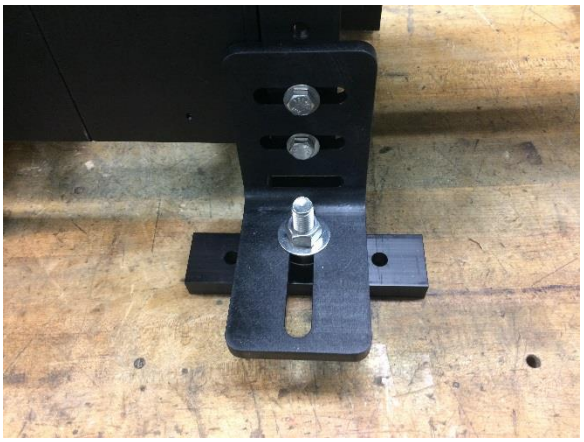
Fasten Hardwood (White Oak) Boards to inside of existing Engine stringers. Use stainless steel Fasteners. Glass in with Fiberglass cloth and epoxy resin. Fasten Motor mounting feet to hardwood with 3/8" lag screws.



Fasten 6061 aluminum L-shaped Extrusions (3/8" thick) to inside of stringers with multiple Stainless steel fasteners. Drill and fasten mounting feet to L-bracket with 3/8" (M10) stainless steel bolts, nuts And washers.



7. Loosely bolt the mounting feet to the motor frame at the height that matches up with the propeller shaft. Use removable (blue) thread locking compound on the threads. Often, the L-brackets will need to be inverted, as in the second pic below.



8. Move motor into position. Adjust the height and location to get the shafts into approximate alignment. Leave the nuts on the topside of the L-brackets loose for now.

9. Drill holes through the hole at each end of each mounting foot and secure to engine beds with 3/8" lag bolts (supplied) or other appropriate hardware.

10. Tighten bolts securing mounting foot hardware to motor frame.

11. Do a course alignment with the motor and shaft flanges close, but not quite touching. Once they are visually aligned, bring them together so that the male pilot on the shaft coupler just engages the female pilot on the motor's coupler.

12. Loosely install the 4 bolts, washers and nuts that will hold the flanges together.

13. Using feeler gages, check the spacing between the two couplers and adjust the nuts supporting the motor on the mounting feet in small increments until there is no more than 0.004" difference between the space measured anywhere around the circumference of the two flanges.

14. Once they are aligned, tighten the bolts securing the flanges.

15. Tighten the nuts on top of the L-brackets to secure the motor in place.

16. Connect a yellow (-) cable to the (B-) terminal on each controller. There will also be up to three smaller yellow wires with 5/16" terminals on the port side and one on the starboard side. Put these on top of the battery cable terminal and secure with the supplied bolt.

17. Connect the red (+) cable from the relay with the 18AWG red wire to the **(+)** terminal on the controller with the grey controller mounted with it (PORT). The B+ terminal has a plastic plug installed and is not used.

18. Connect the red (+) cable from the other relay to the **(+)** terminal on the other motor controller (STBD). MAKE SURE THIS POLARITY IS CORRECT. Reconnect the cable between the (+) battery terminal and the fuse. The B+ terminal is not used.

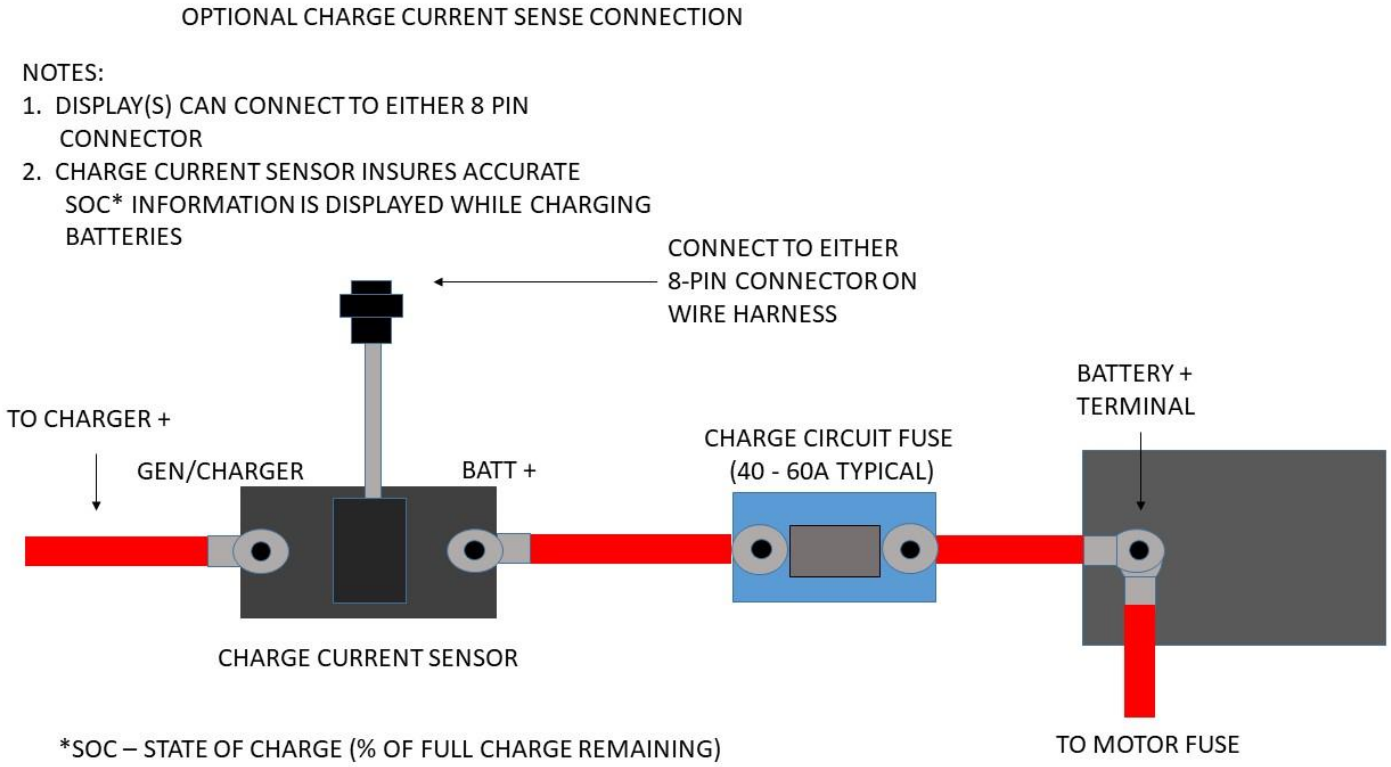
19. Connect the Throttle Quadrant cable and Battery Monitor cable. They secure with a twist and are waterproof. The display connector has 8 pins. There are two connectors on the wire harness (Port side of motor) allowing for two displays or a display and a current sensor. Either connection can be used for either purpose.

20. The throttle connection has 6 pins. There is only one throttle connection.

    NOTE: The connectors have an alignment post. Make sure to connect the correct connectors together and rotate until the alignment post is aligned. Do not force them together. They go together easily when properly aligned. Rotate the locking collar clockwise to secure.

21. Install and connect the (optional) Charge Current Sensor. It plugs into one of the 8 pin connectors as noted above. See wiring diagram “Charge Current Sensor Connection.

    *****Note: If you have a diesel generator or intend to motor frequently with an auxiliary (suitcase) generator, this device is highly recommended. It will insure accurate state of charge and time to discharge information is displayed.*****



Cooling System:

The “LC” designation in our product labeling refers to liquid cooled motors. In these systems, freshwater cooling of the motors and the motor controllers are used. This is similar to the freshwater cooling systems employed in most modern marine diesel engines. The “fresh water” is a water/glycol solution. This solution is pumped through the water jackets of the motors and the motor controllers where it picks up the excess heat generated when they are in operation. It then passes through a heat exchanger where the glycol solution comes in close thermal contact to seawater that is pumped through copper tubes. The excess heat is transferred to the seawater and pumped overboard.

