MARINE INSTALLATION AND USER GUIDE

FMMS

FREEDOM MEDICAL & MARINE SOLUTIONS

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DBA MERMAID MANUFACTURING

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Overview

Congratulations! You have just purchased one the most dependable Marine Air Conditioners on the market today, an FMMS.

FMMS supplies pleasure boat owners, custom boat builders, yacht brokers, boat dealers and marinas around the world with their marine air conditioning needs.

FMMS air conditioners are manufactured to the highest of quality standards using only top of the line components and materials assembled by long-term technicians. All of our air conditioners are modularized, self contained, prewired, precharged and mounted on a solid foundation of stainless steel. The entire unit is assembled proudly in the USA. All electrical parts are standard refrigeration components and are available around the world. Any four wire 24-volt digital thermostat will operate any standard FMMS air conditioner.

Our standard electrical control box does not contain any printed circuit boards or solder. All electrical connections are "snap on" color coded wires, making part replacement simple and fast. The electrical box can be unplugged for ease of assembly and service and the entire installation can be accomplished with standard shop tools. Our upgraded controller uses state of the art electronics eliminating any contactor or relay noises. Don't forget to see our new flush mount digital controller on our website WWW.FMMSUSA.COM. Upgrades to this controller are available at anytime.

Our warranty is also unsurpassed. For the first 5 years, the FMMS factory warranty covers all issues with your air unit. After 5 years, any certified air conditioner technician, marine, household or commercial, can service any Freedom air conditioner model.

Notes

Warranty

Limited, Nontransferable warranty applicable to the Continental U.S. and Canada

If your air conditioner or dehumidifier fails to function (due to a defect in material or workmanship) within 5 years from the date of purchase, Freedom Medical & Marine Solutions, LLC. (hereafter "FMMS") will replace or repair (at FMMS'S discretion) any defective parts free of charge after written notice to FMMS of your intent to ship the air conditioner and after the air conditioner has been returned to freedom's factory with transportation charges to the factory prepaid. FMMS covers shipping charges both ways for the first year of the 5 year warranty. after the 1 year period you are responsible for shipping fees to the factory and FMMS will cover shipping back to you. If any of the labeled "distributed products" fails to function as expected, contact the FMMS factory for assistance. FMMS accepts no liability for improperly handled or installed "distributed products".

If your pump. thermostat, or digital control fails to function within one year respectively from the date of purchase, FMMS will replace the pump, thermostat, or digital control free of charge after written notice to FMMS of your intent to ship the pump, thermostat, or digital control and after the pump, thermostat, or digital control has been returned to FMMS's factory with the transportation charges to the factory prepaid.

The 5 year and one year provision of this limited warranty shall be null and void if the air conditioner, dehumidifier, thermostat, pump, or digital control has been damaged after sale, subjected to unreasonable use or operation, altered, repaired by anyone other than FMMS without the company's consent, subjected to water flow (on the air conditioning unit) rates exceeding 500 G.P.H, wired with undersized wiring, or installed or used other than as indicated in the installation and user's guide.

FMMS is not responsible for the installation or removal of units. FMMS is not responsible for labor reimbursement

FMMS makes this limited warranty expressly in lieu of all other warranties, expressed or implied, including but not limited to, the expressed warranties of merchantability and breach of any warranty the liability of FMMS shall be limited to repairing or replacing the non-conforming goods. FMMS shall not be liable for any other damages, either direct incidental or consequential, regardless of their kind or nature

NON-TRANSFERABLE

INSTALLATION AND OPERATION

A.) AIR CONDITIONER INSTALLATION:

First, **AND MOST IMPORTANTLY**, the air conditioner and electrical box must be installed in a non-explosive, dry environment. **SEE THE FOLLOWING WARNING:**

WARNING: If the air conditioner or electrical box are: placed in an explosive environment, exposed to an explosive environment, or exposed to explosive materials, explosion could occur resulting in serious injury or death and/or destruction of the boat. This component does not meet federal requirements for ignition protection. Do not install in spaces containing gasoline engines, tanks, LPG/CPG cylinders, regulators, valves or fuel line fittings. Failure to do so may result in injury or death.

Typical unit mounting spots are under the vee berth, under settee seats, in hanging lockers, in cabinets or in outside dry lazzeretts and sail lockers. Everything must fit in and/or be accessible to the selected spot. The selected spot must accommodate the following eight requirements:

(1) The physical size of the unit and electrical box.
(2) Water in and out hoses.
(3) Electrical power cable for the unit and pump connections.
(4) Air ducting and air splitters.
(5) Mounting of the return air grill to insure the proper volume of return air.
(6) Access to the air conditioning unit.
(7) Condensation removal.
(8) Thermostat installation and wiring.

IMPORTANT: Read the entire installation instructions before you commit to cutting or drilling any holes. Remember “Holes are forever”. Measure, measure, then measure again before picking up any tool with a sharp edge.

IMPORTANT: Leave ample excess of hose, wire, and ducting when routing in to the air conditioner mounting compartment to allow for final positioning of the air conditioner after all the installation tasks are complete.

We will now address the 8 requirements in detail:

1.) Physical size of the unit and electrical box:

The air conditioner needs to be mounted in an area where it will physically fit, as well as accommodate a properly sized return grill and any ducting or splitters which would be attached to the air output collar. In addition, you need to insure there is space for the water hoses to be connected.

INSTALLATION AND OPERATION CONT'D

Air conditioner dimensions

Unit BTU	Length	Width	Height
3,500	10-3/4 Inches	15-3/4 Inches	9-1/2 Inches
6,500	10-3/4 Inches	15-3/4 Inches	11-1/2 Inches
9,000	20 Inches	13 Inches	13-3/4 Inches
12,000	20 Inches	13 Inches	13-3/4 Inches
16,500	20 Inches	13 Inches	13-3/4 Inches
24,000	Inches	Inches	Inches

The air conditioner must be securely mounted on a flat surface. If the sole of the boat (cabin floor) cannot accommodate the size of the air conditioner base plate, a mounting shelf or platform must be built. Typically the shelf will be made from 3/4 inch marine grade plywood which can be either fiberglassed or mechanically attached to the boat's sole or superstructure. **Never screw directly into the hull!**

When attaching the unit to the sold of the boat, the superstructure, or a fabricated mounting shelf, always make absolutely sure that the length of the screws being used to mount the unit will not engage the hull. If there is any question as to whether the hull may be compromised, an alternative mounting method must be used or another mounting spot must be located.

The electrical box, unlike the air conditioner, can be mounted in any attitude. It is attached to the air conditioner by a detachable 40 inch electrical cable, allowing it to be mounted above the unit, on a side wall or bulkhead and, if needed, in a totally inverted position.

Important

It is not uncommon in air conditioning systems for condensate lines or pans to become blocked over prolonged use. When selecting the electrical box mounting spot make sure that it is not located where condensation water can come in contact with it should the condensation water over flow its pan. Never place the electrical box below the air conditioning unit

Warning

If condensation water contacts the electrical box electrical shorting could occur causing fire which could result in serious injury, death, and/or destruction of the boat

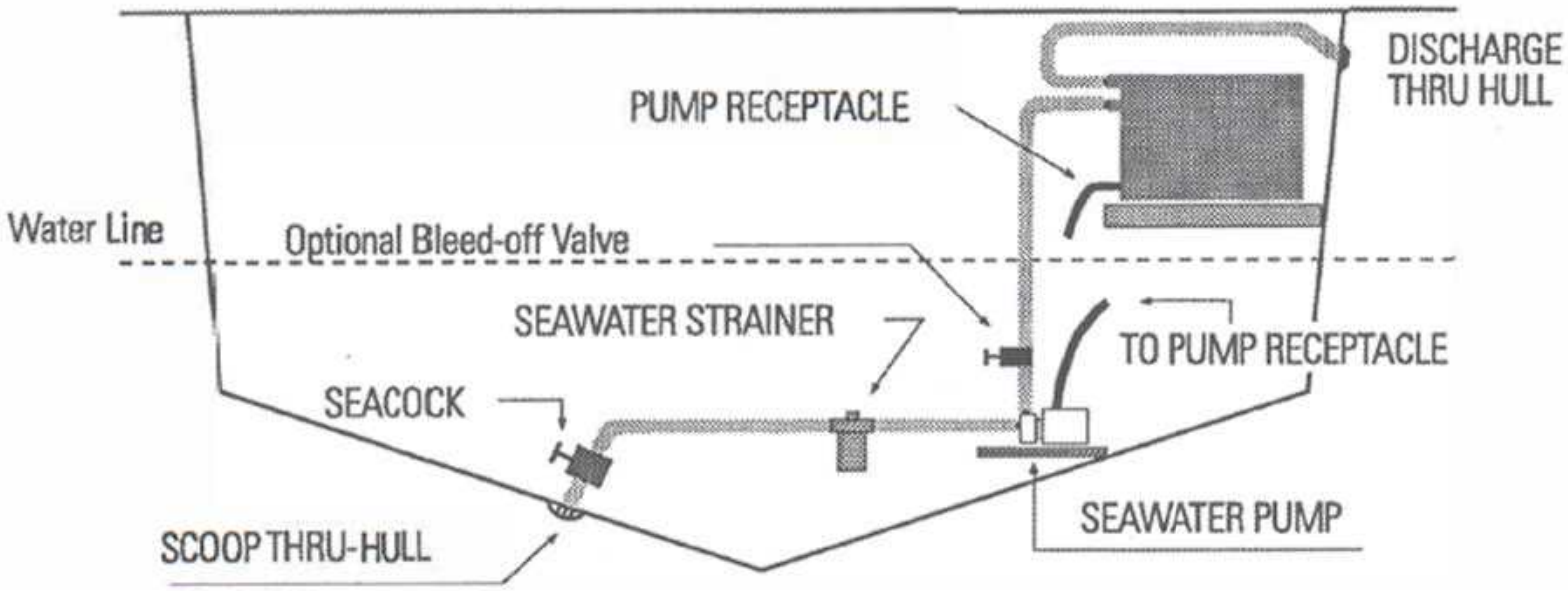
We suggest that once you are satisfied that the unit and electrical box, along with all of the other items required in the air conditioner compartment will fit, that you remove the air conditioning unit and electrical box or cover them completely until all holes and construction in the compartment are completed and the area cleanly vacuumed.

INSTALLATION AND OPERATION CONT'D

2.) Cooling water in and out:

All central marine air conditioning and heating units are water cooled. Cooling water is provided to the air conditioner via a foot scoop, sea cock, water strainer and pump assembly all of which are mounted below sea level. Typically the sea cock, water strainer, and pump are installed remotely to the air conditioner. **(See Figure 1)**

FIGURE 1



Water in:

Generally, in power boats, the sea cock will be installed in the engine compartment. In sail boats, because of their more uniform draft characteristics, it is usually installed under a settee seat or some other compartment more convenient to the air conditioner.

Water is then routed to the air conditioner from the pump via 5/8" marine water hose (also known as 1/2" I.D. hose) where it is connected to the air conditioner condensing coil "water in" connection. Make sure that space is allowed around the unit to make this connection. The water hose is easily kinked, restricting water flow. If needed, use a hose barb 90 degree fitting to eliminate any kinking. (These can be found at any PVC supply store).

An additional length of 5/8" marine hose (1/2" I.D.) is connected to the condensing coil "water out" connection. Cooling water passes through the condensing coil and routed through this hose to the "water out" thru-hull fitting which will be installed installed above the water level in the side of the boat's hull. **(See Figure 1)**

INSTALLATION AND OPERATION CONT'D

Important

The sea cock, water strainer and water pump must be installed below sea level. The sea water pump is not self priming and relies on water seeking its own level along with the hydraulic pressure of the boat to attain priming of the pump.

Warning

Before drilling the mounting hole for the sea cock the entire boat must be out of the water. Drilling the sea cock mounting hole with the boat in the water could cause extreme flooding and sink the boat or cause sever water damage to equipment in the boat.

Important

When selecting the spot for the sea cock, before drilling the hole, make sure that the pump and water strainer can be installed in the same adjacent area and remain below sea level. Also check the operation of the ball valve shut off handle on the sea cock for any possible interference once installed.

When selecting your sea cock mounting spot, you should also try to select a spot where the pump and water strainer are a maximum distance of 2 feet from the sea cock. We realize that in some boats it is not possible to incorporate the two foot rule. However, remember the closer you keep these three items together, the fewer pump priming problems you will experience. Once you are sure that all components will fit in the spot selected and remain below sea level and the boat is totally out of the water, you are ready to cut the sea cock mounting hole (see warning above). If you are using a sea cock assembly from fmms, we recommend that a 1-1/16" hole saw be used to make this hole. If you are using a sea cock purchased elsewhere, you must use the appropriate hole saw for that specific sea cock.

Important

Before cutting your sea cock mounting hole check the outside hull in the are you will be cutting to make sure there are no ribs or other hull variations which will not allow the sea cock foot scoop to mount flat against the hull. If there are any concerns, drill a small pilot hole first which can be easily sealed if interference exists. Drill the 1-1/16" sea cock mounting hole and pilot hole at the same angle as the hull. This will insure that the foot scoop lies flat against the hull.

Once the sea cock hole is drilled, inspect the hole to determine if you boat has a "corded" hull.That is, a hull not of solid fiberglass, but two layers of fiberglass separated by balsa or foam. When not properly sealed, "Cording" acts like a wick absorbing sea water into the hull. If the hull is "corded", obtain a fiberglass sealing kit from your local marine supplier to seal the cording before installing the sea cock to prevent "water logging". Same goes for water thru-hulls.

INSTALLATION AND OPERATION CONT'D

Important

Failure to seal a "corded" hull may result in serious damage to the boat's structure.

Note: The threads on the foot scoop end about 3/8" from the actual foot scoop. If after drilling the hole for the foot scoop you discover that your hull is thinner than 3/8", you will need to reinforce the hull with a 6"x6" pad to shim up to insure that the nut tightens correctly. We usually use 3/4" marine grade plywood to fashion the pad. Apply fiberglass on both sides of the pad and affix to the inside of the hull. After the fiberglass has cured, assuming that you had already drilled the hole for the foot scoop through the hull, then drill through the pad from the outside of the hull to insure proper alignment through the pad and hull. Do not attempt to drill through the pad from the interior of the boat.

Before installing the sea cock, apply a bead of marine sealant around the foot scoop and mounting post. We recommend "3M 5200" brand or a sealant brand of equivalent quality.

Insert the foot scoop up into the boat with the foot scoop facing toward the bow (Fore ward) and secure it to the hull with (2) 1/4" flat head s/s screws. We recommend the screw holes be pre-drilled with the appropriate size drill bit to eliminate cracking of the outer gel-coat of the hull. When drilling the holes, take care not to drill through the hull. Use a hand-held screwdriver to eliminate stripping the hole out. These screws are intended only to keep the foot scoop from turning under the boat when the inside fastening nut is not tightened down.

Inside the boat, attach the bronze retaining nut to the sea cock threaded post. Using an appropriate size tool or slip jaw pliers, tighten the nut to the hull snugly to insure that it will seal against the hull. After tightening the nut completely, cover it with a thick coat of marine sealant from the post out to about 1" from the nut onto the hull.

Now that the foot scoop is mounted, the ball valve (shut-off valve) can be attached. Generously coat the foot scoop post threads with marine sealant and screw the ball valve onto the post. After the ball valve is fully tightened to the post, check the action of the shut-off arm to make sure it can be fully articulated without obstruction. If the valve hits an obstruction, turn it on the post to a more optimal position. **Close the valve, repeat, close the valve!**

To connect your water hose you will need a 90 degree "thread to hose barb" fitting and a 3/4" "closed end nipple." Using 3m 5200, thread the 3/4" "closed end nipple" to the sea cock, then fasten the 90 degree thread to hose barb, with 5200 on to the 3/4" nipple. The "closed end nipple" is the bronze threaded pipe open on either end.