Unlike a diesel engine cooling system, this system does not need to operate under pressure. There is far less excess heat generated in an electric motor than in an internal combustion engine. For this reason, the cooling system can operate at much lower temperatures and at atmospheric pressure. Even in warm tropical waters and high power settings, the glycol solution temperature will remain below 55 C (131 F). At this temperature, there is no need to raise the boiling point by operating under pressure.

Unlike a conventional internal combustion engine, the glycol solution does not come in contact with ferrous metals. As such, it will stay clean and does not need flushing and replacing at regular intervals.

The glycol solution is circulated by a small magnetically coupled centrifugal pump. This pump comes on anytime the key switch is “on”.

The seawater is drawn into the heat exchanger by a self-priming impeller pump. It is positioned on the front of the propeller shaft and turns any time the motor is in operation. Its speed goes up and down with motor speed, thus providing more seawater flow at high power levels when there is more waste heat produced.

Since the seawater pump is on the end of the propeller shaft, the flow will be reversed when the motor is operating in the reverse direction. Since the seawater exit is normally above the waterline, it will not pump seawater. For this reason a reverse recirculating loop is installed on the pump to insure it does not go dry and damage the impeller when operating in reverse.

In addition, the system will cut back power in the event of a loss of cooling water for an extended time. There is no concern for damaging the motors or motor controllers. Continued operation is allowed, though power will be cut back to insure the motors and controllers do not overheat.

Heat Exchanger/Pump Assembly Installation:

Your motor will be shipped with the fresh water cooling part of the system filled and ready for operation. The heat exchanger/pump assembly will need to be installed near the motor and connected to a seawater supply. Once this is done, the system will be ready for operation.

Installation:

1. Find a location close enough to the motor that the hoses will reach and secure the heat exchanger to the assembly horizontally to a flat surface near the motor.

2. Connect a 1” ID hose from the intake seacock to the intake side of a seawater strainer.

3. Connect a hose from the other side of the heat exchanger to the intake side of the seawater pump.

4. The pump is fitted with check valves that will keep seawater circulating through the pump when the motor is running in reverse. This prevents the pump from going dry and damaging the impeller when operating in reverse for longer periods of time. If the check valve assembly is not used, operation in reverse should be limited to no more than two minutes at a time.

5. Connect a 1” ID hose from the outlet side of the strainer to the intake side of the heat exchanger. Use a high quality hose designed for this purpose. If you have a right hand (RH) prop, connect to the port side fitting. If you have a left hand (LH) prop, reverse the connections to the pump and connect to the starboard side. See illustration below.

6. Connect a 1” ID hose from the seawater pump to the seawater hull exit fitting. Normally, this is above waterline.

7. There is a grounding lug on the heat exchanger that should be connected to the boat’s grounding system.

8. There is a white two wire cable coming from the motor that is not connected. It is approx. 6’ long and has a tag labeling it as “12Vdc, 2A max Pump Circuit”. Connect this to a 12Vdc circuit to power the circulating pump. The red wire is positive.

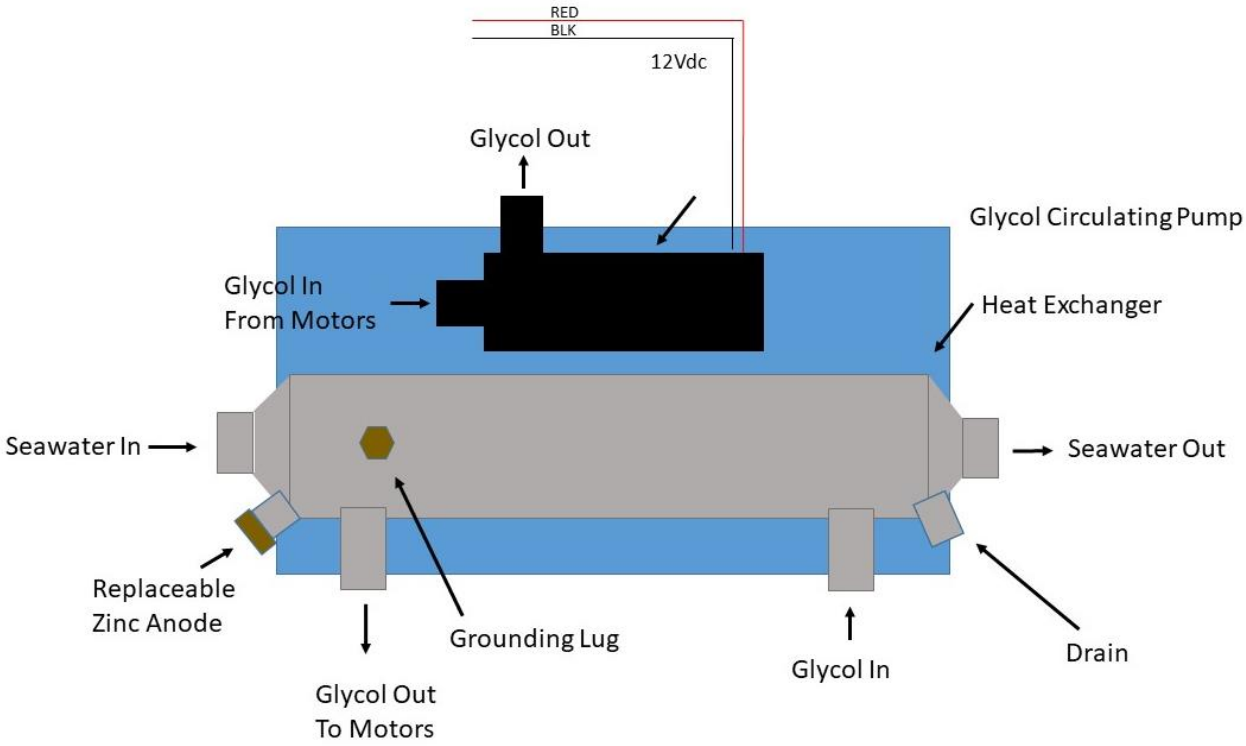
9. Remove the plug from the end of the filler hose that is connected to the intake side of the circulating pump.