INSTALLATION AND OPERATION CONT'D

The water strainer and pump can now be mounted, but first you must get each component fully assembled and ready to mount. The water strainer and pump brackets must be securely mounted on a flat surface. Do not mount on the sole of the boat (cabin floor). If a nearby bulkhead cannot accommodate the size of the mounting brackets, a mounting shelf or platform must be built. Typically the shelf will be made from 3/4" marine grade plywood which can be either fiberglassed or mechanically attached to the boat's sole or superstructure. **Never screw directly into the hull!**

When attaching the mounting brackets to the superstructure or a fabricated mounting shelf, always make absolutely positive that the length of the screws being used to mount the bracket will not engage the hull. if there is any question as to whether the hull may be compromised, an alternative mounting method must be used or another mounting spot must be located.

The water strainer:

If you are using a FMMS furnished water strainer, it will come with (2) 3/4" thread to hose barb hose fittings. Attach these fittings to the strainer using ample amounts of marine sealant on the threads. Again, if you are using an FMMS strainer, locate the strainer mounting bracket. This is the bracket with a large hole in it. Unscrew the plastic bowl from the strainer body and place the strainer body in the hole. Replace the plastic bowl on the strainer body to lock the strainer in the bracket. This is meant to be a loose fit to facilitate cleaning when the strainer is dirty.

Water will flow from the sea cock through the strainer into the inlet of the pump. Ideally, the strainer and pump will be mounted so the water flow is at a slight upward grade to help eliminate air locks. Once you have settled on the mounting locations of the strainer and pump, attach each of their mounting brackets with (2) 1/2" s/s pan head screws. Note that the strainer is directional. Take notice of the stamped arrow and make sure it is pointed toward the ac unit.

Ideally, the pump should be mounted with the external 5/8" water discharge (the line that goes to the ac unit) pointed vertically. However, there is an alternative position. The pump can be mounted with the external 5/8" water discharge on the side. To accomplish this successfully, it is imperative that the actual pump discharge is at the highest level. In this position, the external 5/8" discharge will be located on the upper right corner of the pump with the 3/4" intake facing you. In this alternative position, the pump will still operate as originally designed. Failure to follow either of these recommendations will void any warranty with the pump.

Never screw the pump directly to the hull. If a stringer or other structure is not hand, you may have to fiberglass a mounting board to the hull to accept the mounting screws.

INSTALLATION AND OPERATION CONT'D

Note: If you are supplying cooling water to more than one air conditioner a larger GPH pump is required. Follow the mounting mounting instructions of the larger pump. Also a "tee" fitting must be used on the discharge side of the water pump to run cooling water to each unit.

Using the appropriate length of the 3 feet of 3/4" red stripe marine hose and (2) s/s hose clamps per connection, connect the sea cock, water strainer and pump together.

The pump:

Important

On dual air conditioner installations, an in-line shut off valve must be installed in each of the "water in" lines to allow operation of either air conditioner if one unit is removed for service.

Warning

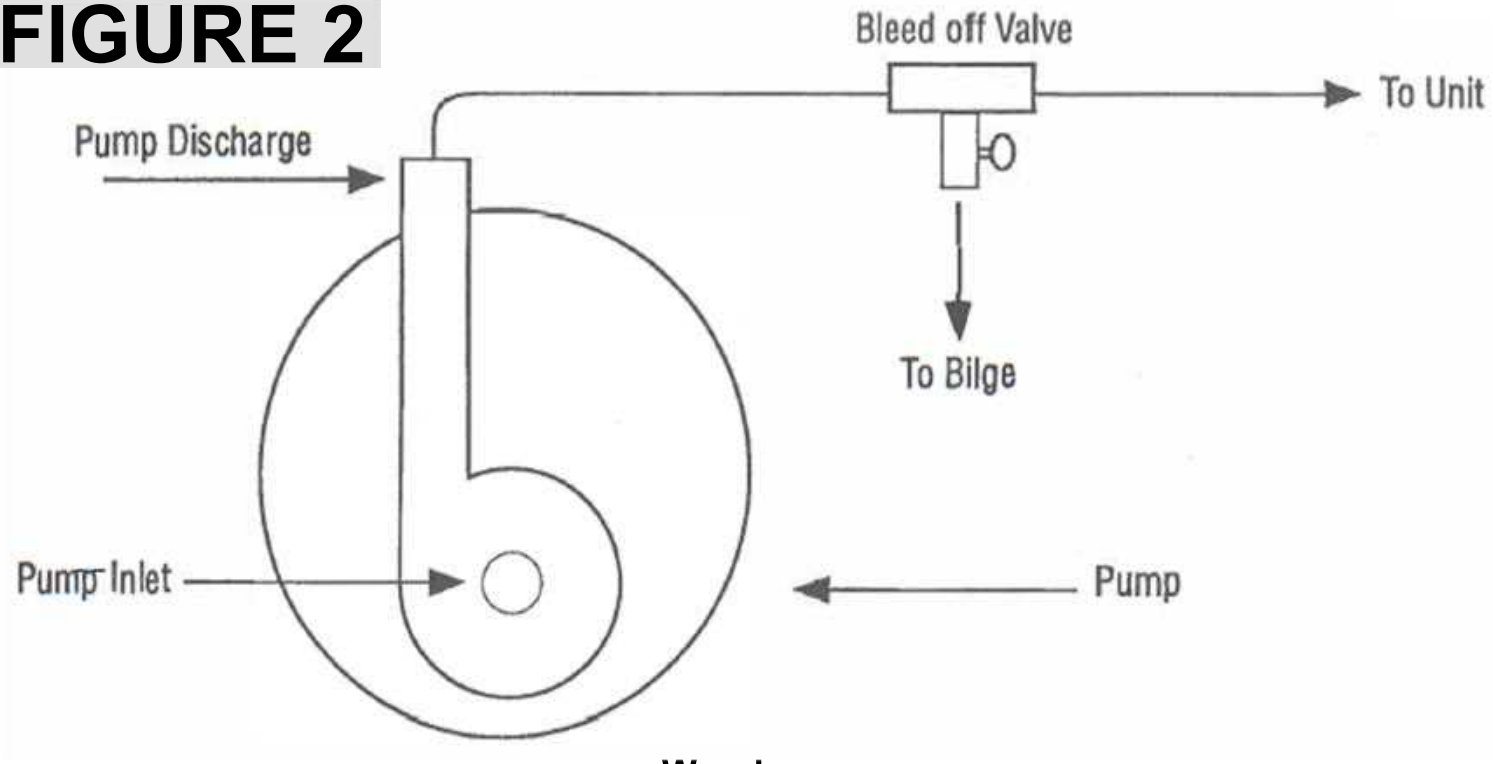
All hose connections must be secured using (2) s/s hose clamps. Failure to double clamp all hose connections may result in a hose disconnecting which could cause flooding damage and/or sinking of the boat. Damage to the air conditioner from excessive and recurrent leaking due to failure to double clamp all connections will void the warranty.

The 5/8" blue stripe water hose (or black reinforced hose) and the pump cord may now be routed to the air conditioner compartment. If the power cord that is permanently attached to the pump is not long enough to reach the air conditioner compartment, it must be extended using 16 gauge boat power cable. Cut off the connector on the end of the pump power cord (if present) and splice in the 16 gauge boat power cord. Appropriate electrical splicing must be used and the connection must be water proof and secured well above the bilge water level to insure that the connection will always remain dry. Heat shrink tubing is recommended after the connectors are applied. **Failure to keep this connection dry may result in fire and will void the warranty.**

Note: Loss of prime on the water pump is a common occurrence. An optional "bleed off" valve is available that aids in regaining pump prime. If you are using this option, it must be installed at this stage of the installation at the output of the pump (see FIGURE 2). Remember, all water hose connections must be secured using double s/s clamps. To install the bleed off valve, attach a short length of blue tracer hose to the water-out on the pump and secure the bleed off valve to the other end of the hose. Attached the blue tracer hose that you are running up toe the air conditioning unit to the other end of the bleed off valve. Close the bleed off valve. At each connection point, use (2) s/s clamps to properly secure the attachment.

INSTALLATION AND OPERATION CONT'D

FIGURE 2



Warning

After the installation of the "bleed off" valve, make sure valve is in the "off" position, that is, the position where water cannot flow into the bilge. Failure to close the valve will result in flooding when the boat is placed back into the water possibly causing serious damage or sinking of the boat.

After cutting off the three prong plug, temporarily combine the pump power cord and the water hose and route both items together into the air conditioner compartment (see following note). Secure both items along the way at one and two foot intervals to eliminate sagging or kinking due to boat or wave action.

Note: If you are using a single pump to supply cooling water to two air conditioners, you must install a pump relay box. before running pump power cable please see section "pump relay box".

Water Out:

The "water out" thru-hull can be mounted any place on the boat's hull that is a minimum of 6" above the water line. If using a FMMS supplied thru-hull fitting, the required hole size is 1-1/16" so the same hole saw used for the "water in" sea cock can be used. Typically the "water out" thru-hull will be mounted close to the air conditioner to eliminate the extra work of having to route the water hose to difficult places.

INSTALLATION AND OPERATION CONT'D

Warning

After the installation of the "bleed off" valve, make sure valve is in the "off" position, that is, the position where water cannot flow into the bilge. Failure to close the valve will result in flooding when the boat is placed back into the water possibly causing serious damage or sinking of the boat.

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The water line on the outside of the hull will give a good base line to determine the lower limit of the hole location. If your boat is new or kept high and dry, you will have to place it in the water to determine the water line. Once you know the water line you can determine where on the inside of the boat you can drill, staying above the water line and out of view. This hole should always be drilled from the inside of the boat. Once you have settled on a location for the hole, check outside again to insure you will be above the water level and that you will be clear of any outside ribs or other interference which will not allow the outside lip of the fitting to lay flat against the hull. **Always drill a pilot hole and check outside before committing the larger hole!**

When installing the thru-hull fitting apply an ample amount of marine sealant to the outside lip of the fitting and its mounting post. If possible, have someone hold the outside of the fitting to keep it from turning when you attach the retaining nut from the inside. Be careful not to over tighten the nut. Use (2) s/s hose clamps to attach the hose to the thru-hull fitting. Route this hose into the air conditioner compartment where it will eventually be connected to the condensing coil "water out" fitting.

INSTALLATION AND OPERATION CONT'D

3.) Electrical power:

Both the air conditioner and pump requires 110/120 Vac 60 hz power to operate. (220 vac models are available) this power is obtained from the master 110/120 vac circuit breaker panel in the boat. Power is routed from this panel to the air conditioner. The air conditioner will then supply power to the pump as required.

Warning!

Before proceeding further, check to insure that all 110/120 vac power has been disconnected from the boat and circuit breaker panel! Failure to do so could cause electrical shock resulting in serious injury or death!

Using 12 gauge boat power cable, beginning on the inside of the main circuit breaker panel, route the cable to the air conditioning compartment. Leave ample excess before cutting to allow for positioning of the unit's electrical box will be covered later.

At the circuit breaker panel locate a blank hole and install a 20 amp circuit breaker of the same style as as those breakers currently in the panel. Note that all of the breakers are connected together on one side by either a buss bar or individual jumper wires. Connect the new breaker in the same manner. remove about 12 inches of the outer insulation from the end of the boat cable to expose the inner wires. This cable contains (3) inner insulated wires which are "black","white", and "green" in color. Using the appropriate wire connections, as those currently used in the panel, connect the wires as follows: "Black" to the remaining terminal on the circuit breaker "white" to the buss bar connecting all "white" wires together and the "green" to the buss bar connecting all "green" wires together. Included in the installation kit, if you purchased that option, is a small FMMS sticker. Place this on your breaker panel to properly denote the air conditioner circuit breaker. The main circuit breaker can now be closed up.

For 220 vac units that have a 4-wire system (black, red, green, white) do the following:
Black goes to black (hot)
Red goes to white (neutral)
Green goes to ground
White gets cut off and not used

INSTALLATION AND OPERATION CONT'D

4.) Air ducting and splitting:

Regardless of the BTU size of the air conditioner, at least one vent must be within 4 to 5 feet of the unit. Insure though, that the airflow is not directed back towards the return air grill. in the case of 16,500 BTU unit, the largest grill is required to be the closest grill. Improper ducting accounts for the majority of marine air conditioner problems. Though there are exceptions to the rule, the following rule of thumb applies to the number and size of the supply air grills required for each BTU size air conditioner.

These are the minimum requirements, and more is always better:

M3- 3,500 BTU: (2) 4" vents

M6- 6,500 BTU: (2) 4" vents

M9- 9,000 BTU: (1) 6" vent and (1) 4" vent

M12- 12,000 BTU: (1) 6" vent (2) 4" vents

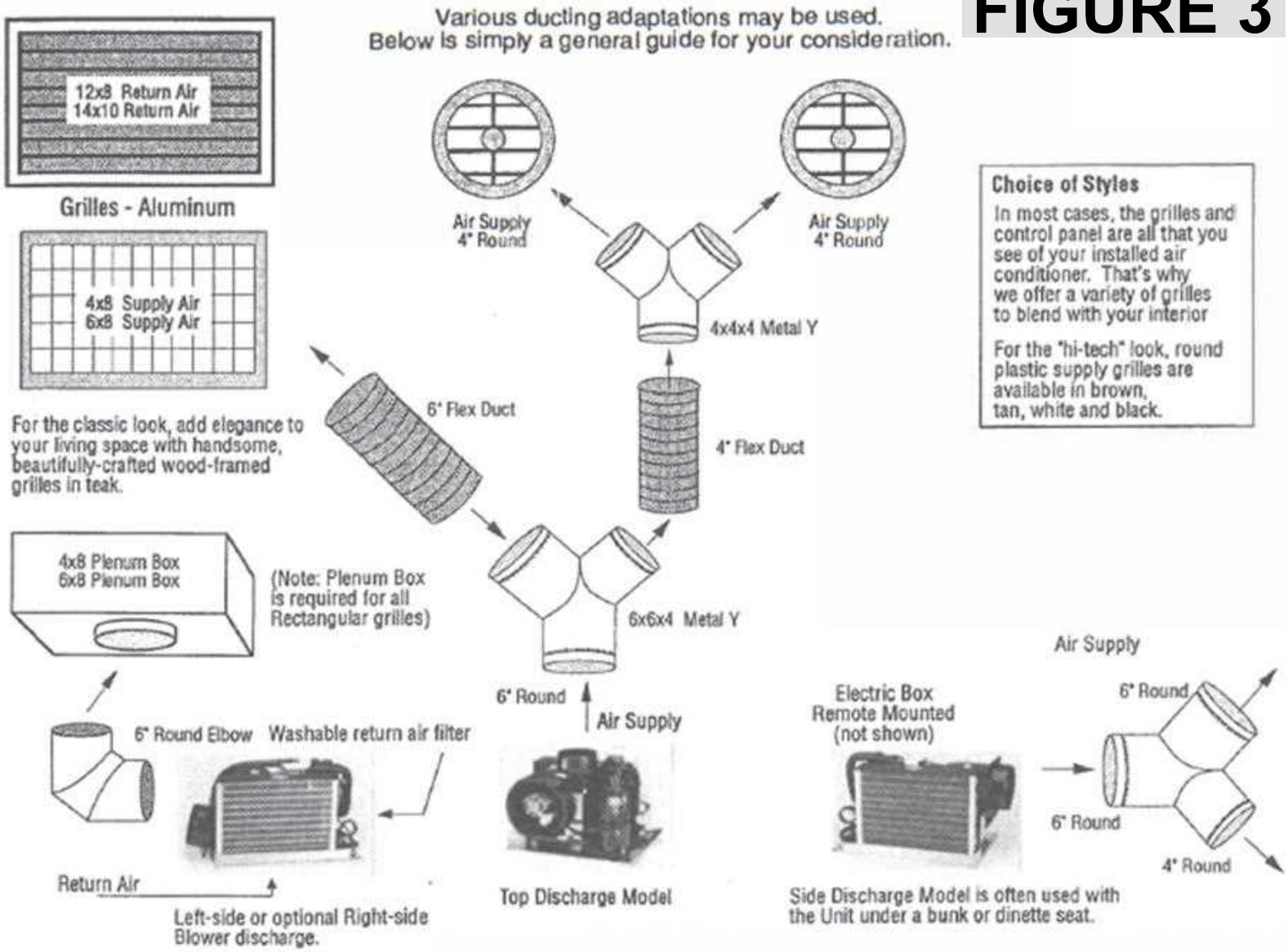
M16- 16,500 BTU: (2) 6" vents

M24- 24,000 BTU: (4) 6" vents

When it comes to ducting, a general rule is that more grills are always better. Any time more than one supply grill is used, an air splitter is required. Air splitters come in a variety of sizes and styles. Splitters may be mounted directly on the unit output air collar, or placed in line a short distance from the unit where space restrictions preclude mounting the splitter on the unit. Additional air splitters may be used at various intervals along the duct routing to distribute air to multiple cabins. Wye's are always preferable to tee's. We do not use tee's for air splitters. Refer to (figure 3), on the next page, for a typical ducting scheme. When surveying the boat for your air conditioner mounting spot, you must also decide what size supply air grills will be used and where they will be mounted. The size of the grill will dictate the size of the ducting. It is also important that you decide upon using insulated or non-insulated air duct before beginning. Generally the ducting will be 4", 5", or 6" diameter non-insulated duct. If you decide on insulated duct, add 2 inches to the outside diameter of the non-insulated duct. Typically power boats will use non-insulated duct and sail boats insulated. Except for passing through a hot engine room, the only benefit to using insulated duct is preventing condensation forming on the exterior of the duct (sweating) which could cause water staining on the fabrics. Because sail boats generally sit lower in the water and have less glass than power boats, they tend to produce more duct condensation than the power boat, however, space constraints may not