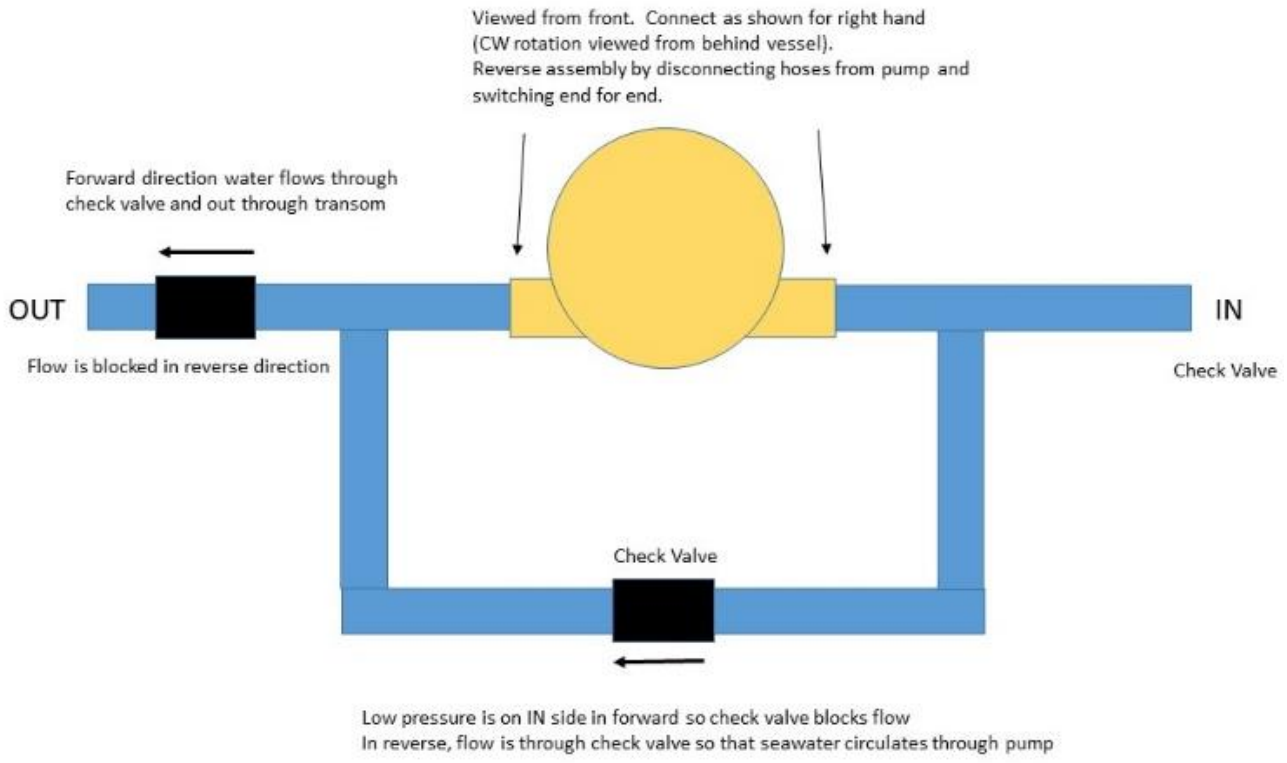
10. Install the coolant reservoir to the hose and secure with a hose clamp. Make sure the tube exits the elbow fitting next to the circulating pump vertically. This insures bubble in the system can rise up into this tube and exit through the coolant reservoir. This tube should be mounted as vertically as possible.

11. Secure the bracket holding the reservoir bottle in a location just above the highest point of the motor.

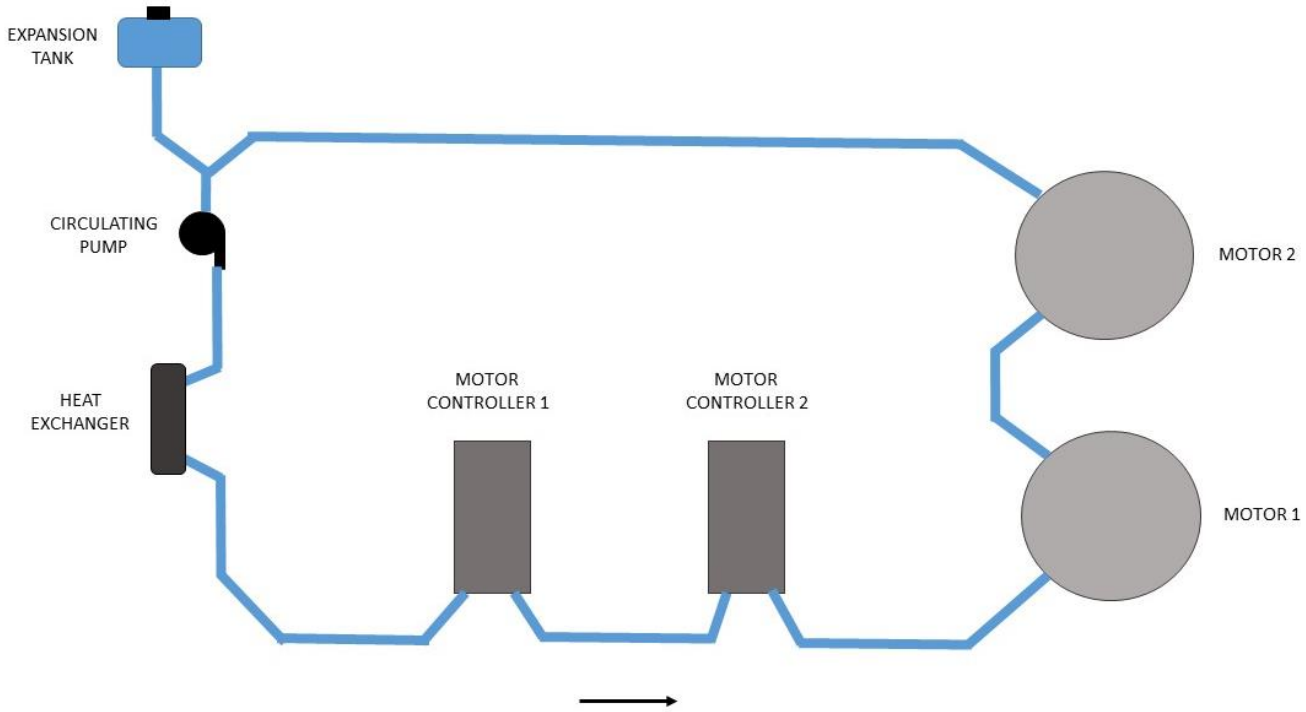
12. Fill the coolant reservoir with 50/50 water/glycol mix to approx. the 50% point.

13. In operation, this should be checked periodically and filled if the level has gone down. This may be necessary several times when new, as there will be small air bubbles trapped within the system.