INSTALLATION AND OPERATION CONT'D

FIGURE 3



allow the total use of the insulated duct and you may need to use a combination of the two duct types. Some situations will require the use of non-insulated duct, but will require insulating the duct after the installation with an insulation wrap. All duct runs should be as short and straight as possible. Every 90 degree turn in a duct reduces performance by about 14%. Ducting should be tied to a permanent structure every foot or two to eliminate sagging. Using tie wraps, insure ducting is appropriately fastened to each supply air grill.

Another important consideration is the physical size of the supply air grills. 4" round grills require a 4.5" hole and the duct merely slides over the neck of the grill. a four inch rectangular grill usually measures 4"x8" for the hole size but also requires a plenum or transition box behind the grill, also measuring 4"x8" to extending approximately four inches behind the wall. These boxes are needed to attach the air duct to the grill and are required for every size rectangular supply grill.

INSTALLATION AND OPERATION CONT'D

We suggest that you lay out a simple sketch of your boat on paper and then overlay your ducting scheme. Take this diagram on board and make measurements to be assured that the scheme is attainable. Remember once committed, "holes are forever." If you need help or would just like to discuss your installation with an experienced technician, give us a call. FMMS will be happy to aid you in the layout of your duct and venting scheme.

5.) Return air:

Sufficient cabin "return air" back to the air conditioner is just as important to the cooling of the boat and the performance of the air system as "supply air" is going into the cabin. Air conditioning is just that, conditioning of the air in a closed environment by continually pulling it back into the air conditioning unit, removing heat and moisture, and sending it back into the room or cabin.

It is important that the same volume of air being forced into the cabin is allowed to return to the air conditioner. As long as the physical opening of the return air grill is at least the minimum specified below for your specific air conditioner, the actual shape is not important. Where it is not possible to have a single return grill, multiple grills may be used. Make sure that the air conditioner evaporator (the part that looks like a radiator and has the foam filter) is not blocked or restricted from receiving the cabin return air. It must always be at least 3" or more from the bulkhead or any structure. Never stow items such as life preservers, bedding, or other items of this nature between the air conditioner and return grill. To allow better access to the air conditioner compartment, do not attach the return air grill until the unit has been completely installed.

Return Air Requirements

Model	BTU	SQ. INCHES OF RETURN
M-3	3,500	96
M-6	6,500	96
M-9	9,000	96
M-12	12,000	140
M-16	16,500	140
M-24	24,000	168

INSTALLATION AND OPERATION CONT'D

6.) Access To The Unit:

FMMS no longer uses a manual high pressure safety switch, and now uses an automatically resetting one. Even though the unit is primarily self sustaining, access should still be retained after the installation is complete. The unit has a foam filter on the evaporator that needs to be checked and cleaned at recommended intervals (3 months for intermittent use, and once a month if you live on the boat and use the unit frequently). The unit also has a drain that needs to be checked to prevent plugging from drain pan debris. Maintenance of any ac unit is essential to its longevity and reliability. Poor maintenance will lead to efficiency loss and reduced life expectancy.

7.) Condensation Removal

Depending on the BTU rating of your unit and the actual run time, the air conditioner will remove up to 5 gallons of water (condensation) from the air in a 24-hour period. This water collects in the tray of the unit to be drained out. Most boat owners will drain this water into the bilge for removal overboard by the existing bilge pumps. When running your condensation hose remember that condensation flows only by gravity and the hose must never rise up anywhere along the way or condensation will backup into the pan and overflow. This will not sink your boat, but it can get the surrounding area very wet. In many boats it is not possible to drain to the bilge, and the condensation must be removed by other means. One solution is the "FMMS Condensator Kit", which operates using a siphon effect created by the water flow from the air conditioner cooling water pump. Please contact the FMMS dealer or the factory for other options to remove condensation.

8.) Mounting The Standard Thermostat: (Wifi and Non-Wifi)

Note: The optional upgrade for a flush-mount thermostat has the same consideration and steps for mounting to the wall. The primary difference is it connects with a cable that looks like a phone/ethernet cable and has a predetermined length with a plug/jack at both ends. One end of the cable plugs directly into the back of the thermostat and the other plugs into the motherboard in the "display"/"main display" port. There is only one port properly sized on the motherboard for this cable. The motherboard is located inside the control box and the cover will need to be removed when plugging the thermostat cable in.

Every FMMS air conditioner comes with a 24 volt thermostat and a 20 foot 5-wire cable as standard. The 24 volt thermostat comes in wifi and non-wifi configurations. The thermostat may be mounted on any flat wall surface with space behind the wall to run the thermostat power cable out of view and still reach the air conditioner electrical box. It is important for the thermostat to be located where it is sensing the "true" cabin temperature. Ideally, the

INSTALLATION AND OPERATION CONT'D

thermostat will be about 2/3 the way up on an interior wall, out of direct sunlight, and not directly in front of a "supply air" vent or hatch. If your boat does not have an ideal location, the second best area to read temperature of the cabin is right by the air conditioner return vent. As the unit runs, the air around the return vent will be an area that is an average of the temperature in the cabin. Be aware that where the thermostat is located will determine how long and how often the air conditioner runs, and there may be uneven temperature distribution in certain places if one unit is providing air to multiple areas of the boat.

Once you have selected the thermostat location, it needs to be mounted to the wall. The thermostat will come with the brand specific instructions on how to mount it, but a brief summary of the process to mount the thermostat on the wall:

1.) Remove the thermostat and its components from its box.
2.) Locate the thermostat mounting plate, also known as the thermostat backplate, and position it on the wall where you would like the thermostat.
3.) Mount the thermostat back plate to the wall with anchors or screws.
4.) In the center of the thermostat backplate is a hole where the thermostat wire will pass to the space behind the wall. Cut a hole in the wall inside the backplate hole so that you can pass the thermostat wire from the thermostat to the AC unit.
5.) Run the thermostat wire through the hole so that one end is at the thermostat and the other is at the AC unit.
6.) The thermostat wire should be 5 strands and each is a different color. Common 5 wire thermostat cable is red, green, white, yellow, and blue. Each color has to be correctly attached to the proper thermostat terminal and the correctly paired control box terminal. The type of unit purchased will determine which terminals will be used. Consult (figure 4 and figure 5) to determine the wiring configuration you will use.
7.) Once you have the correct wiring configuration from (figure 4 and figure 5), the next step is to connect the wires at both the thermostat and ac control box. The wires at the control box will be attached using the spade crimps that came with the thermostat cable. Strip the wires back about 1/4" to 3/8" and crimp the spade terminals to the thermostat wires. Then connect them to the thermostat terminals on the control box, making sure to follow (figure 4 and figure 5) for correct color placement. Then strip the wires back 1/4" to 3/8" at the thermostat and insert the thermostat wires into the thermostat terminals based on (figure 4 and figure 5) for your unit's configuration. **WARNING: Improper wiring connections will lead to the unit not operating correctly and/or damage to the thermostat, control box, and air conditioning unit.**
8.) Once the thermostat is hooked up to the control box, additional thermostat setup may be required. For the thermostat included with a unit purchased from FMMS, the setup is laid out in (figure 6). If the thermostat is from a different provider, the basic configuration steps are as follows:

INSTALLATION AND OPERATION CONT'D

FIGURE 4

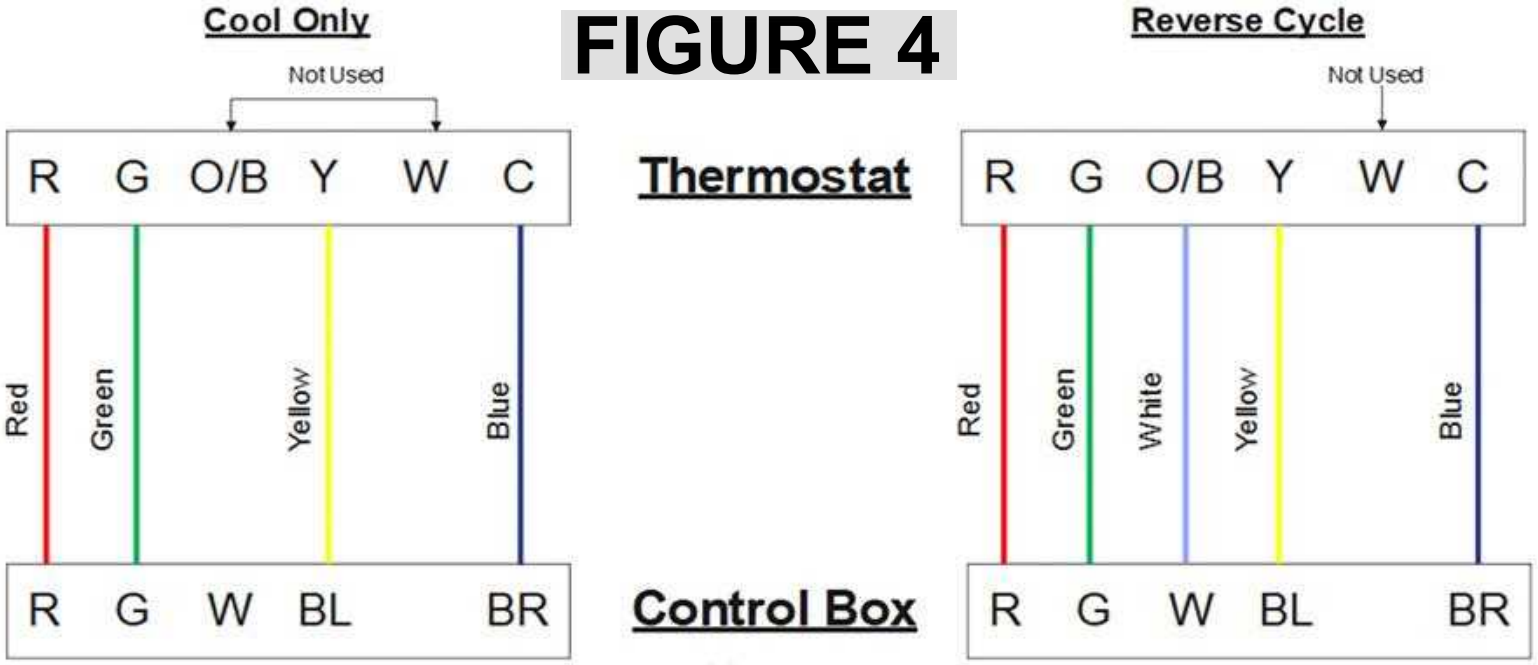
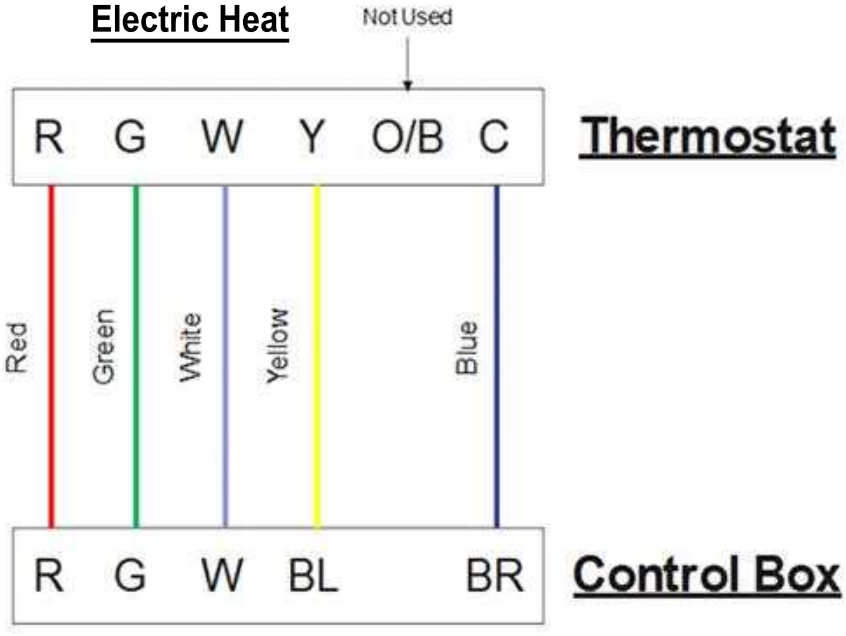


FIGURE 5



Note:

C/BR is an optional wire and not all thermostats will require it or have the terminal available. For any WIFI/Smart Thermostat the C/BR connection is essential for 24V power to run the thermostat when the unit has power. If thermostat requires 24V power to operate it will turn off if unit is disconnected from high voltage power in any way

INSTALLATION AND OPERATION CONT'D

-For cool only units, very little setup is required and the only step if desired is to turn off the "heat" mode since the unit will not use it.
-For reverse cycle units, the thermostat needs to be set to "heat pump mode" with the reversing valve being energized with the "b" terminal.
-Electric heat setup will require the thermostat to be set to "electric heat" mode or changing the setting "thermostat controls fan" to "enabled". This will ensure that the blower and electric heat strip come on at the same time to prevent damage to the electric heat strip.

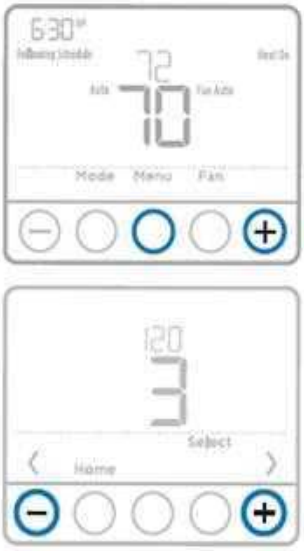
Note: Consult your specific thermostat manual if you are not using one provided by FMMS. For added insurance, please call FMMS technical support before first start up to consult on your setup and make sure everything is ready to go. Failure to ensure proper setup may result in personal injury, damage to your boat, and/or damage to your air conditioner, which may void your warranty or result in repairs not covered under the warranty.