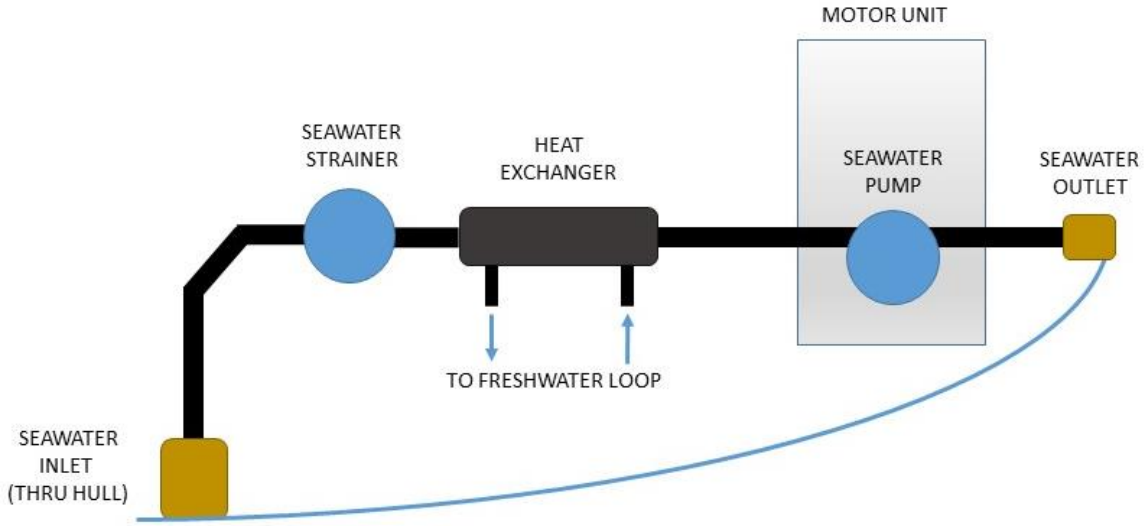




FRESH WATER COOLING LOOP

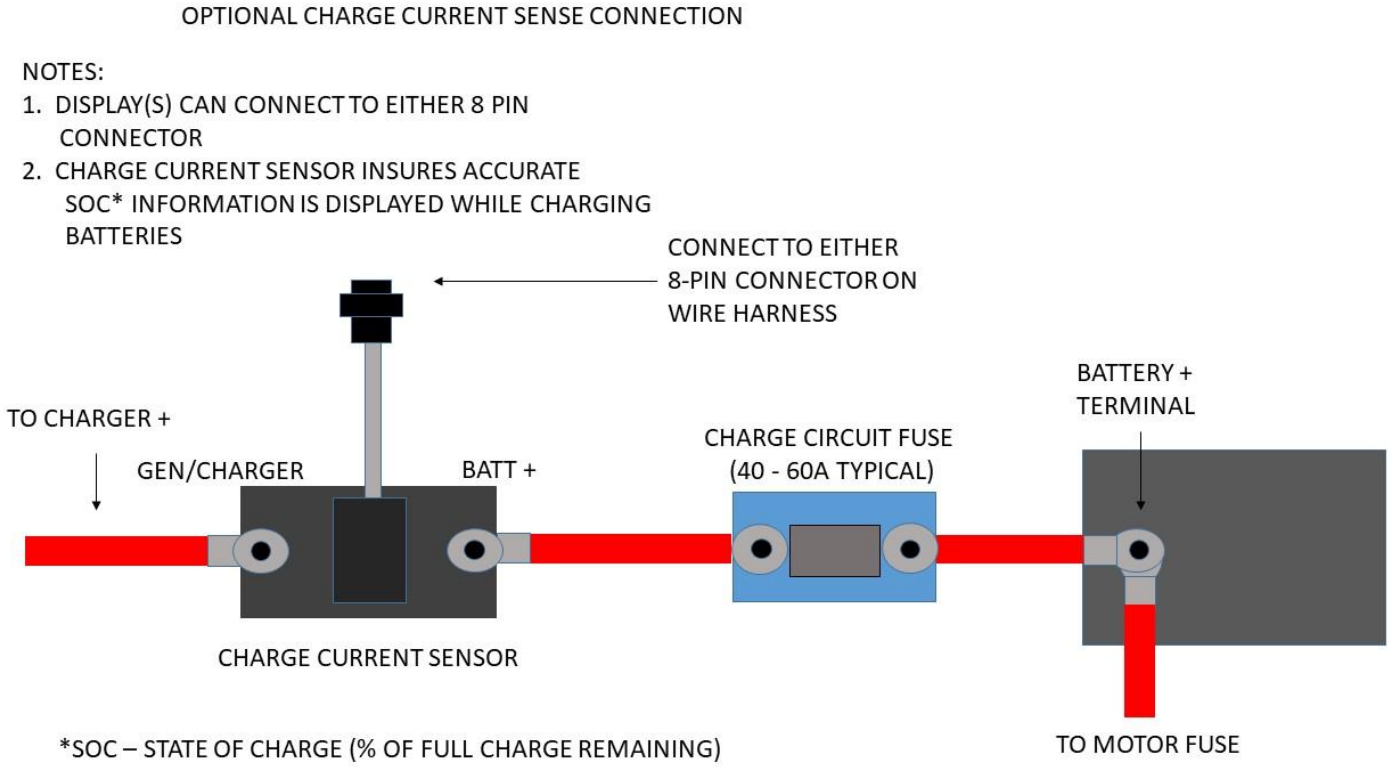


SEAWATER COOLING FLOW



Charger/Generator Current Sensor Wiring:

If you plan to charge while underway, either directly from a dc generator, or through an ac generator powering one or more battery chargers, refer to the wiring diagram below. This charge current sensor will ensure the SOC reading on the display is accurate while charging. If it is not used, the Electric Yacht controls will not be aware that charging current is flowing into the batteries and will display an incorrect value. It is highly recommended that this sensor is installed if charging while underway will be done with any frequency.



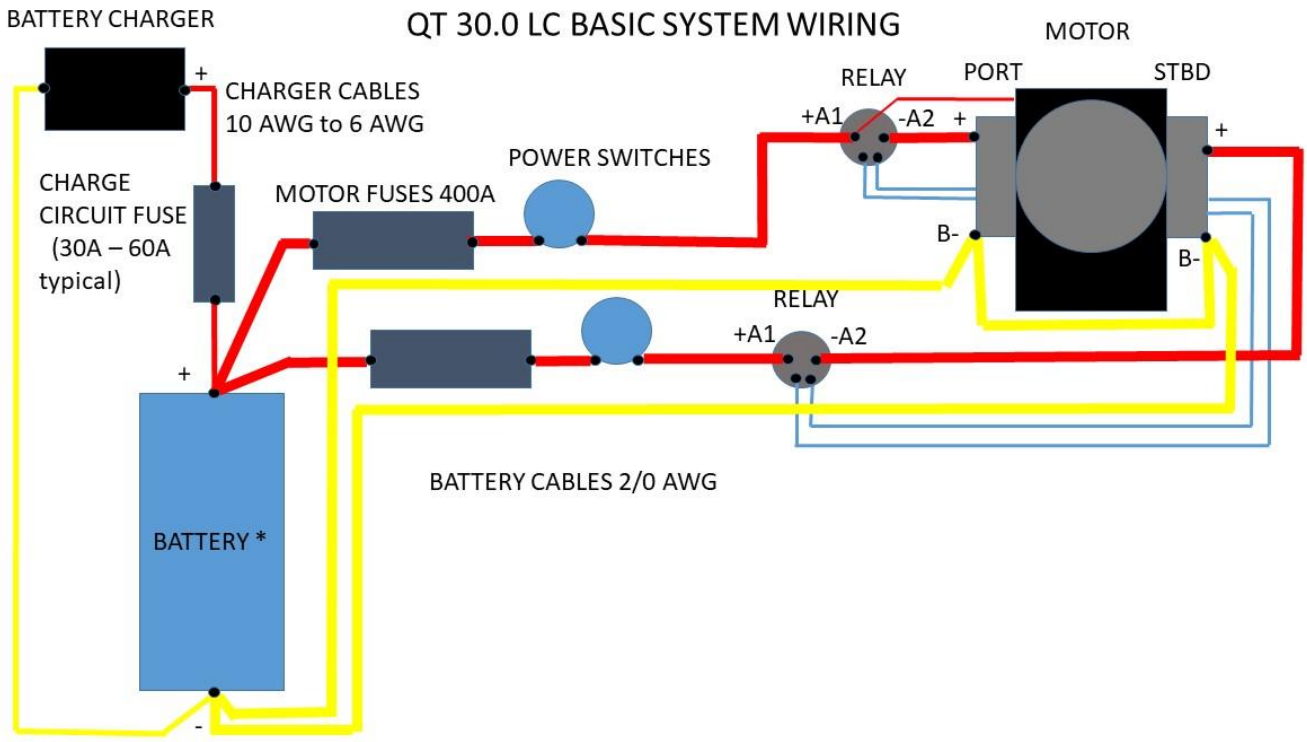
Charging System Connections:

To complete your system, you will need to address the battery charging system. This can be a complex topic, as there are many ways to accomplish battery charging. Below are some representative wiring diagrams.

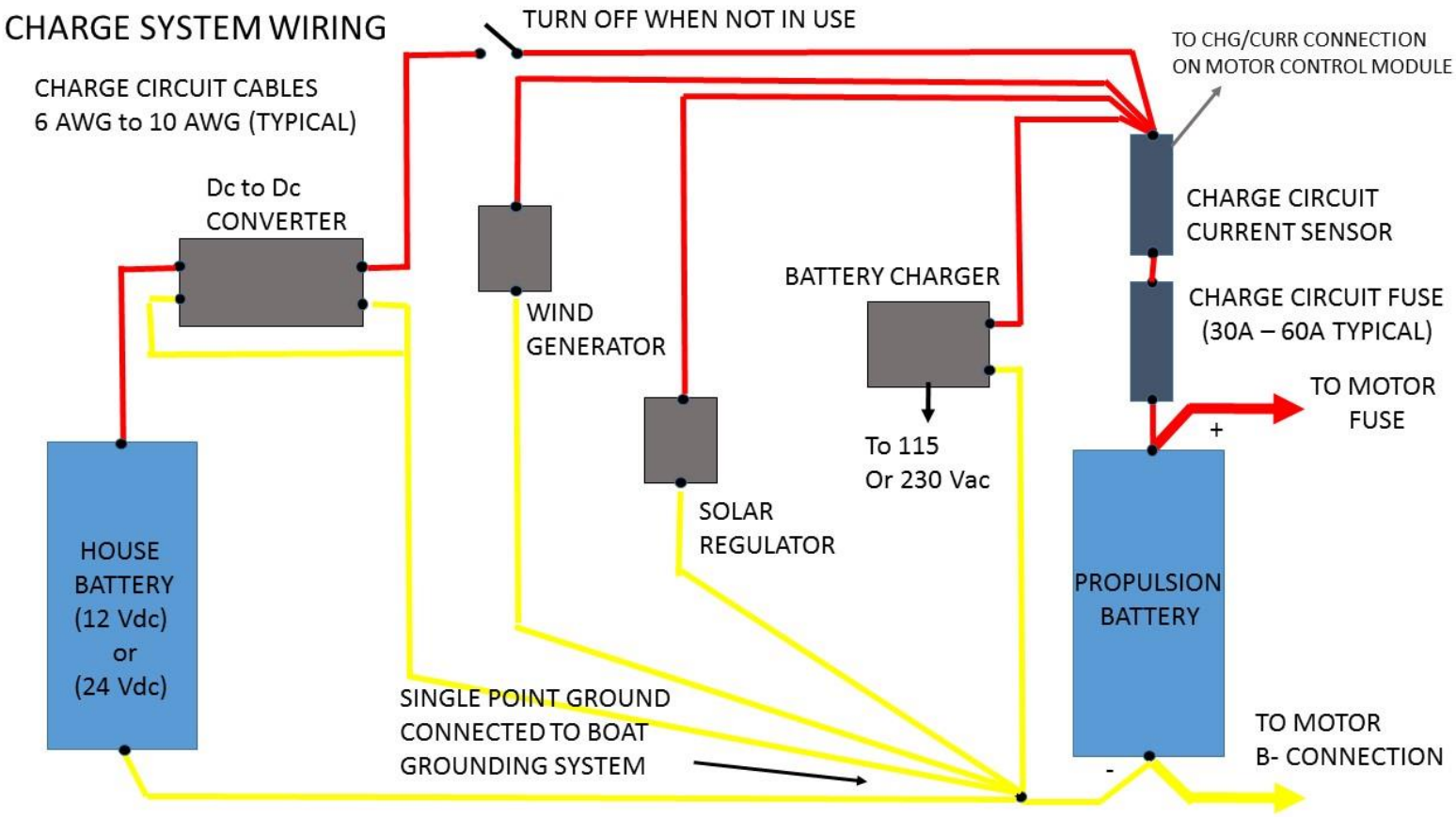
A basic system is addressed in the diagram below. In this system, charging is accomplished using shore power and a battery charger. Power for the charger can also come from a small “suitcase” generator. Typically, this is a 2 kW generator powering a charger with an output of 25Adc – 30Adc.

A battery charger of this size would be powered by a 115Vac circuit with a minimum 15A rating. Ideally, it will have its own circuit breaker, allowing it to be turned on or off, as needed.

If an onboard diesel generator will be used multiple battery chargers can be connected in parallel to increase the power available to the motor.



Following is a more general diagram showing multiple charging sources. Also, note that all of the negative battery connections are made at one point. This point should also be connected to the boat's grounding system.



Please feel free to contact us with questions concerning your installation.

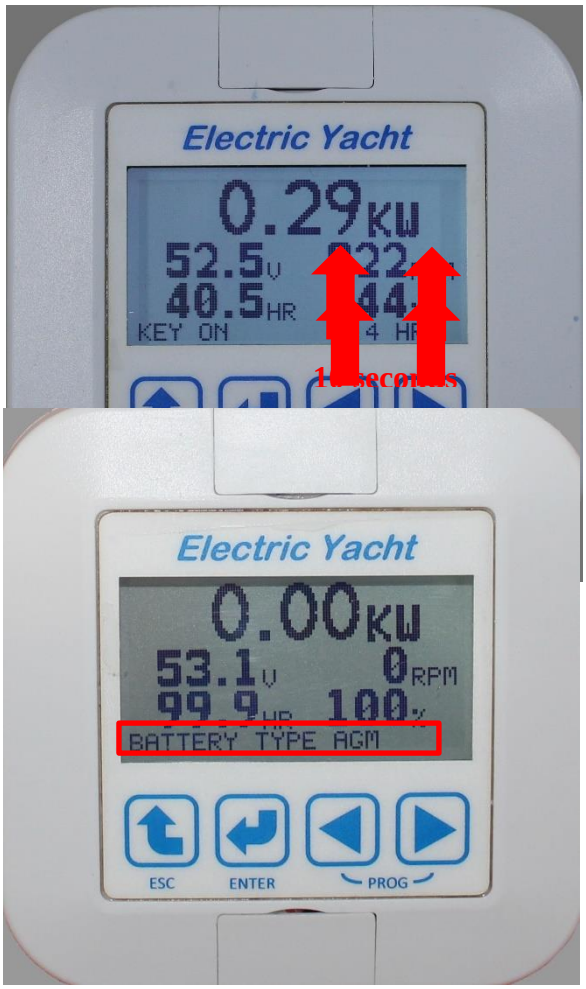
Initial Check Out:

1. Connect a voltmeter between the (B-) terminal on the motor controller and the (+) terminal on the relay. This is the forward terminal with a cable coming from the Master Power switch. Verify correct voltage and polarity.

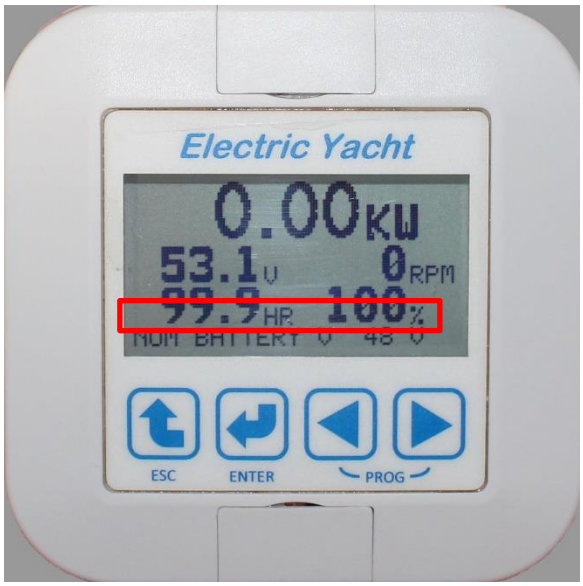
2. Turn the key switch to the “ON” position and verify the battery monitor (display) comes on.

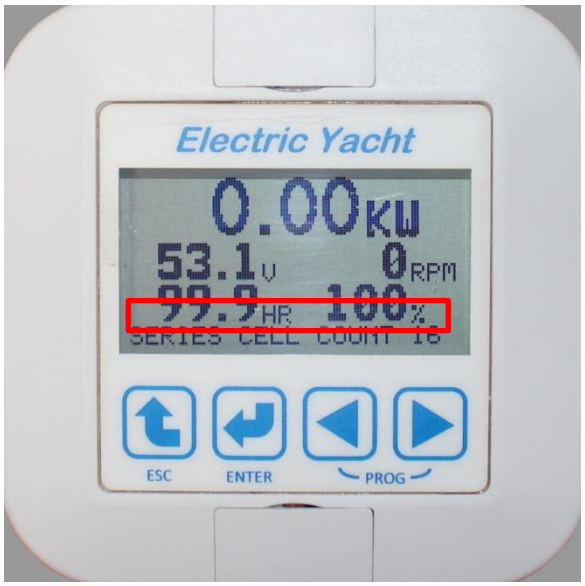
3. Press and hold the left and right arrow buttons on the battery monitor simultaneously for about 10 seconds until the bottom line of the display changes to show battery type. You are now in programming mode.