FIGURE 6

Installer setup (ISU)

1. Press and hold **CENTER** and **+** buttons for approximately 3 seconds to enter advanced menu.
2. Press **Select** to enter **ISU**.
3. Press **Select** to cycle through menu setup options.
4. Press **+** or **–** to change values or select from available options.
5. Press **Select** and confirm your settings or press **Back** to ignore changes and return to ISU menu screen to continue editing another setup option.
6. To finish setup process and save your setting, press **Home** and return to Home screen.

NOTE: A complete list of all setup (ISU) parameters and options starts below



Installer setup will be available at first startup, if bypassed, return using these steps

# ISU	ISU Name	ISU Options (factory default in bold)
120	Scheduling Options	0 - Non-Programmable 2 - 5-2 Programmable **3 = 5-1-1 Programmable** 4 - 7-Day Programmable *Note: You can change default MO-FR, SA-SU schedule here. To edit periods during days, temperature setpoints, or to turn Schedule On/Off, touch MENU and go to SCHEDULE.*
125	Temperature Indication Scale	**0 = Fahrenheit** 1 - Celsius
200	Heating System Type	**1 = Conventional Forced Air Heat** 2 - Heat Pump 3 - Radiant Heat 5 - None (Cool Only) *Note: This option selects the basic system type your thermostat will control.*
205	Heating Equipment Type	*Conventional Forced Air Heat:* 1 - Standard Efficiency Gas Forced Air **2 = High Efficiency Gas Forced Air** 3 - Oil Forced Air 4 - Electric Forced Air 5 - Hot Water Fan Coil *Heat Pump:* **7 = Air to Air Heat Pump** 8 - Geothermal Heat Pump *Radiant Heat:* **9 = Hot Water Radiant Heat** 12 - Steam *Note: This option selects the equipment type your thermostat will control.* *Note: This feature is NOT displayed if feature 200 is set to Cool Only.*

Personal Preference, this setting will activate or deactivate program scheduler

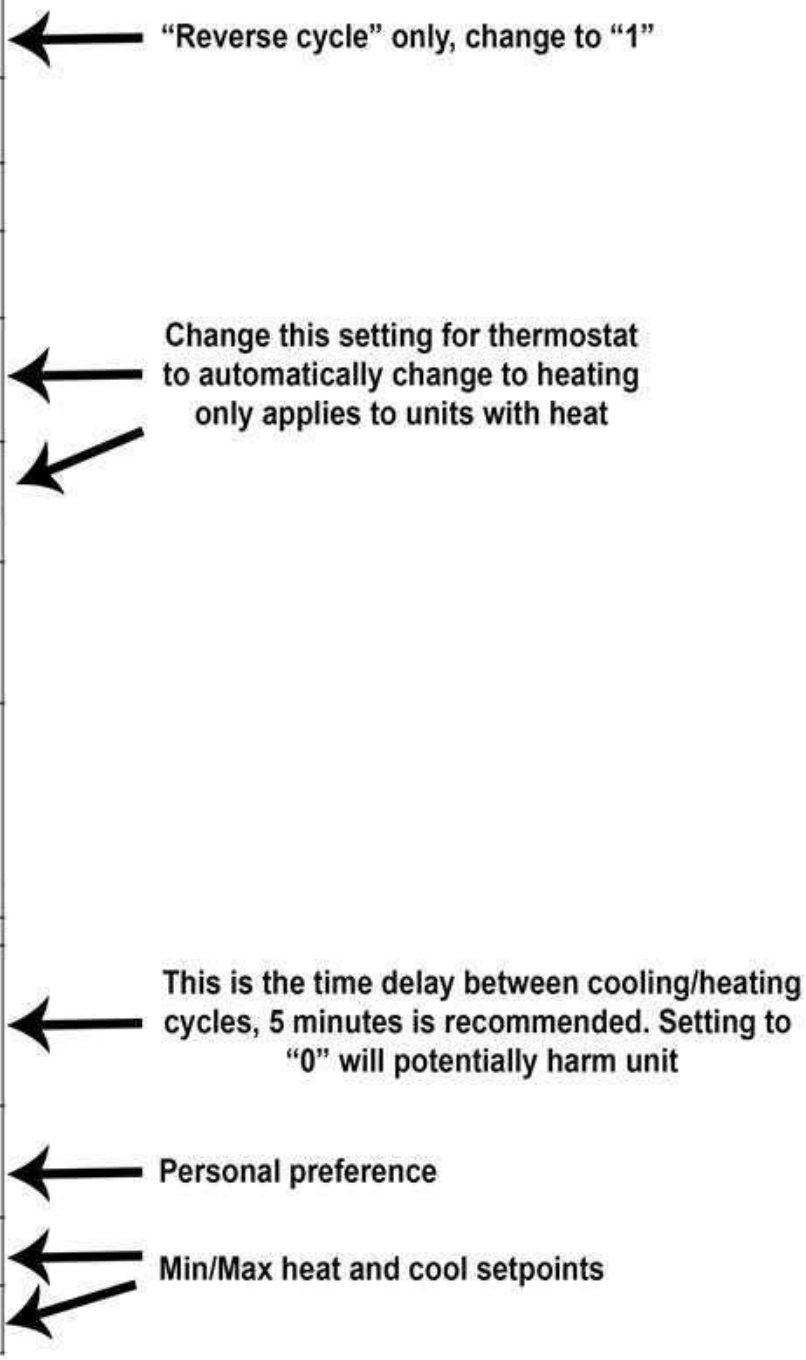
-If unit is "cool only" change to "5"
-If unit is "reverse cycle" change to "2"
-If unit is "electric heat" leave on "1"

-If unit is "reverse cycle" leave on "7"
-If unit is "electric heat" change to "4"

INSTALLATION AND OPERATION CONT'D

FIGURE 6 CONT'D

# ISU	ISU Name	ISU Options (factory default in bold)
218	Reversing Valve O/B	**0 = O (O/B in Cool)** 1 - B (O/B in Heat) *Note: This option is only displayed if the Heat Pump configured. Select whether reversing valve O/B should energize in cool or in heat.*
220	Cool Stages / Compressor Stages 200-Conv / 200-HP	0, **1** *Note: Select how many Cool or Compressor stages of your equipment the thermostat will control. Set value to 0 if you do not have Cool Stage/ Compressor Stage.*
221	Heat Stages / Backup Heat Stages	**1** *Note: Select how many Heat or Aux/E stages of your equipment the thermostat will control.*
230	Fan Control In Heat	1 - Equipment Controls Fan **2 = Thermostat Controls Fan** *Note: This ISU is only displayed if ISU 205 is set to Electric Forced Air or Fan Coil.*
300	System Changeover	**0 = Manual** 1 - Automatic *Note: Thermostat can automatically control both heating and cooling to maintain the desired indoor temperature. To be able to select "automatic" system mode on thermostat home screen, turn this feature ON. Turn OFF if you want to control heating or cooling manually.*
303	Auto Changeover Differential	**0 °F** to 5 °F **0.0 °C** to 2.5 °C *Note: Differential is NOT deadband. Differential means how far past the setpoint before switching to the mode selected. Deadband setup is not an option. Honeywell uses an advanced algorithm that fixes deadband at 0 °F. This is more advanced than previous thermostats.*
365	Compressor Cycle Rate (Stage 1)	1 - 6 *Note: This ISU is only displayed when Cool /Compressor Stage is set to 1 stage. Cycle rate limits the maximum number of times the system can cycle in a 1 hour period measured at a 50% load. For example, when set to 3 CPH, at a 50% load, the most the system will cycle is 3 times per hour (10 minutes on, 10 minutes off). The system cycles less often when load conditions are less than or greater than a 50% load.*
370	Heating Cycle Rate (Stage 1)	1 - 12 *Note: This ISU is only displayed when Heat Stage is set to 1 stage. Cycle rate limits the maximum number of times the system can cycle in a 1 hour period measured at a 50% load. For example, when set to 3 CPH, at a 50% load, the most the system will cycle is 3 times per hour (10 minutes on, 10 minutes off). The system cycles less often when load conditions are less than or greater than a 50% load. The recommended (default) cycle rate settings are below for each heating equipment type: Standard Efficiency Gas Forced Air - 5 CPH; High Efficiency Gas Forced Air - 3 CPH; Oil Forced Air - 5 CPH; Electric Forced Air - 9 CPH; Fan Coil - 3 CPH; Hot Water Radiant Heat - 3 CPH; Steam - 1 CPH.*
370	Heating Cycle Rate Auxiliary Heat	1 - 12
387	Compressor Protection	0 - Off 1 - **5** minutes *Note: The thermostat has a built in compressor protection (minimum off timer) that prevents the compressor from restarting too early after a shutdown. The minimum-off timer is activated after the compressor turns off. If there is a call during the minimum-off timer, the thermostat shows "Wait" in the display. This ISU is displayed if ISU 220 is set to at least 1 stage.*
425	Adaptive Intelligent Recovery	0 - No **1 = Yes** *Note: Adaptive Intelligent Recovery (AIR) is a comfort setting. Heating or cooling equipment will turn on earlier, ensuring the indoor temperature will match the setpoint at the scheduled time.*
430	Minimum Cool Setpoint	50 °F to 99 °F **(50 °F)** 10.0 °C to 37.0 °C **(10.0 °C)** *Note: The cool temperature cannot be set below this level.*
431	Maximum Heat Setpoint	40 °F to 90 °F **(90 °F)** 4.5 °C to 32.0 °C **(32 °C)** *Note: The heat temperature cannot be set above this level.*



INSTALLATION AND OPERATION CONT'D

FIGURE 6 CONT'D

# ISU	ISU Name	ISU Options (factory default in bold)
435	Keypad Lockout	**0 = None** 1 - Partial 2 - Full *Note:* **Unlocked:** *User has access to all thermostat settings.* **Partially Locked:** *User can modify only temperature settings.* **Fully Locked**: *User cannot modify any settings. Screen will be locked by default factory code and cannot be changed. This code is displayed for a short time, when you are about to lock the thermostat screen. Please note the code in safe place for future reference.*
702	Number of Air Filters	**0** - 2 *Note: This ISU refers to the number of air filters in the system.*
711	Air Filter 1 Replacement Reminder	**0 = Off** 1 - 10 Run Time Days 2 - 20 Run Time Days 3 - 30 Run Time Days 4 - 45 Run Time Days 5 - 60 Run Time Days 6 - 90 Run Time Days 7 - 120 Run Time Days 8 - 150 Run Time Days 9 - 30 Calendar Days 10 - 45 Calendar Days 11 - 60 Calendar Days 12 - 75 Calendar Days 13 - 3 Calendar Months 14 - 4 Calendar Months 15 - 5 Calendar Months 16 - 6 Calendar Months 17 - 9 Calendar Months 18 - 12 Calendar Months 19 - 15 Calendar Months *Note: Set a reminder for when to change your air filter. Choose either calendar or equipment run time-based reminder.*
712	Air Filter 2 Replacement Reminder	**0 = Off** 1 - 10 Run Time Days 2 - 20 Run Time Days 3 - 30 Run Time Days 4 - 45 Run Time Days 5 - 60 Run Time Days 6 - 90 Run Time Days 7 - 120 Run Time Days 8 - 150 Run Time Days 9 - 30 Calendar Days 10 - 45 Calendar Days 11 - 60 Calendar Days 12 - 75 Calendar Days 13 - 3 Calendar Months 14 - 4 Calendar Months 15 - 5 Calendar Months 16 - 6 Calendar Months 17 - 9 Calendar Months 18 - 12 Calendar Months 19 - 15 Calendar Months *Note: Set a reminder for when to change your air filter. Choose either calendar or equipment run time-based reminder.*
1400	Backlighting	**0 = On Demand** 1 - Continuous *Note: Common wire needed for continuous.*
1401	Backlight brightness	1 - **5** *Note: Only displayed if continuous backlight selected.*
1410	Clock Format	**12** / 24
1415	Daylight Saving Time	0 - Off **1 = On** *Note: Set to Off in areas that do not follow Daylight Saving Time.*
1420	Temperature Display Offset	-3 to 3F **(0)** -1.5 to 1.5C **(0)** *Note: 0 °F - No difference in displayed temperature and the actual room temperature. The thermostat can display up to 3 °F (1.5 C) lower or higher than the actual measured temperature.*

Setting to prevent tampering

Air filter reminder

If thermostat is placed in a non-ideal location this will help adjust thermostat to read a more "accurate" space temperature

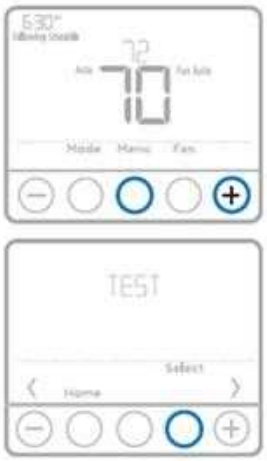
INSTALLATION AND OPERATION CONT'D

FIGURE 6 CONT'D

Installer system test

To perform a System Test:

1. Press and hold **CENTER** and + buttons for approximately 3 seconds to enter advanced menu.
2. Use + to go to **TEST**. Press **Select** to enter System Test.
3. Use + to change between Heat, Cool, Fan, Em. Heat (TH4210U only), or Ver (thermostat version information). Press **Select**.
4. Press + to turn heat, cool, or fan on. Press − to turn them off.
5. Use the **Home** button to exit the System Test.



Thermostat testing procedure to confirm proper operation

System test		System status
Heat	0	Heat Off
	1	Heat On
Cool	0	Cool Off
	1	Cool On
Fan	0	Fan Off
	1	Fan On
Em. Heat (TH4210U only)	0	Em. Heat Off
	1	Em. Heat On

Specifications

Temperature Ranges
Heat: 40 °F to 90 °F (4.5 °C to 32.0 °C)
Cool: 50 °F to 99 °F (10.0 °C to 37.0 °C)

Operating Ambient Temperature
37 °F to 102 °F (2.8 °C to 38.9 °C)

Shipping Temperature
-20 °F to 120 °F (-28.9 °C to 48.9 °C)

Operating Relative Humidity
5% to 90% (non-condensing)

Physical Dimensions in inches (mm) (H x W x D)
4-1/16" H x 4-1/16" W x 1-5/32" D
103.5 mm H x 103.5 mm W x 29 mm D

Electrical Ratings

Terminal	Voltage (50/60Hz)	Running Current
W Heating	20-30 Vac	0.02-1.0 A
(Powerpile)	750 mV DC	100 mA DC
W2 (Aux) Heating (TH4210U only)	20-30 Vac	0.02-1.0 A
E Emergency Heat (TH4210U only)	20-30 Vac	0.02-0.5 A
Y Compressor Stage 1	20-30 Vac	0.02-1.0 A
G Fan	20-30 Vac	0.02-0.5 A
O/B Changeover	20-30 Vac	0.02-0.5 A
L/A Input	20-30 Vac	0.02-0.5 A

Thermostat technical specifications

9.) Once the thermostat is programmed and tested, move on to the remainder of the install and cleanup.

9.) Putting It All Together:

At this point the unit can be placed back into its compartment, and all the power, water hoses, and ducting should be available and ready to connect if they are not already. Your air conditioner is accompanied by a 7/8" thick black rubber mounting pad. This pad is to be placed directly under the air conditioning unit to aid in the isolation of any vibration. If height is a concern for your installation, the pad is not a necessity for the unit to operate properly.

INSTALLATION AND OPERATION CONT'D

Important

Do not cut any excess water hose, wire, or ducting before determining that all requirements can be met when unit is secured.

Position the air conditioning unit so "water in" and "water out" hoses can be attached without kinking. Now check the air splitter and ducting for fit. Make sure that all ducting bends are as slight as possible to keep air restriction to a minimum. Once you are satisfied with the compromises you have make between the water and the air connections, locate a place for the electric box. **Remember, this box may be mounted in any attitude, but must never get wet.** Now, before cutting any excess hose, etc. check to see that all four air conditioner mounting screws can be installed **without making contact with the hull.**

Note: Enclosed in the kit are (4) brackets with a hole drilled in one side. These are the hold down brackets for mounting the AC unit. They can be positioned anywhere along the base.