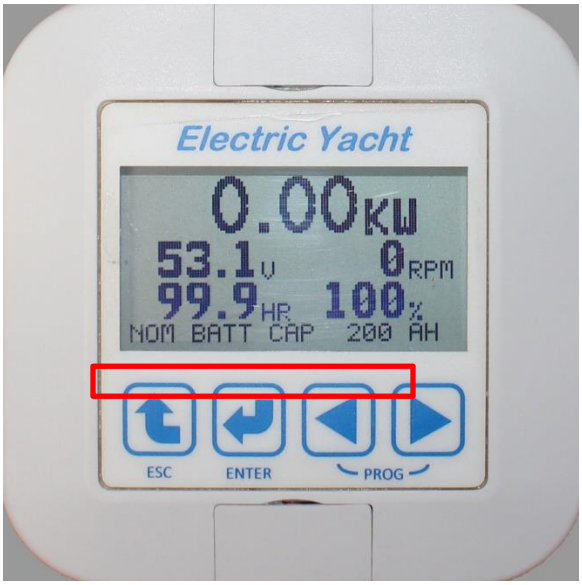
4. Use the left or right arrow to choose your battery type. Press the “ENTER” key.
    a. Flooded refers to traditional “wet cell” batteries.
    b. AGM refers to traditional Absorbed Glass Matt, such Lifeline batteries.
    c. TPPL refers “Thin Plate Pure Lead”, examples would include Odyssey and Northstar brands.
    d. LiFePO4 refers to “Lithium Iron Phosphate”, an examples are Dakota and Lynac brand.
    e. NMC refers to lithium “Nickel Manganese Cobalt”, an example is the Torqeedo brand.



5. Use the left and right arrows to choose the nominal battery voltage. In most cases, this will be 48V. Press the “ENTER” key. If one of the Li-ion types are chosen, select the series “cell count”. The most common “48V” series string of LiFePO4 cells uses 16 cells in series. A typical Li-NMC “48V” battery will use 14 cells in series.

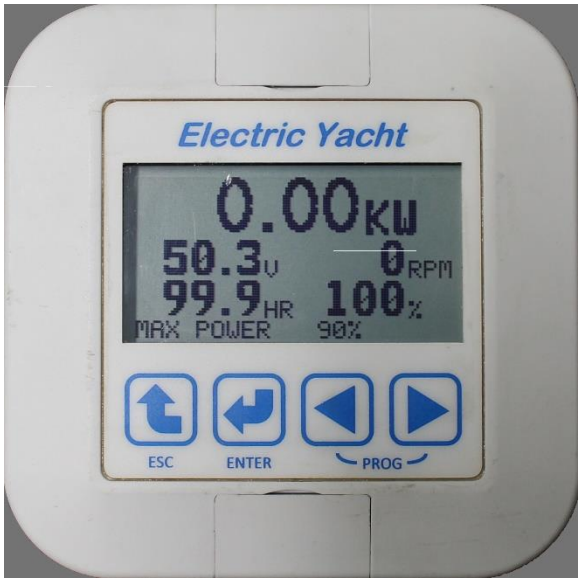






6. Use the left and right arrow keys to select the amp-hour capacity of your battery. Press the “ENTER” key.

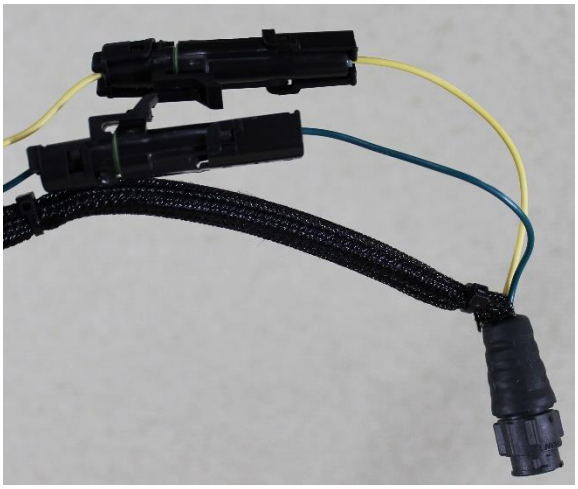
7. Allow 5 seconds for the Battery Monitor to get the Max Power setting from the Sevcon motor controller. In most cases, leave the setting at 100%. If reducing maximum power is desired, use the left or right arrow keys to set it to the desired setting. Wait 5 seconds before pressing the “ENTER” key.



8. Allow 5 seconds for the Battery Monitor to get the Regeneration setting from the Sevcon motor controllers. Use the left and right arrows to adjust this to the desired setting. 35% is a good starting point. The value can be optimized later while sailing. Press “ENTER” again to exit programming mode and save all settings.

1. Slowly move the “throttle” handle forward and observe direction. If the boat is moving ahead, no action needs to be taken. If it is moving astearn, turn off the main power switch and reverse the two black connectors in the wire harness located at the front of the motor. When reversed, each will have a green wire on one end and yellow on the other.

   Note: If operating out of the water, the motor will spin up to full speed at low power settings. This is normal. Final adjustments must be made in the water.



2. Secure the covers over motor controllers.

Open Water Checkout:

1. In protected water with light to no wind and minimal wave action, slowly advance the throttle to full throttle and let the boat accelerate until running at a constant speed.

2. Observe the battery current.
    a. If it is at least 550A, you have a good match between your reduction ratio and your propeller.
    b. If it is less than 550A and the motor speed is over 2000RPM you have a little too much reduction. As long as you are getting adequate performance, this is fine. If not, you will need to replace the top pulleys with the next larger size or increase propeller pitch. Contact us and we will supply.
    c. If the maximum motor speed is less than 1750 RPM, you don't have enough reduction. This condition will result in slightly reduced efficiency. It is not harmful, but it is a recommended to replace the upper pulleys with a smaller size or decrease propeller pitch.

3. Check the reverse (astearn) performance. Due to differences in propeller efficiency between forward and reverse, the current draw will likely be different.

4. If significant vibration is observed, loosen the top nuts securing the mounting L-brackets to the jack screws. Gently bump the motor from side to side and make adjustments to the jackscrew heights until vibration is minimized. This should be done with the boat underway to avoid excessive turbulence that can occur with the boat moored. Some vibration is normal. The electric motor is much lighter than a diesel/gas engine. Therefore, any vibration due to turbulence, a slightly bent shaft, propeller out of balance, etc will show up as vibration of the motor. Once vibration is minimized, tighten the ½" nuts securing the front mounting feet to their L-brackets. This should eliminate any significant vibration. If vibration cannot be eliminated, realignment and checking of shaft and propeller for imbalance are in order.

The motor system is now ready to operate. Happy sailing!

*****Note for users of LiFePO4 batteries*****

LiFePO4 Li-ion batteries have a very flat voltage discharge curve. This does not allow resetting the SOC based on voltage, which can be done with lead acid chemistries.

If these batteries are charged with the motor power off, which is commonly done, the SOC may not reset to 100%. To correct this, press and hold the ESC key. Use the left and right arrow keys to set the desired SOC value while continuing to hold down the ESC key. Normally, this is 100% after a full charge. A battery voltage at rest of 53Vdc or higher indicates batteries are at full charge.