Next, cut the water hoses to fit and attached each hose with two s/s clamps. Make sure that each hose is placed on the proper end of the condensing coil as marked "water in" and "water out". **Make sure to remove any plastic caps on the ends of the condensing coil that were installed for shipping purposes.**

The FMMS AC unit drain pan Connect the clear 1/2" hose to one or both of the drain nipples. This hose generally fits snugly without a hose clamp. If you are using both nipples you can either have them each drain separately into the bilge or connect them together with a "wye" or "tee" fitting for a common drain. If you are using an "FMMS Condensator Kit" it is recommended to pick one drain connection and use that. If the unit is tipping toward one drain connection lower than the other, that is the ideal drain connection to choose. If you are using one drain, plug the unused drain before the unit is operational.

WARNING

MAKE SURE THAT ALL AC POWER TO THE BOAT HAS BEEN DISCONNECTED! FAILURE TO REMOVE ALL BOAT AC POWER COULD RESULT IN ELECTRICAL SHOCK CAUSING SERIOUS INJURY OR DEATH!

Using the full length of the electric box cable or unplugging the cable, bring the box out to where it is more convenient for you to work with in making all the required connections. Determine which power cable is from the pump (16 gauge cable) and strip the outside insulation back about six inches. Then strip each of the three individual wires back about 1/4 inch. Facing the white terminal block on the side of the electric box, locate the

INSTALLATION AND OPERATION CONT'D

connection labeled "pump". Using the appropriate size flat blade screw driver, open the connections marked "white" and "black" and slide the "black" and "white" wires into the open connector slots for each color. Make sure that no bare wire is exposed outside the connector slot and tighten the screw. Pull each wire to insure it is tightly connected. Using an appropriate size electrical ring connector, attach the "green" wire to the "ground" post located on the mounting bracket.

WARNING
HAVING ANY BARE WIRE EXPOSED OUTSIDE THE WHITE TERMINAL BLOCK COULD CREATE ELECTRICAL SHOCK CAUSING SERIOUS INJURY OR DEATH

Next, locate the 115 (or 220) VAC power cable from the Circuit Breaker Panel (12 gauge cable) and connect this cable to the electric box white terminal block by inserting the wires into the connector slots marked "power". To do this, follow the same procedure as with the pump connections. (SEE ABOVE WARNING ON EXPOSED BARE WIRE CONNECTIONS).

Locate the black terminal strip on the outside of the electrical box just above the power terminal block) and attach the thermostat power cable. This terminal strip is color coded for easy determination of which wire is attached to which connection ("RED" to "R", "GREEN" to "G" etc.). Any excess cable may be neatly coiled next to the box or cut off and shortened to fit. If excess is cut off, do not make connections with bare wires, install new connectors on each wire. Check the previous pages for thermostat wiring and programming

IMPORTANT
MAKE SURE THAT YOU SECURE ALL LOOSE WIRING AND HOSES WITH APPROPRIATE SIZE NYLON CLIPS OR CABLE TIES TO MAKE SURE THAT BOAT OR WAVE ACTION WILL NOT CAUSE STRESS OR KINKING.

Note: The upgraded thermostat option and control box are pre-wired and use an 8-pin display cable to communicate with the display. Only the power wires and pump wires need to be connected during install and the display cable slots into a jack on the display and motherboard.

Now connect the air splitter and air ducting. You may use appropriate size cable ties or a high grade ducting tape. If the air splitter is attached directly to the unit air collar, we recommend that you secure it with (1) or (2) 1/2" s/s screws along with duct tape or foil tape.

Now, attach the return air grill and your installation is completed.

INSTALLATION AND OPERATION CONT'D

B.) SYSTEM OPERATION:

Note: If the boat has not been placed back in the water, do so now. The air conditioner requires proper cooling water to operate.

1. Priming The Pump:

A.) Because marine air conditioner pumps are not self priming, generally, the pump may need priming each time the boat is removed from the water and then placed back into the water. Priming may also be required when the water strainer is cleaned or when the boat has returned to the dock after being used. Normally, once primed at the dock, the pump will retain its prime until used or taken in and out of the water as mentioned above.

B.) To prime the pump, open the sea cock and view the water flow through the clear red stripe hose. If the water flows into the input of the pump with no air bubbles in the strainer or hose, the pump is primed. However, if air bubbles are present you must loosen the hose clamps on the pump discharge hose (blue stripe or black reinforced) and momentarily remove the hose. Water will immediately flow from the pump breaking the air lock. Quickly replace the hose and re-tighten the hose clamps. The pump is now primed. If you have installed the optional "bleed off" valve, it is usually not necessary to remove the discharge hose from the pump. Open the "bleed off' valve until water flow is observed and then close the valve. (Ideally this water should be directed to the bilge or a container that can be later discharged overboard).

WARNING
AS STATED EARLIER, FAILURE TO CLOSE THE "BLEED OFF" VALVE WILL RESULT IN FLOODING AND POSSIBLE SINKING OF THE BOAT.

Note: If water does not flow from the pump when the discharge hose is removed or from the "bleed off' valve when opened, the pump is not below the water line of the boat and must be remounted.

2.) Power:

A.) With the air conditioner circuit breaker in the "off" position connect the dock power cord back to the boat.

B.) Place the main circuit breaker and the air conditioner circuit breaker in their "on" positions.

3.) Water Out:

INSTALLATION AND OPERATION CONT'D

A.) Once the air conditioner starts, immediately go out on deck and check that water is coming out of the "water out" thru-hull. Once all of the latent air is forced from the hoses a steady stream should be present with enough force that the water stream clears the side of the boat hull.

B.) If the water flow is not present or weak, the pump was not properly primed. Shut the air conditioner off and prime the pump as described above. (You may also attempt to prime via the bleed off valve ONLY while the air conditioner is running - allowing for the pump to function). If the air conditioner is allowed to run without water for more than a minute, the high pressure switch will activate and disengage power from the entire unit. The high pressure switch is automatically resetting and does not require any interaction. The high pressure switch should reset in under 5 minutes and the unit will resume operation. Be aware that the thermostat may have its own delay once the high pressure switch resets.

4. Checking Out The System:

A.) Air Flow: Once the air conditioner is running and water flow is present, check each supply air vent to make sure it is open and cooling air is present. If air flow is not present, check ducting for good air tight connections and that kinking or sagging of the duct has not occurred.

B.) Water Connections: Check each water connection beginning at the sea cock, then the water strainer, pump, the air conditioner and the "water out" thru-hull. No water leaks should be present. Also, at this time, it is always good to check the hose clamps for tightness in case one may have been overlooked during installation.

C.) Condensation: By now the unit should be producing condensation. Check to make sure that condensation is flowing freely into the condensation hose. If the unit has not produced sufficient condensation to check the flow, pour water into the condensation pan to see that in fact it is flowing freely.

D.) The Air Conditioner Unit: The unit should be free of vibration noises and the sides of the evaporator should be sweating and cool all the way up. If vibration noise is present, adjust the unit mounting screws. If this does not correct the noise, use a socket wrench with an extender or a large phillips head screwdriver (or 5/16 nut runner if applicable) and tighten down the compressor mounting bolts until the vibration noise stops. In some situations, although very rare, it may lessen the sound vibration to actually loosen the compressor bolts a very, very small amount. In some boats where a mounting shelf was installed, sound will travel through the board to the side walls and a "speaker effect" will take place. The included mounting pad should eliminate a generous portion of any known or heard vibration.

OPERATION AND PROGRAMMING

A.) Introduction:

Standard FMMS units come equipped with a 24V thermostat like you would find in a residential home, which allows the wiring and control components to be simpler. The leads to longer operational life and makes parts easy to aquire. With the help of FMMS factory technical support and available technical documentation, many of our customers who are mechanically able have performed repairs on their own units around the world, from busy marinas to remote destinations.

Standard features include:
-Battery back-up with (2) AA batteries
-Built in short cycle protection during normal operation (up to 5 minutes)
-Auto or manual fan control
-LCD display
-Fahrenheit or Celsius temperature scales
-12 or 24 hour clock
-Programmable shedule

The thermostat comes with 20 feet of cable. One end will be connected to the control box and the other will be connected to the thermostat. The thermostat installation and programming was previously described in the installation and operation section, and will also be re-explained in this section.

The thermostat may be mounted on any flat wall surface with space behind the wall to run the thermostat power cable out of view and still reach the air conditioner electrical box. It is important for the thermostat to be located where it is sensing the “true” cabin temperature. Ideally, the thermostat will be about 2/3 the way up on an interior wall, out of direct sunlight, and not directly in front of a “supply air” vent or hatch. If your boat does not have an ideal location, the second best area to read temperature of the cabin is right by the air conditioner return vent. As the unit runs, the air around the return vent will be an area that is an average of the temperature in the cabin. Be aware that where the thermostat is located will determine how long and how often the air conditioner runs, and there may be uneven temperature distribution in certain places if one unit is providing air to multiple areas of the boat.

Once you have selected the thermostat location, it needs to be mounted to the wall. The thermostat will come with the brand specific instructions on how to mount it, but a brief summary of the process to mount the thermostat on the wall:

1.) Remove the thermostat and its components from its box.

OPERATION AND PROGRAMMING

2.) Locate the thermostat mounting plate, also known as the thermostat backplate, and position it on the wall where you would like the thermostat.
3.) Mount the thermostat back plate to the wall with anchors or screws.
4.) In the center of the thermostat backplate is a hole where the thermostat wire will pass to the space behind the wall. Cut a hole in the wall inside the backplate hole so that you can pass the thermostat wire from the thermostat to the AC unit.
5.) Run the thermostat wire through the hole so that one end is at the thermostat and the other is at the AC unit.
6.) The thermostat wire should be 5 strands and each is a different color. Common 5 wire thermostat cable is red, green, white, yellow, and blue. Each color has to be correctly attached to the proper thermostat terminal and the correctly paired control box terminal. The type of unit purchased will determine which terminals will be used. Consult (figure 4 and figure 5) to determine the wiring configuration you will use.
7.) Once you have the correct wiring configuration from (figure 4 and figure 5), the next step is to connect the wires at both the thermostat and ac control box. The wires at the control box will be attached using the spade crimps that came with the thermostat cable. Strip the wires back about 1/4” to 3/8” and crimp the spade terminals to the thermostat wires. Then connect them to the thermostat terminals on the control box, making sure to follow (figure 4 and figure 5) for correct color placement. Then strip the wires back 1/4” to 3/8” at the thermostat and insert the thermostat wires into the thermostat terminals based on (figure 4 and figure 5) for your unit’s configuration. **WARNING: Improper wiring connections will lead to the unit not operating correctly and/or damage to the thermostat, control box, and air conditioning unit.**
8.) Once the thermostat is hooked up to the control box, additional thermostat setup may be required. For the thermostat included with a unit purchased from FMMS, the setup is laid out in (figure 6). If the thermostat is from a different provider, the basic configuration steps are as follows:

-For cool only units, very little setup is required and the only step if desired is to turn off the “heat” mode since the unit will not use it.
-For reverse cycle units, the thermostat needs to be set to “heat pump mode” with the reversing valve being energized with the “b” terminal.
-Electric heat setup will require the thermostat to be set to “electric heat” mode or changing the setting “thermostat controls fan” to “enabled”. This will ensure that the blower and electric heat strip come on at the same time to prevent damage to the electric heat strip.
Note: Consult your specific thermostat manual if you are not using one provided by FMMS. For added insurance, please call FMMS technical support before first start up to consult on your setup and make sure everything is ready to go. Failure to ensure proper setup may result in personal injury, damage to your boat, and/or damage to your air conditioner, which may void your warranty or result in repairs not covered under the warranty.

OPERATION AND PROG. CONT'D

FIGURE 4

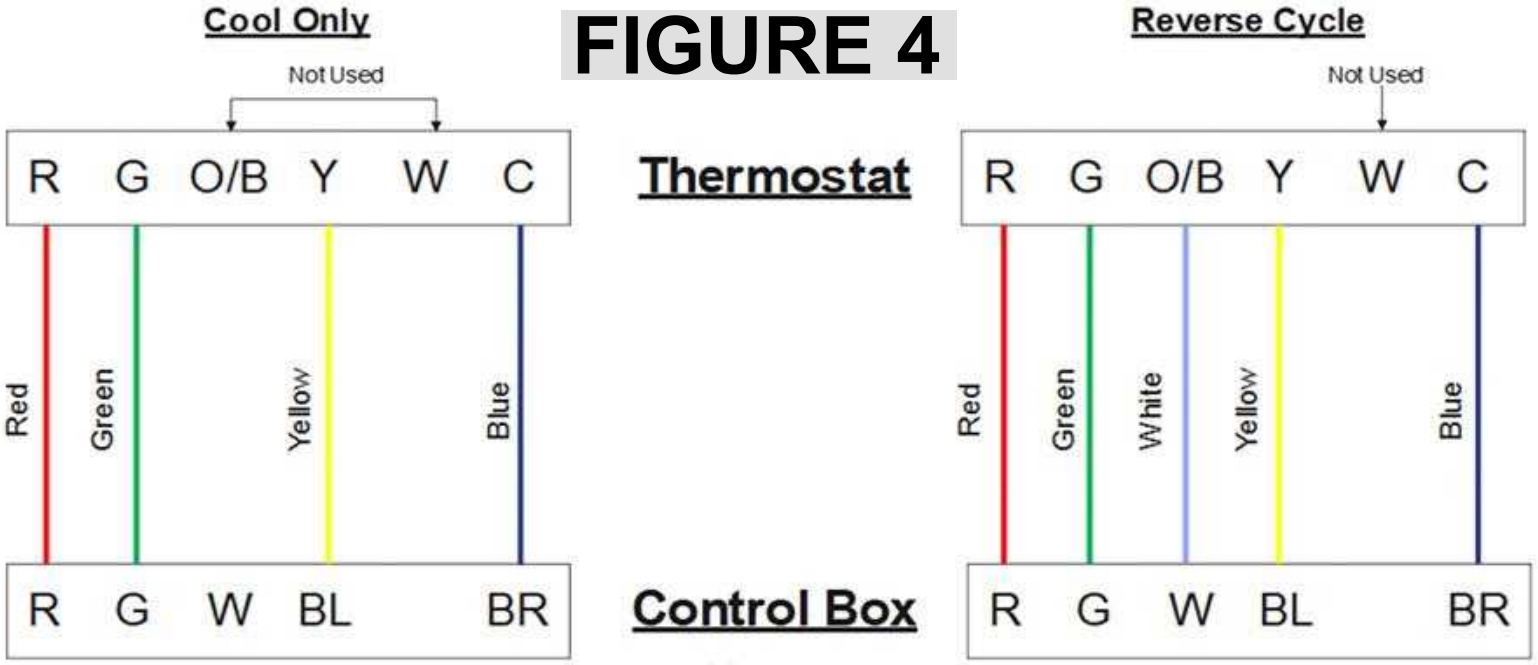
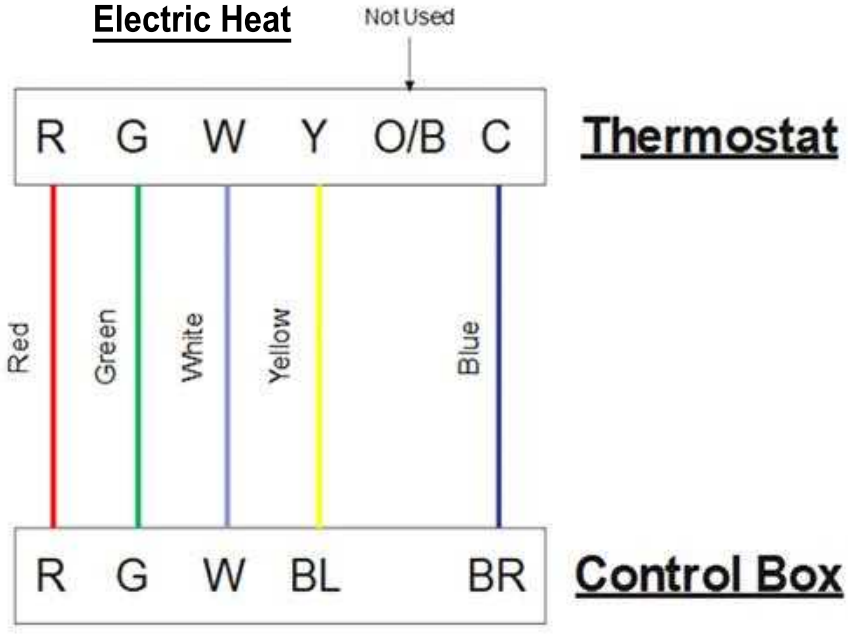


FIGURE 5



Note:

C/BR is an optional wire and not all thermostats will require it or have the terminal available. For any WIFI/Smart Thermostat the C/BR connection is essential for 24V power to run the thermostat when the unit has power. If thermostat requires 24V power to operate it will turn off if unit is disconnected from high voltage power in any way

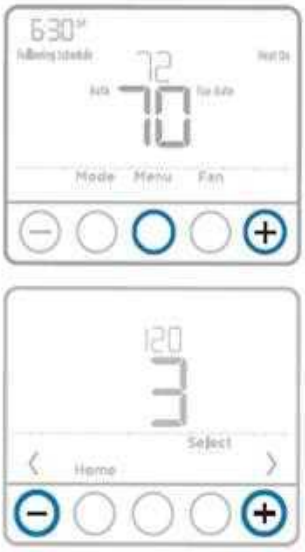
OPERATION AND PROG. CONT'D

FIGURE 6

Installer setup (ISU)

1. Press and hold **CENTER** and **+** buttons for approximately 3 seconds to enter advanced menu.
2. Press **Select** to enter **ISU**.
3. Press **Select** to cycle through menu setup options.
4. Press **+** or **–** to change values or select from available options.
5. Press **Select** and confirm your settings or press **Back** to ignore changes and return to ISU menu screen to continue editing another setup option.
6. To finish setup process and save your setting, press **Home** and return to Home screen.

NOTE: A complete list of all setup (ISU) parameters and options starts below



Installer setup will be available at first startup, if bypassed, return using these steps

# ISU	ISU Name	ISU Options (factory default in bold)
120	Scheduling Options	0 - Non-Programmable 2 - 5-2 Programmable **3 = 5-1-1 Programmable** 4 - 7-Day Programmable *Note: You can change default MO-FR, SA-SU schedule here. To edit periods during days, temperature setpoints, or to turn Schedule On/Off, touch MENU and go to SCHEDULE.*
125	Temperature Indication Scale	**0 = Fahrenheit** 1 - Celsius
200	Heating System Type	**1 = Conventional Forced Air Heat** 2 - Heat Pump 3 - Radiant Heat 5 - None (Cool Only) *Note: This option selects the basic system type your thermostat will control.*
205	Heating Equipment Type	*Conventional Forced Air Heat:* 1 - Standard Efficiency Gas Forced Air **2 = High Efficiency Gas Forced Air** 3 - Oil Forced Air 4 - Electric Forced Air 5 - Hot Water Fan Coil *Heat Pump:* **7 = Air to Air Heat Pump** 8 - Geothermal Heat Pump *Radiant Heat:* **9 = Hot Water Radiant Heat** 12 - Steam *Note: This option selects the equipment type your thermostat will control.* *Note: This feature is NOT displayed if feature 200 is set to Cool Only.*

Personal Preference, this setting will activate or deactivate program scheduler

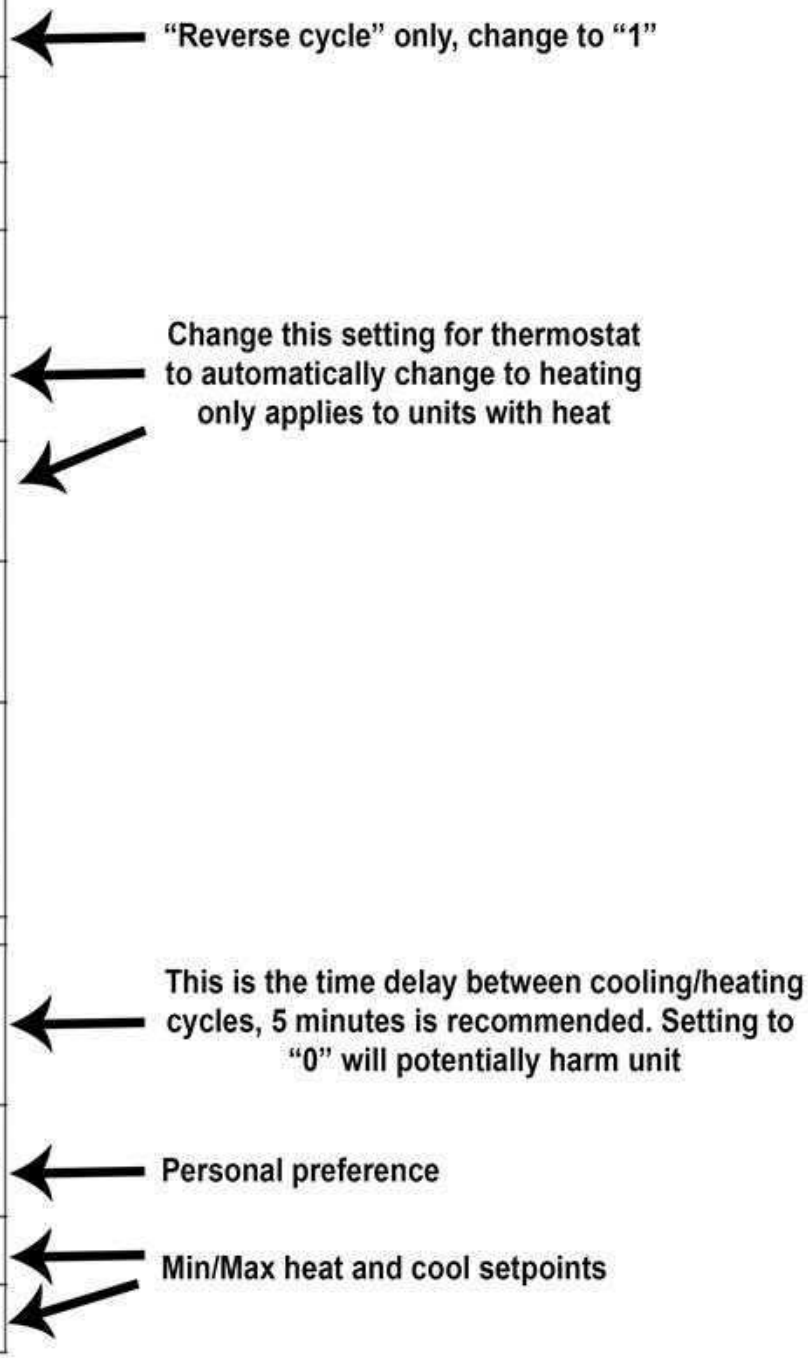
-If unit is "cool only" change to "5"
-If unit is "reverse cycle" change to "2"
-If unit is "electric heat" leave on "1"

-If unit is "reverse cycle" leave on "7"
-If unit is "electric heat" change to "4"

OPERATION AND PROG. CONT'D

FIGURE 6 CONT'D

# ISU	ISU Name	ISU Options (factory default in bold)
218	Reversing Valve O/B	**0 = O (O/B in Cool)** 1 - B (O/B in Heat) *Note: This option is only displayed if the Heat Pump configured. Select whether reversing valve O/B should energize in cool or in heat.*
220	Cool Stages / Compressor Stages 200-Conv / 200-HP	0, **1** *Note: Select how many Cool or Compressor stages of your equipment the thermostat will control. Set value to 0 if you do not have Cool Stage/ Compressor Stage.*
221	Heat Stages / Backup Heat Stages	**1** *Note: Select how many Heat or Aux/E stages of your equipment the thermostat will control.*
230	Fan Control In Heat	1 - Equipment Controls Fan **2 = Thermostat Controls Fan** *Note: This ISU is only displayed if ISU 205 is set to Electric Forced Air or Fan Coil.*
300	System Changeover	**0 = Manual** 1 - Automatic *Note: Thermostat can automatically control both heating and cooling to maintain the desired indoor temperature. To be able to select "automatic" system mode on thermostat home screen, turn this feature ON. Turn OFF if you want to control heating or cooling manually.*
303	Auto Changeover Differential	**0 °F** to 5 °F **0.0 °C** to 2.5 °C *Note: Differential is NOT deadband. Differential means how far past the setpoint before switching to the mode selected. Deadband setup is not an option. Honeywell uses an advanced algorithm that fixes deadband at 0 °F. This is more advanced than previous thermostats.*
365	Compressor Cycle Rate (Stage 1)	1 - 6 *Note: This ISU is only displayed when Cool /Compressor Stage is set to 1 stage. Cycle rate limits the maximum number of times the system can cycle in a 1 hour period measured at a 50% load. For example, when set to 3 CPH, at a 50% load, the most the system will cycle is 3 times per hour (10 minutes on, 10 minutes off). The system cycles less often when load conditions are less than or greater than a 50% load.*
370	Heating Cycle Rate (Stage 1)	1 - 12 *Note: This ISU is only displayed when Heat Stage is set to 1 stage. Cycle rate limits the maximum number of times the system can cycle in a 1 hour period measured at a 50% load. For example, when set to 3 CPH, at a 50% load, the most the system will cycle is 3 times per hour (10 minutes on, 10 minutes off). The system cycles less often when load conditions are less than or greater than a 50% load. The recommended (default) cycle rate settings are below for each heating equipment type: Standard Efficiency Gas Forced Air - 5 CPH; High Efficiency Gas Forced Air - 3 CPH; Oil Forced Air - 5 CPH; Electric Forced Air - 9 CPH; Fan Coil - 3 CPH; Hot Water Radiant Heat - 3 CPH; Steam - 1 CPH.*
370	Heating Cycle Rate Auxiliary Heat	1 - 12
387	Compressor Protection	0 - Off 1 - **5** minutes *Note: The thermostat has a built in compressor protection (minimum off timer) that prevents the compressor from restarting too early after a shutdown. The minimum-off timer is activated after the compressor turns off. If there is a call during the minimum-off timer, the thermostat shows "Wait" in the display. This ISU is displayed if ISU 220 is set to at least 1 stage.*
425	Adaptive Intelligent Recovery	0 - No **1 = Yes** *Note: Adaptive Intelligent Recovery (AIR) is a comfort setting. Heating or cooling equipment will turn on earlier, ensuring the indoor temperature will match the setpoint at the scheduled time.*
430	Minimum Cool Setpoint	50 °F to 99 °F **(50 °F)** 10.0 °C to 37.0 °C **(10.0 °C)** *Note: The cool temperature cannot be set below this level.*
431	Maximum Heat Setpoint	40 °F to 90 °F **(90 °F)** 4.5 °C to 32.0 °C **(32 °C)** *Note: The heat temperature cannot be set above this level.*



OPERATION AND PROG. CONT'D

FIGURE 6 CONT'D

# ISU	ISU Name	ISU Options (factory default in bold)
435	Keypad Lockout	**0 = None** 1 - Partial 2 - Full *Note:* **Unlocked:** *User has access to all thermostat settings.* **Partially Locked:** *User can modify only temperature settings.* **Fully Locked:** *User cannot modify any settings. Screen will be locked by default factory code and cannot be changed. This code is displayed for a short time, when you are about to lock the thermostat screen. Please note the code in safe place for future reference.*
702	Number of Air Filters	**0** - 2 *Note: This ISU refers to the number of air filters in the system.*
711	Air Filter 1 Replacement Reminder	**0 = Off** 1 - 10 Run Time Days 2 - 20 Run Time Days 3 - 30 Run Time Days 4 - 45 Run Time Days 5 - 60 Run Time Days 6 - 90 Run Time Days 7 - 120 Run Time Days 8 - 150 Run Time Days 9 - 30 Calendar Days 10 - 45 Calendar Days 11 - 60 Calendar Days 12 - 75 Calendar Days 13 - 3 Calendar Months 14 - 4 Calendar Months 15 - 5 Calendar Months 16 - 6 Calendar Months 17 - 9 Calendar Months 18 - 12 Calendar Months 19 - 15 Calendar Months *Note: Set a reminder for when to change your air filter. Choose either calendar or equipment run time-based reminder.*
712	Air Filter 2 Replacement Reminder	**0 = Off** 1 - 10 Run Time Days 2 - 20 Run Time Days 3 - 30 Run Time Days 4 - 45 Run Time Days 5 - 60 Run Time Days 6 - 90 Run Time Days 7 - 120 Run Time Days 8 - 150 Run Time Days 9 - 30 Calendar Days 10 - 45 Calendar Days 11 - 60 Calendar Days 12 - 75 Calendar Days 13 - 3 Calendar Months 14 - 4 Calendar Months 15 - 5 Calendar Months 16 - 6 Calendar Months 17 - 9 Calendar Months 18 - 12 Calendar Months 19 - 15 Calendar Months *Note: Set a reminder for when to change your air filter. Choose either calendar or equipment run time-based reminder.*
1400	Backlighting	**0 = On Demand** 1 - Continuous *Note: Common wire needed for continuous.*
1401	Backlight brightness	1 - **5** *Note: Only displayed if continuous backlight selected.*
1410	Clock Format	**12** / 24
1415	Daylight Saving Time	0 - Off **1 = On** *Note: Set to Off in areas that do not follow Daylight Saving Time.*
1420	Temperature Display Offset	-3 to 3F **(0)** -1.5 to 1.5C **(0)** *Note: 0 °F - No difference in displayed temperature and the actual room temperature. The thermostat can display up to 3 °F (1.5 C) lower or higher than the actual measured temperature.*

Setting to prevent tampering

Air filter reminder

If thermostat is placed in a non-ideal location this will help adjust thermostat to read a more "accurate" space temperature

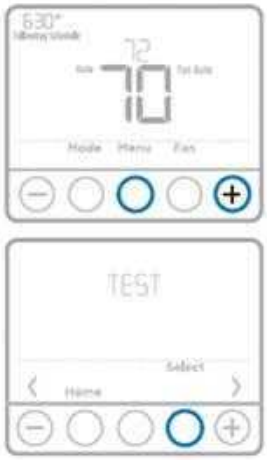
OPERATION AND PROG. CONT'D

FIGURE 6 CONT'D

Installer system test

To perform a System Test:

1. Press and hold **CENTER** and + buttons for approximately 3 seconds to enter advanced menu.
2. Use + to go to **TEST**. Press **Select** to enter System Test.
3. Use + to change between Heat, Cool, Fan, Em. Heat (TH4210U only), or Ver (thermostat version information). Press **Select**.
4. Press + to turn heat, cool, or fan on. Press − to turn them off.
5. Use the **Home** button to exit the System Test.