Regeneration Fine Tuning:

1. Go sailing on a day when the boat can be sailed at or near hull speed.
2. Press and hold both arrow keys to enter the programming mode.
3. Press the “ENTER” key until the Regeneration screen is shown.
4. Use the arrow keys to adjust the regeneration amount to maximize the energy produced, as shown on the screen (in kW).
5. Press “ENTER” again to save the value and return to normal operation.

Usage Guidelines:

1. Take your time. Without the noise of the old engine, it is more enjoyable to cruise under power. Running at a slower speed will increase runtime dramatically.
2. On light air days, dial in a few amps of current to keep the boat moving through dead spots or to point higher.
3. Plan ahead. Minimize motor usage if you might need to make a long cruise home under power.
4. To maximize battery life with lead acid batteries, keep the AVERAGE discharge to 50% or less. Discharging to 20% is not a serious issue. Do not discharge below this level unless necessary. Never leave batteries in a discharged state for a long period of time.
5. Leaving LiFePO4 batteries in a partial state of charge is not detrimental. In fact, it is better to leave them at a partial state of charge, rather than full

charge, anytime they are put into long term storage. See manufacturer's recommendations for care.

6. Always turn off the Master Power switch when leaving the boat. The key switch does not remove power from the controller. There is a small current draw if the Master Power switch is not off.

Maintenance:

Your electric system should require far less maintenance than your old gas or diesel engine. Following are general guidelines.

1. Grease the two bearings on the motor unit once/year or every 500 hours. Use a good grade of waterproof wheel bearing grease. There is a grease fitting near the output shaft on both the forward and aft ends of the motor frame.

2. Check the water level of your batteries periodically, if you have flooded lead acid. Add distilled water if needed. Only add water when the batteries are charged. If you are using good “Smart” chargers, this should only be necessary once or twice a year. AGM or LiFePO4 batteries don’t need watering.

3. Occasionally feel all of the connections after running the motor at high current for at least ten minutes. Any hot terminals should be cleaned and re-tightened.

4. Clean the battery tops and terminals once per year or when corrosion is evident. Recoat the terminals with dielectric grease.

5. If excessive amounts of black rubber particles are observed below the motor it is time to replace the timing belts. It can be done in about an hour with hand tools.

6. Check the coolant level at regular intervals. It should be just visible at the bottom of the overflow reservoir when cold. Add a 50/50 water glycol solution as needed.

7. Replace the seawater pump impeller at annual intervals. Use Johnson Pump p/n 09-1027B or equivalent.

Happy Sailing!

Fault Conditions:

Certain conditions may cause of of the motor controllers to generate a fault code. In some cases, the motor will stop. In other cases, it will continue to operate at full or reduced power. If a controller is in a fault condition, it will flash a fault code with the small green LED on the front of the (Sevcon) motor controller. It is necessary to remove the metal covers to observe the fault code. The LED will flash for a specified number of times corresponding to the code, stop for a second and repeat. It will only show one fault condition at a time.

The following is a description of the fault codes. Many of the codes can have more than one cause. The most likely is listed first. Contact the factory if the cause of the fault code cannot be determined and corrected.

1. Configuration issue	Consult with factory
2. Control sequence fault	Make sure throttle is in neutral when key is turned on. If fault persists, it could be a short circuit in the wire harness. Consult factory if no obvious control wiring damage is evident.
3. Over voltage or over current condition	Check motor power (M1, M2 and M3) cable connections and battery power connections. Make sure they are all correct. If so, try repositioning terminals where they connect to motor controller so they do not touch near the connection. If fault continues, contact factory. This could be an indication of permanent damage due to mis-wiring of battery or motor phases (M1, M2 and M3).
4. Power relay not functioning correctly	Check connections to power relay. If fault cannot be cleared, contact factory.
5. Motor open circuit	Most likely one of the three phase cables (M1, M2 and M3) to the motor are not connected.
6. Throttle potentiometer fault	Indicates a failure of the potentiometer on the back side of the throttle control or an issue with the wiring to the potentiometer.
7. Voltage out of range	Indicates a high voltage or low voltage condition. Check connections and battery voltage.
8. Motor or controller temperature	Motor or motor controller is in high temperature cut back. Motor will

	continue to operate, but at reduced power. If it occurs when motor is not hot, it may be caused by failure of motor temperature sensor or temperature sensor wiring to motor controller. **Note:** The display will show “HI TEMP” at the bottom of the screen if the motor or controller are near their maximum allowed operating temperature. It is advised to reduce power if this occurs. However, no damage will occur. The motor controller will automatically reduce power to insure neither the motor nor controller overheats.
10. Controller in off line programming mode	Contact factory. Cannot be corrected by user.
11. Encoder fault/high current fault	The motor is not getting valid motor rotor shaft position signal from motor shaft position encoder. This signal is carried on the cable with the black 8 pin connector between the motor controller and the motor. May also indicate a current regulation issue. This may be caused by a failed shaft position encoder in the motor, a short circuit, incorrect or missing connection between motor controller and motor controller (M1, M2 and M3).
Contact factory if any other fault code occurs.	

Motor Controller connections (rectangular connector):

1 – Logic Power
2 – CAN Termination
3 – Relay Coil, Main Power Relay (BLU)
4 – Relay Coil, Main Power Relay (BLU)
7 – Relay Coil, Circulating Pump Relay (GRN)
8 – Relay Coil, Circulating Pump Relay (GRN)
13 – CAN High (RED)
15 – Encoder Power (-) (BLK)
21 – Encoder Sine (BLU)
22 – Throttle Potentiometer Signal
24 – CAN Termination (GRN)

26 – Encoder Power (+) (RED)
27 – CAN Low (BLU)
33 – Motor Temp Sensor
34 – Throttle Potentiometer + (- is connected to B- terminal on motor controller)
35 – Encoder Cosine (WHT)

Battery Monitor or Charge Current Sensor Connector Pin Out:

1 – Power (+12Vdc) (RED)
2 – Unused
3 – Unused
4 – Common (BLK)
5 – CAN HIGH
6 – CAN LOW
7 – Unused
8 – Unused

Throttle Connector Pin Out:

1 – Potentiometer Power (+5V) (GRN)
2 – Potentiometer Wiper (WHT)
3 - +48V (RED)
4 – Logic Power to Motor Controller (ORG)
5 – Potentiometer Common (BLU)
6 – Unused

Motor Controller to Motor 3-Phase Power Connection:

M1 to M1 (Label on Cable)
M2 to M2
M3 to M3

Motor Controller to Motor Encoder:

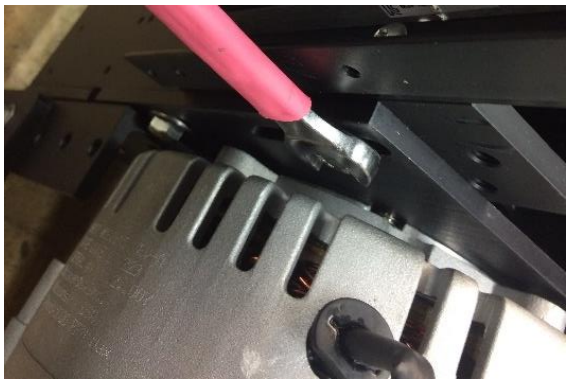
A – Encoder Sine (BLU)
B – Encoder Cosine (WHT)
C – 0Vdc (BLK)
D – N/C
E – +5Vdc (RED)
F – Shield (BLK)
G – Temp Sensor (YLW)
H – Temp Sensor (WHT)

Motor Pulley Replacement:

This procedure can be done with the motor in the boat.