Thermostat testing procedure to confirm proper operation

System test		System status
Heat	0	Heat Off
	1	Heat On
Cool	0	Cool Off
	1	Cool On
Fan	0	Fan Off
	1	Fan On
Em. Heat (TH4210U only)	0	Em. Heat Off
	1	Em. Heat On

Specifications

Temperature Ranges
Heat: 40 °F to 90 °F (4.5 °C to 32.0 °C)
Cool: 50 °F to 99 °F (10.0 °C to 37.0 °C)

Operating Ambient Temperature
37 °F to 102 °F (2.8 °C to 38.9 °C)

Shipping Temperature
-20 °F to 120 °F (-28.9 °C to 48.9 °C)

Operating Relative Humidity
5% to 90% (non-condensing)

Physical Dimensions in inches (mm) (H x W x D)
4-1/16" H x 4-1/16" W x 1-5/32" D
103.5 mm H x 103.5 mm W x 29 mm D

Electrical Ratings

Terminal	Voltage (50/60Hz)	Running Current
W Heating	20-30 Vac	0.02-1.0 A
(Powerpile)	750 mV DC	100 mA DC
W2 (Aux) Heating (TH4210U only)	20-30 Vac	0.02-1.0 A
E Emergency Heat (TH4210U only)	20-30 Vac	0.02-0.5 A
Y Compressor Stage 1	20-30 Vac	0.02-1.0 A
G Fan	20-30 Vac	0.02-0.5 A
O/B Changeover	20-30 Vac	0.02-0.5 A
L/A Input	20-30 Vac	0.02-0.5 A

Thermostat technical specifications

9.) Once the thermostat is programmed and tested, move on to the remainder of the install and cleanup.

110/220 VOLT PUMP RELAY BOX

A.) Introduction:

When two air conditioners are to be cooled using a single water pump, a relay switching box **must be used** to interface the air conditioners to the pump. Only one air conditioner can be allowed to apply power to the pump at any given time to preclude a doubling of power on the pump. The relay switching box will recognize the first air unit providing power to the pump. Whenever the pump is running, both units will receive water even if the second unit is not in operation. When the second air unit becomes operational the relay switching box will isolate this unit from the pump so double power is not applied, however, if the first air unit reaches temperature and shuts down, the relay switching box will automatically turn control of the pump operation over to the second unit allowing normal operation to continue. The second air unit will maintain control of the pump until it reaches temperature and cycles off, even if the first unit cycles back on while the second unit is operating.

Note:

A separate 5 amp circuit breaker will be required to be installed in the main circuit breaker panel to provide 115 (or 220) vac power to the pump relay box.

On the outside of the pump relay box are two (or more) terminal blocks. One is marked “pump” and “power”. This is where the incoming voltage from the breaker panel and the outgoing power to the pump will be connected. The other terminal block(s) are marked “B” and “W”. This is where the control voltage coming in from each air conditioner will be connected.

B.) Installation

Before proceeding further, put the air conditioner(s) circuit breakers in their "OFF" positions and disconnect all AC power from the boat.

WARNING

Failure to disable all AC power to the boat could result in electrical shock causing serious injury or death.

WARNING

The pump relay box must be in a dry non-explosive environment. Exposure to explosive materials or vapors may cause explosion resulting in serious injury, death, or destruction of the boat. Exposure to water could cause electrical shorting resulting in fire and destruction of the boat.

110/220 VOLT PUMP RELAY BOX

Install a 5 amp circuit breaker in the main circuit breaker panel using 16 gauge boat power cable. Route this cable to the pump relay box which must be mounted in a dry non-explosive environment adjacent to the pump. Before cutting the cable leave a sufficient amount to properly locate the box when installation is completed. Follow the same installation procedure for this circuit breaker as with the 20 amp air conditioning unit circuit breaker described in the “Installation and Operation” section. At the pump relay box, connect this cable to the terminal block marked “power”, white wire to the terminal marked “white” and the black wire to the terminal marked “black”. Using a ring terminal, attach the green wire to the post marked “ground” located on the side of the relay box.

Connect the pump to the terminal block marked “pump”, white wire to the terminal marked “white” and the black wire to the terminal marked “black”. Using a ring terminal, attach the green wire to the post marked “ground” located on the side of the relay box.

On the first air conditioner, locate the terminal block marked “pump”. Run a 16 gauge boat cable from here to the terminal block marked “B” and “W” on the pump relay box. Strip all wires back ¼". Using ring terminals, connect the green on both ends to “ground”. On the air conditioner end, connect the white to the “pump” terminal marked “white” and the black wire to the “pump” terminal marked “black”.

Repeat this same operation for any additional air conditioning units that are to use this same water pump. Once all wiring is completed, secure the pump relay box bracket to a convenient stringer or bulkhead and the installation is complete.

Note:

FMMS pump relay boxes can run (1) pump to every (3) AC units, with a maximum of (2) pumps being controlled by the pump relay box. If you are running multiple pumps, make sure they are paired with the correct AC units. If the wrong pump comes on and a unit is being operated without receiving seawater, it could result in damage to the unit and the repairs will not be covered under warranty. It is recommended that when the installation is finished for the pump relay box and the AC units, run each unit individually and confirm that the correct pump operates at the same time and verify that the unit is receiving and flowing an adequate amount of seawater. When sizing a pump, the rule of thumb is 2 GPM or 120 GPH for every 12,000 BTUs of cooling capacity. No two installs are exactly the same, and with varying water pipe runs and a vast array of different flow restrictions from all the components in a water loop, the flow rate recommended is measured from the water outlet on the outside of the hull. For reference, a 500 GPH pump should be able to fill a 5-gallon bucket in about 45 seconds under ideal conditions.

Maintenance and Winterization

A.) Maintenance:

1.) Water System:

After the first 30 days of operation, check all water connections for leaks and all hose clamps to insure that none have become loose. It is always a good policy to make periodic checks of all water connections and to close the "water in" sea cock whenever you leave the boat for extended periods of time.

Your water strainer will require cleaning on a regular basis. The time between cleanings will be dependent on the condition of the water your boat resides in, the amount of time your air unit operates, and the physical size of the strainer you have installed. After you have had your unit for a few months you will develop a feel for how often you should clean the strainer basket.

2.) Air System:

There is little maintenance required for the air system. The main item is the air filter located on the front of the air unit evaporator held on by two velcro strips. This filter will require cleaning on a regular basis. As with the water strainer, the time between cleanings will be dependent on operating time and environment. For instances, if you have a pet, the time between cleanings will be shorter due to the pet hair that will be pulled onto the filter. The filter is easily cleaned by washing it in plain tap water. Never operate the air unit for extended periods of time without the air filter in place. The debris that would normally be collected by the filter will become lodged in the evaporator coil cooling fins and will gradually reduce the efficiency and performance of your air conditioner to a point that it will require professional acid bath cleaning. When cleaning the filter, also wipe the unit off with a dry cloth to eliminate dust build up. Check that the air ducting has not sagged or loosened around the air collar or air vents.

3.) Electrical System:

Unless you have some reason to suspect an electrical problem, there is no maintenance required for the electrical system. That being said, it is prudent to do cursory checks on all equipment on your boat as you perform your general maintenance on various equipment and systems throughout the year. Before doing any electrical system checks, make sure the air conditioner power is turned off at the main breaker panel. Check all wiring connections and make sure they have not loosened. Look for any corrosion that is forming and clean the corrosion or replace the wire/connection that is corroding. If you see any burn marks or signs of overheating contact FMMS technical support before restoring power to the air conditioner. Make sure nothing in the electrical area is wet before restoring power.

Maintenance and Winterization

B.) Winterization:

If your boat is in the water, you must first close the "water in" sea cock before proceeding with winterization.

Warning

Failure to close sea cock before removing water hoses may result in flooding causing significant water damage or sinking of the boat!

The condensing coil, the coil that connects to cooling "water in" and cooling "water out", must be clear of any standing or trapped water. The best way to clear this coil is to remove the "water in" hose from the coil and place a short piece of the same diameter hose on the condensing coil. Blow through the short hose until no water comes out of the "water out" thru-hull fitting on the outside of the boat. A compressed air source would be ideal, should you have access to one.

Before replacing the condensing coil "water in" hose, go to where the pump is located and remove the "water in" hose to the water pump. This is the hose between the pump and the water strainer. Now return to the air unit and blow through the "water in" hose forcing any trapped water back and through the pump. Again, a compressed air source would be ideal, should you have access to one. This will clear the hose and the pump. Replace both hoses to their original connections.

If you have any doubt about not clearing the condensing coil, you can add a legally acceptable standard antifreeze or alcohol to the coil. Certain locales prohibit the use of automotive antifreeze. Should you be using alcohol, insure you do not allow alcohol to be in the water strainer. Clear plastic water strainer cups will cloud with alcohol.

Winterization is now completed. If the boat is to remain in the water, do not reopen the sea cock until you are ready to again use the air conditioning unit when freezing is no longer a threat.

Warning

If the sea cock is reopened with the boat in the water and freezing occurs, water hoses may rupture and flooding may occur causing significant damage or sinking of the boat. Also if freezing occurs in the air conditioner water coil, it could crack and leak all the refrigerant. This damage will not be covered under warranty and will void the warranty completely. Once water has entered the air conditioner refrigerant piping, repairs may not be possible.

Theory Of Operation and Troubleshooting

CLEAN AIR ACT AMENDMENTS OF 1990 [TITLE VI - SECTION 608(C-1)]

"Effective July 1, 1992, it shall be unlawful for any person, in the course of maintaining, servicing, repairing, or disposing of an appliance or industrial process refrigeration, to knowingly vent or otherwise knowingly release or dispose of any Class I* or Class II** substance used as a refrigerant in such appliance (or industrial process refrigeration) in a manner which permits such substance to enter the environment. De-minimus releases associated with good faith attempts to recapture and recycle or safely dispose of any such substances shall not be subject to the prohibition set forth in the proceeding sentence."

All FMMS air conditioners are charged with a refrigerant that meets the current EPA standards. As of January 1st, 2025 all FMMS air conditioners will be charged with “R32” which is a new refrigerant that will comply with the EPA ruling that will prevent the use of R410A and other refrigerants starting January 1st, 2025. Because FMMS air conditioners are custom built to order, the transition to “R32” will begin in late 2024. The new EPA requirements will allow parts and repairs on R410A units and any other refrigerants used previously, it only prevents the creation of new units with non-compliant refrigerants.

A.) Theory Of Operation:

1.) Introduction:

Before going over how each mode works on FMMS air conditioners we are going to give a brief explanation of how air refrigeration works. This may help you understand the unit operation better and assist with explaning the troubleshooting steps later in this guide. This is not meant to be a complete explanation and is only for illustrational purposes.

Refrigeration is the method of moving heat from one area to another using a refrigerant. For this explanation the refrigerant used will be “R410A”. The basic components of a refrigeration system are: the compressor, condenser, evaporator, expansion device, and the refrigerant. This is a mechanical system and the compressor is driven by electricity in FMMS air conditioners.

The compressor is a mechanical pump. Compressors have a wide variety of shapes, sizes, and methods to pump refrigererant. As it rotates it creates a suction force on the inlet and a compression and pressurized force on the outlet. As the compressor is running it produces a massive amount of heat and friction like the engine in a car. To overcome these effects the refrigerant contains oil for lubrication and the inlet gas entering the compressor doubles as a coolant for the electric motor inside. For the compressors on FMMS air conditioners it is not uncommon for the shell (or outside) of the compressor to reach 200 degrees F or more.

Theory Of Operation and Troubleshooting

The condenser's job is to condense the refrigerant. When the refrigerant leaves the compressor it is a very hot gas. The hot gas enters the condenser and as it flows from the condenser inlet to the condenser outlet it gets cooled and converts from a gas to a liquid. Condensers can take many different forms but on FMMS air conditioners the condenser is the water coil that uses seawater or freshwater to cool the refrigerant gas into a liquid. The condenser is the location for the area of very high pressure in the system and must be made of a very durable material. R410A operates at between 300 to 500 psi based on various condtions and FMMS water coils are rated for 650 psi during normal operation and are made of copper and cupronikel for durability. Close to the condenser is a high pressure safety switch that will stop the unit from running if the condenser pressure rises too high. This pressure switch is set to go off at 600 psi and reset at 475 psi.

The evaporator and the expansion device are paired together after the condenser to perform the opposite task. The cool liquid refrigerant hits the expansion device and as it passes through it moves into an area of low pressure in the evaporator coil. In the evaporator the pressures drop from the 300+ psi in the condenser down to between 110 and 135 psi under normal operation. In this low pressure environment the refrigerant changes from it's liquid state to a gas, and this transition creates a cooling effect. Air is passed over the evaporator coil and temperature and humidity are removed. The BTU rating of the air conditioner determines how much temperature and humidity are removed based on the volume of air that moves through the evaporator coil. As the refrigerant leaves the evaporator coil it heads back to the compressor to start the process all over again. This repeats until the thermostat tells the air conditioner to stop running.

The refrigerant is a clear and colorless chemical. At room temperature R410A is over 200 psi in a pressurized refrigerant tank and in an air conditioner when it is off and has not run recently. Caution is advised any time refrigerant charging or servicing is involved. Because of the very high resting pressure, any major leak or sudden discharge is cold enough to cause frostbite within several seconds of exposure. Any time connecting or disconnecting gauges is usually the point to be aware of refrigerant exposure to skin. Should any refrigerant contact the skin or eyes it should be immediately washed with lukewarm water. Refrigerant and oil in an air conditioner are designed to be compatible with each other and mix very well as they flow around the circuit. This oil is often helpful for finding leaks on joints or coils as the refrigerant leaves behind an oil residue near the leak location.

(Figure 7 and Figure 8) show a diagram of how a heat pump air conditioner works in the forward direction (cooling mode) and in the reverse direction (heat mode). For heat mode the only thing that changes is that the water coil becomes the evaporator coil and the previous evaporator coil becomes the condensing coil. All other descriptions remain the same.

Theory Of Operation and Troubleshooting

FIGURE 7

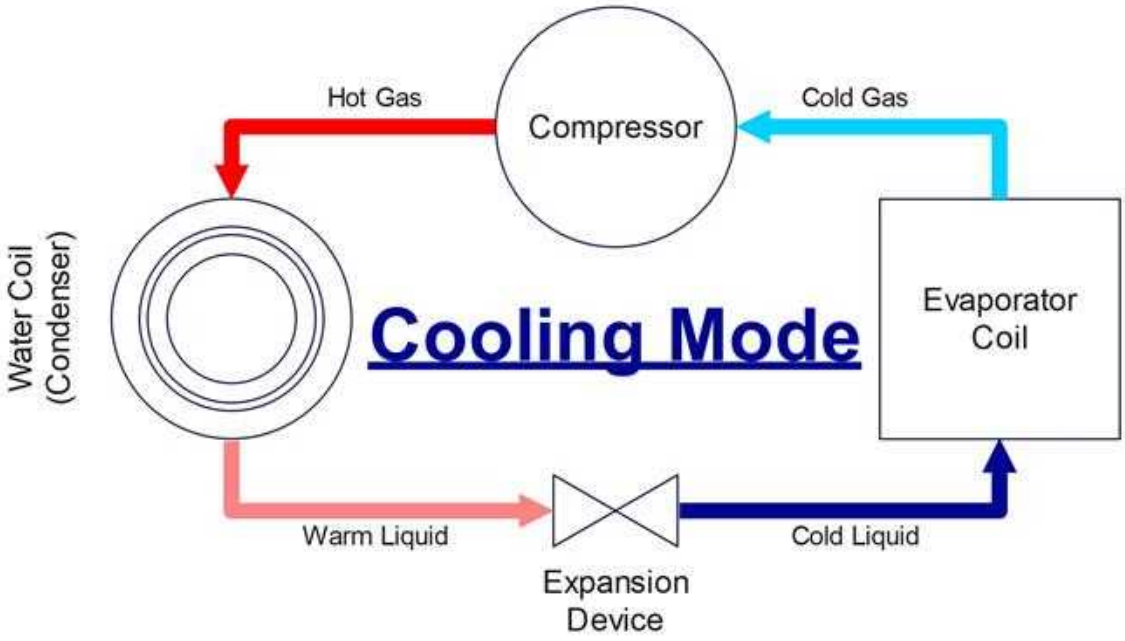
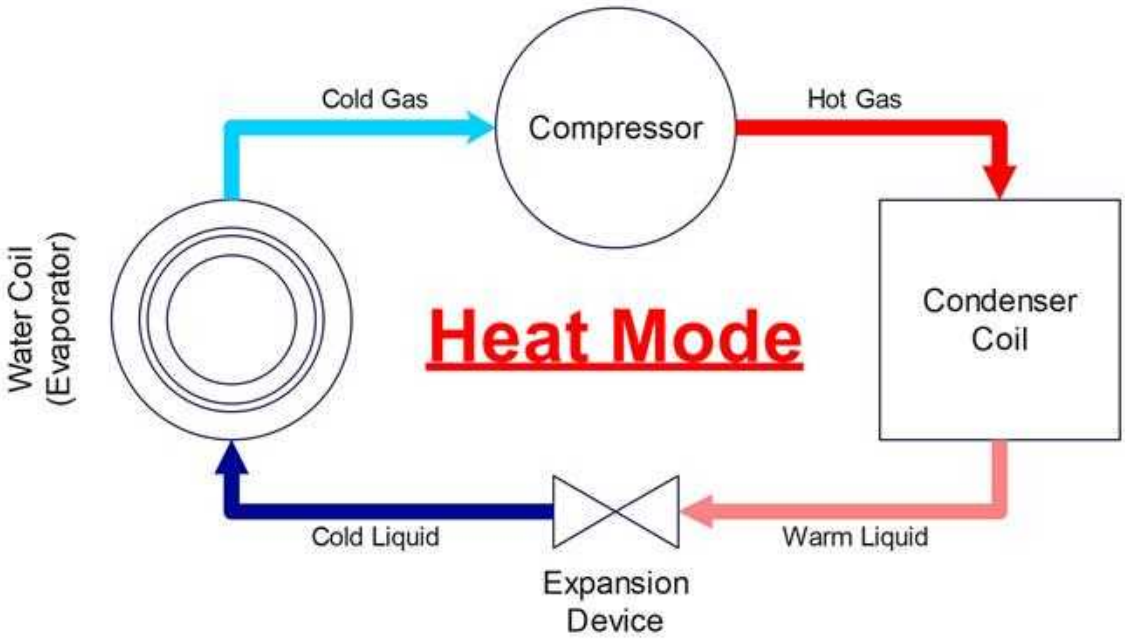