1. Disconnect the battery bank positive terminal.

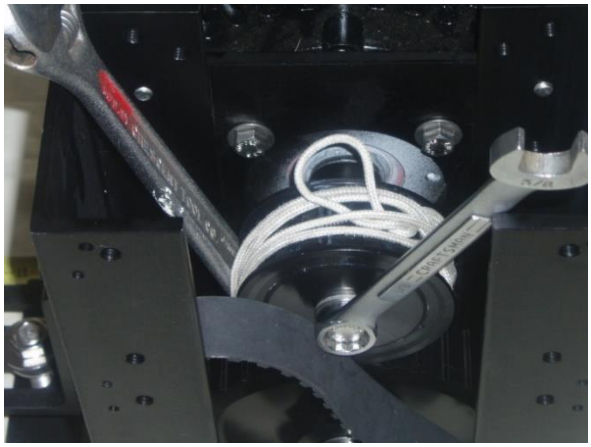
2. Remove the sheet metal covers and motor controller. The cables can be left connected. Move the controller out of the way.



3. Loosen the four bolts (on back side of motor assembly) that hold the motor plate to the frame.

4. Slide the belt off the motor pulley.

5. Make a pulley holding tool by passing a 6' (approx.) piece of 1/8" or 3/16" rope line through the handle of a Crescent wrench (or similar) and tying the ends.



6. Wrap the rope around the pulley CW.

7. Loosen the bolt on the end of the motor shaft with a 5/8" box end wrench.

8. Slide off the old pulley, key and spacer washers that are under it. If it is stuck, use a gear or wheel puller to remove it. DO NOT hammer, as this can damage the motor bearings.

9. Put some fresh anti-sieze compound on the motor shaft.

10. Slide the pulley and key onto the motor shaft.

11. Wrap the rope around the pulley CCW.

12. Install and tighten the bolt, use removable (blue) Locktite on the threads.

13. Slide the belt back on the pulley.

14. If the motor is out of the boat, turn it upside down so the weight of the motor will tension the belt.

15. If not, push the motor upward until the belt is tight. Cog tooth timing belts do not need to be overly tight. A deflection of ¼" with light pressure is good.

16. Tighten the four motor plate bolts.

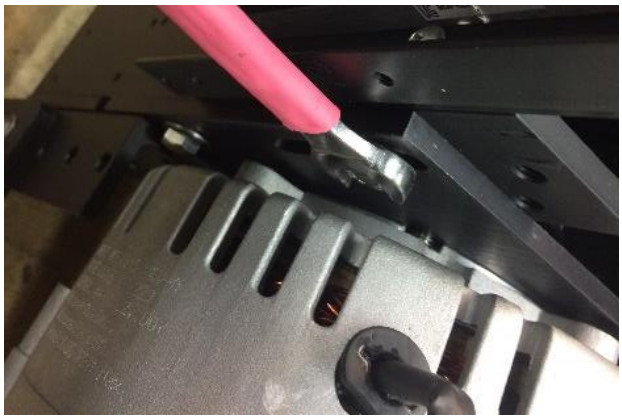
17. Re-install controller and sheet metal guard. Re-connect battery and you are ready to go.

Belt Replacement:

This procedure can be done with the motor in the boat.

1. Disconnect the battery bank positive terminal.

2. Remove the sheet metal covers and motor controller. The cables can be left connected. Move the controller out of the way.



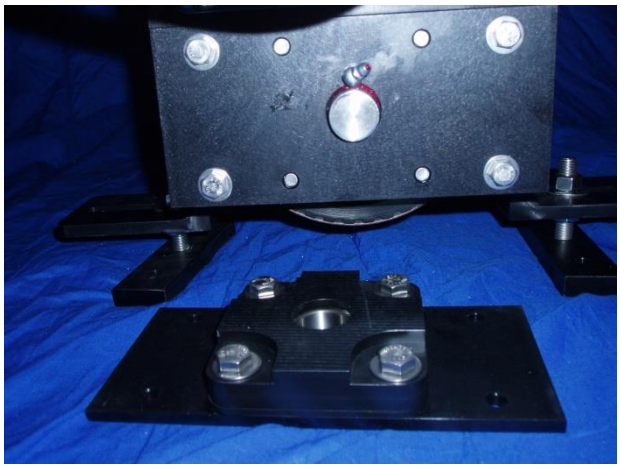
3. Loosen the four bolts (on back side of motor assembly) that hold the motor plate to the frame.

4. Slide the belt off the motor pulley.

5. Remove the four bolts securing the forward bearing plate to the motor frame and slide off bearing plate.

6. Remove the old belt and replace with the new one.

7. Replace the bearing plate and tighten bolts. Use removable (blue) Loctite on the bolt threads.



8. If the motor is out of the boat, turn it upside down so the weight of the motor will tension the belt.

9. If not, push the motor upward until the belt is tight. Cog tooth timing belts do not need to be overly tight. ¼" deflection with moderate finger pressure is ok.

10. Tighten the four motor plate bolts.

11. Re-install controllers and sheet metal covers. Re-connect battery and you are ready to go.

LIMITED WARRANTY:

This products of JASM, LLC d/b/a Electric Yacht, a Minnesota Limited Liability Corporation, are warranted to be free from defects in material and workmanship for a period of 36 months from the date of purchase by the first non-commercial retail customer and 12 months from date of purchase for commercial use customers. The above warranty shall be subject to the terms, conditions, and exclusions below.

For warranty service, contact JASM, LLC for instructions. For work required by the manufacturer, prior authorization will be obtained before part(s) are shipped to JASM, LLC.

This warranty is applicable to the first purchaser only and is not transferable. All requests for warranty service must be made within the warranty period.

During the warranty period, JASM, LLC, will repair or replace or refund the purchase price of any part that, upon examination by JASM, LLC, is found to be defective in material or workmanship under normal use and service. JASM, LLC shall in its sole discretion determine a defective part will be repaired or replaced or purchase price refunded. In the event of a refund, purchaser shall return the entire product to JASM, LLC, or its Authorized Service Dealer prior to receiving such refund. JASM, LLC, may retain all defective parts or components. Any repaired or replaced part or equipment will only be covered by the warranty period remaining on the original purchase.

JASM, LLC, does NOT warrant or make any representation in respect to installation errors made by a dealer, mechanic, installer, or individual. This warranty applies to defects in material and workmanship only; it does NOT apply to the following:

• Normal Wear and Tear: Like all mechanical devices, this motor needs periodic parts and service to perform well. This warranty does not cover repair when normal use has exhausted the life of a part or the motor.
• Improper Installation and Maintenance: This warranty does not apply to equipment or parts that have been subjected to improper or unauthorized installation, alteration, or modification, or that have been improperly maintained, repaired, serviced, or stored., as per the Owner's Manual.
• Damage caused by fire, flood, storm, or other natural acts and natural disasters.
• Damage caused by an accident or collision. Nicks and normal wear are not covered. This includes damage incurred during shipping.
• Damage caused by misuse, mistreatment, negligence.
• Products and components not manufactured by JASM, LLC. Purchaser shall be limited to warranty, if any, provided by the manufacturer, and JASM, LLC will not be held liable for any such defects.
• Use in an application for which the equipment was not designed.
• Reimbursement for transportation or shipping charges, towing charges, in and out of water charges, technician travel time, labor supplied by anyone other than JASM, LLC.
• Growth of marine organisms on internal or external surfaces or components.

This warranty is void if the equipment has been altered or modified in any way. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS WARRANTY IS PROVIDED IN PLACE OF ANY IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE TO THE EXTENT ALLOWABLE BY LAW. TO THE EXTENT SUCH WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE CANNOT BE EXCLUDED AS A MATTER OF LAW, SUCH WARRANTIES ARE HEREBY LIMITED TO ONE YEAR AND SUBJECT TO THE Warranty
EXCEPTIONS HEREIN TO THE EXTENT ALLOWED BY LAW. IN NO EVENT WILL JASM, LLC, INCLUDING THEIR OFFICERS, DIRECTORS, MEMBERS, EMPLOYEES OR AGENTS BE LIABLE FOR ANY CONSEQUENTIAL,

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