FIGURE 8



Theory Of Operation and Troubleshooting

2.) FMMS Unit Operation:

Cool only units are just that, they only have cooling mode available to them. If the thermostat is placed in “heat” mode the fan will run but the compressor and pump will not operate. When the thermostat is placed in “cool” mode the compressor, pump, and fan will all come on and run until the thermostat meets the temperature it is set for.

Reverse cycle units have both heating and cooling modes which are driven by the compressor. The common name for reverse cycle units is “heat pump”. When the thermostat is in “cool” mode the compressor, pump, and fan all come on and run until the thermostat meets the temperature it is set for. When the thermostat is in the “heat” mode the compressor, pump, and fan all come on. In this mode the reversing valve is activated to change the direction the refrigerant is flowing and produce heated air instead of cooled air. The unit will operate until the thermostat meets the temperature it is set for. The reversing valve typically remains powered all the time while the thermostat remains in the “heat” mode.

Electric heat units have both heating and cooling modes but the compressor only operates in cooling. When the thermostat is set to “cool” the compressor, pump, and fan all come on and run until the thermostat reaches the temperature it is set for. When the thermostat is in “heat” mode the fan comes on and power is also given to an electric heat strip located between the evaporator coil and blower motor. The blower and electric heat strip will remain powered until the thermostat reaches the temperature it is set for. This option is not available in 220V and is available for the M6 up to the M12 units.

3.) Electrical:

All FMMS units operate on 115 or 220 VAC. Power is applied to the air conditioner through the main circuit breaker through a dedicated air conditioner circuit breaker. This power is converted to 24 VAC using a step down transformer. The thermostats use the 24 VAC to activate relays and contactors inside the electrical box which supply main voltage power to the individual components. The fan may be operated separately from the compressor and other components by switching the thermostat fan mode from “auto” to “on”.

4.) Cooling Water:

Cooling water enters the boat through the foot scoop under the boat, up into the boat through the sea cock, through the raw water strainer, through the pump, and into the “water in” on the air conditioner. As it passes through the air conditioner water coil the refrigerant exchanges heat with the water which is then expelled out the “water out” and overboard through the thru-hull fitting.

Theory Of Operation and Troubleshooting

B.) Troubleshooting:

Before attempting troubleshooting it is recommended to review this entire section. If at any point you do not feel confident or willing to continue troubleshooting alone, please contact FMMS technical support for assistance.

Basic steps to follow:
-Check the main power
-Check the thermostat
-Observe unit operation
-Check the water flow

1.) Power:

Air conditioners pull a large amount of current at startup and while running compared to many other electrical devices. Main power flows from the source, to the boats main electrical panel, through a circuit breaker, to the air conditioner electrical box. Check each component in the pathway starting at the source.

If your boat is hooked up to a pedestal make sure the breaker on the pedestal is in the “on” position and is not tripped. If the pedestal is “off” or tripped nothing on the boat should have power unless you have an alternative source such as a generator or battery bank.

Check the main electrical panel of the boat by visual inspection and making sure every relevant power switch is in the “on” position and is not tripped. Check the dedicated air conditioner breaker as well by performing the same inspection.

Older “Mermaid MFG” air conditioners used a 30 AMP inline fuse or glass fuse in a holder. Current FMMS air conditioners use a 30 AMP resettable breaker and a 5 AMP fuse for the transformer. Make sure the breaker/fuse is not blown or tripped and reset it or replace it. Next to the breaker will be the main power input on the control box terminal strip. Make sure the wires are intact and connected properly. If you have a multimeter, place it in “VAC” mode and check for 115/220 VAC. If voltage is present proceed to the next sections.

2.) Thermostat:

Standard FMMS units operate using a 24 VAC thermostat. The thermostat communicates with the air conditioner electrical box via 4 or 5 wires. The thermostat also has a set of batteries in the back that it will operate on in 4 wire installations or when the main power is off to save your settings.

Theory Of Operation and Troubleshooting

Check the wires both behind the thermostat and at the electrical control box and both visually inspect and check to make sure the wires are intact and properly connected. If you have a multimeter, place it in VAC mode and there should be between 24 and 28 VAC with one lead on the “R” wire and one lead on the “C” wire in a 5-wire setup which is the current configuration for FMMS units. If the thermostat has 4 wires there should be between 24 and 28 VAC with one lead on the “R” wire and one lead on a nearby ground.

If the thermostat has batteries and you are troubleshooting the unit, replace the batteries with a fresh set to make sure they are not the culprit. Many thermostats have an indicator of some kind that the batteries are low, but there are models that may not indicate this. If the thermostat is a 4-wire setup the batteries are an essential component for the thermostat to function. If the thermostat is a 5-wire setup with the optional “C” wire, the thermostat draws power from the air conditioner 24 VAC transformer to operate. This means that batteries can typically last for years or thermostats that do not have batteries at all are able to function such as “Wi-Fi” enabled thermostats.

Place the thermostat in the desired mode and wait the designated delay time for the unit to operate. Many thermostats have a 3 to 5 minute delay before the unit will operate. This is a short cycle prevention feature to make sure the unit has adequate rest time between off and on for system longevity. You may hear an audible click inside the thermostat when the communication pathway is activated to operate the unit.

If the thermostat is a suspected culprit for operational issues a jumper may be placed on the electrical box thermostat terminals to bypass the thermostat and its wiring. Always turn off the main power when attempting to place or adjust a jumper. Using a solid piece of wire to jumper between the terminals should result in unit operation as follows:

-A jumper placed between the “R” terminal and the “G” terminal will result in only the fan operating. No other component should operate or receive power. There is no harm in letting the fan operate for an extended period of time.

-A jumper placed between the “R” terminal and the “W” terminal will result in an audible “click” at the unit on a reverse cycle heat model. This is the reversing valve operating the switching solenoid. There is no harm in letting the solenoid remain powered for an extended period of time. It is not recommended to place a jumper between “R” and “W” on a cool only or electric heat model unit. In a cool only unit, nothing will happen. In an electric heat unit, the electric heat strip will become powered and if it remains powered for anything longer than a few seconds with no fan operation it will burn up a fusible link high temperature safety device and no longer function.

Theory Of Operation and Troubleshooting

-A jumper placed between the “R” terminal and the “BL” terminal will result in only the compressor and pump running. No other component should be receiving power or operating. It is not recommended to allow the compressor to operate for an extended period of time without the fan.

Warning

Never place a jumper between the “BR” terminal and any other terminal. The “BR” terminal is the 24 VAC ground. Any 24 VAC power that is applied directly to this terminal could cause the transformer in the electrical box to fail and will result in the repairs not being covered under warranty.

After verifying operation of each terminal separately, proper unit operation can be verified by combining jumpers. Combining several terminals together with jumpers will simulate normal thermostat operation. Be aware that as long as the jumpers are installed that the unit will run in the mode that is jumpered for without ever stopping until main power is removed. Jumpers for the different modes are as follows:

Cooling Mode:

Jumpers placed between the “R” terminal and both the “G” and the “BL” terminals will result in the compressor, fan, and pump operating. This will run cool only, reverse cycle, and electric heat models all in cooling mode. As long as main power is on and the jumpers are installed should result in the unit operating indefinitely unless a safety device removes main power or disables the unit.

Heating Mode (not applicable to cool only models):

In a cool only model refer to the previous “cooling mode” section for the jumper configuration for proper operation testing.

In a reverse cycle model jumpers placed between the “R” terminal and the “G”, “W”, and “BL” terminals will result in the compressor, pump, and fan operating but also adds power to the reversing valve which allows heat to be produced instead of cooling. As long as main power is on and the jumpers are installed should result in the unit operating indefinitely unless a safety device removes main power or disables the unit.

In an electric heat model jumpers placed between the “R” terminal and the “G” and the “W” terminals will result in the blower and electric heat strip operating. As long as main power is on and the jumpers are installed should result in the unit operating indefinitely unless a safety device removes main power or disables the unit.

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If placing jumpers at the electrical box are successful in resolving the issue, the problem is in the wiring or the thermostat. Double check all connections and replace thermostat with a store bought unit or replacement from FMMS or run a new wire to the existing thermostat to see if the issue is resolved. Contact FMMS technical support for assistance if needed and review the thermostat installation section for wiring instructions.

3.) Observing Unit Operation:

If a unit is not operating as designed, observe the operation and go to the section of troubleshooting related to that issue. This guide is meant to be as thorough and descriptive as possible and will be updated as needed with revised troubleshooting steps and sections as time goes on. If you are experiencing an issue that is not covered in this guide please contact FMMS technical support for assistance.

4.) Checking Water Flow:

If the unit is operating the water pump should have power any time that the compressor is running. If the compressor is running and no water is flowing through the unit, depending on the mode the unit will either go out on high pressure or freeze protection. Check ball valves and make sure they are open, especially the sea cock. Check the pump strainer and make sure it is clean and flowing water properly. Make sure that the pump is primed and is not running dry. If the pump is not properly primed it can cavitate and will result in the air conditioner cycling on high pressure or the freeze stat because not enough water is flowing. Pumps can lose there prime in a multitude of ways, which makes this often the first check if the air conditioner is not functioning correctly.

C.) Troubleshooting Continued (Specific Scenarios):

Note:

All of these troubleshooting scenarios assume that main power has been previously checked and verified. Power is often overlooked and checking what most would consider a basic step can save time, frustration, and cost associated with a step being missed. See the previous basic troubleshooting steps for a brief overview of often overlooked or easy to diagnose problems.

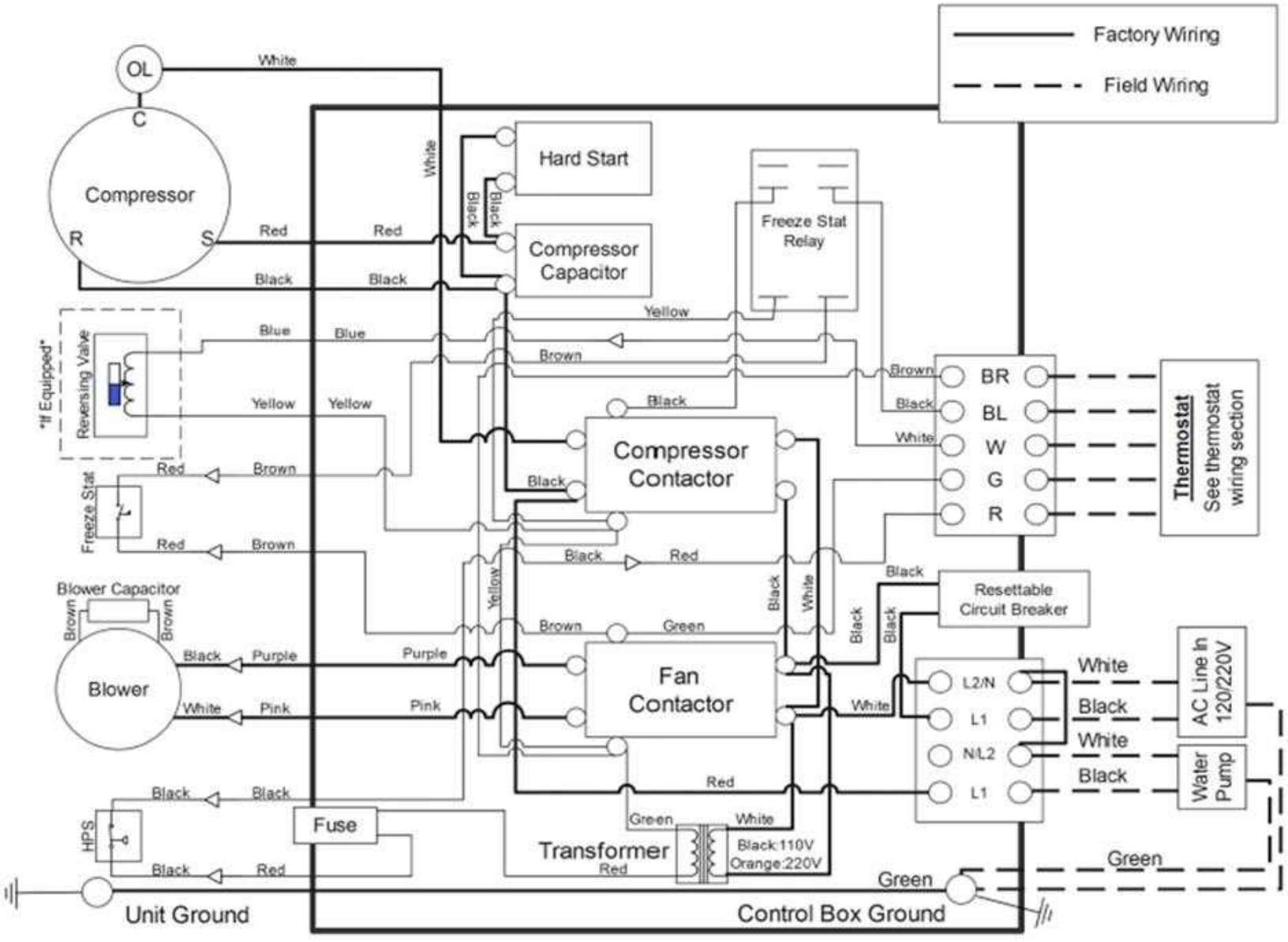
Unit Does Not Operate In Any Mode (No Fan, No Compressor):

If the unit was previously operating and suddenly shut down the unit may have shut down on high pressure. The high pressure switch will prevent all components from operating while the unit is cooling off. Allow up to 10 minutes for the unit to reset before moving on with diagnostic.

Theory Of Operation and Troubleshooting

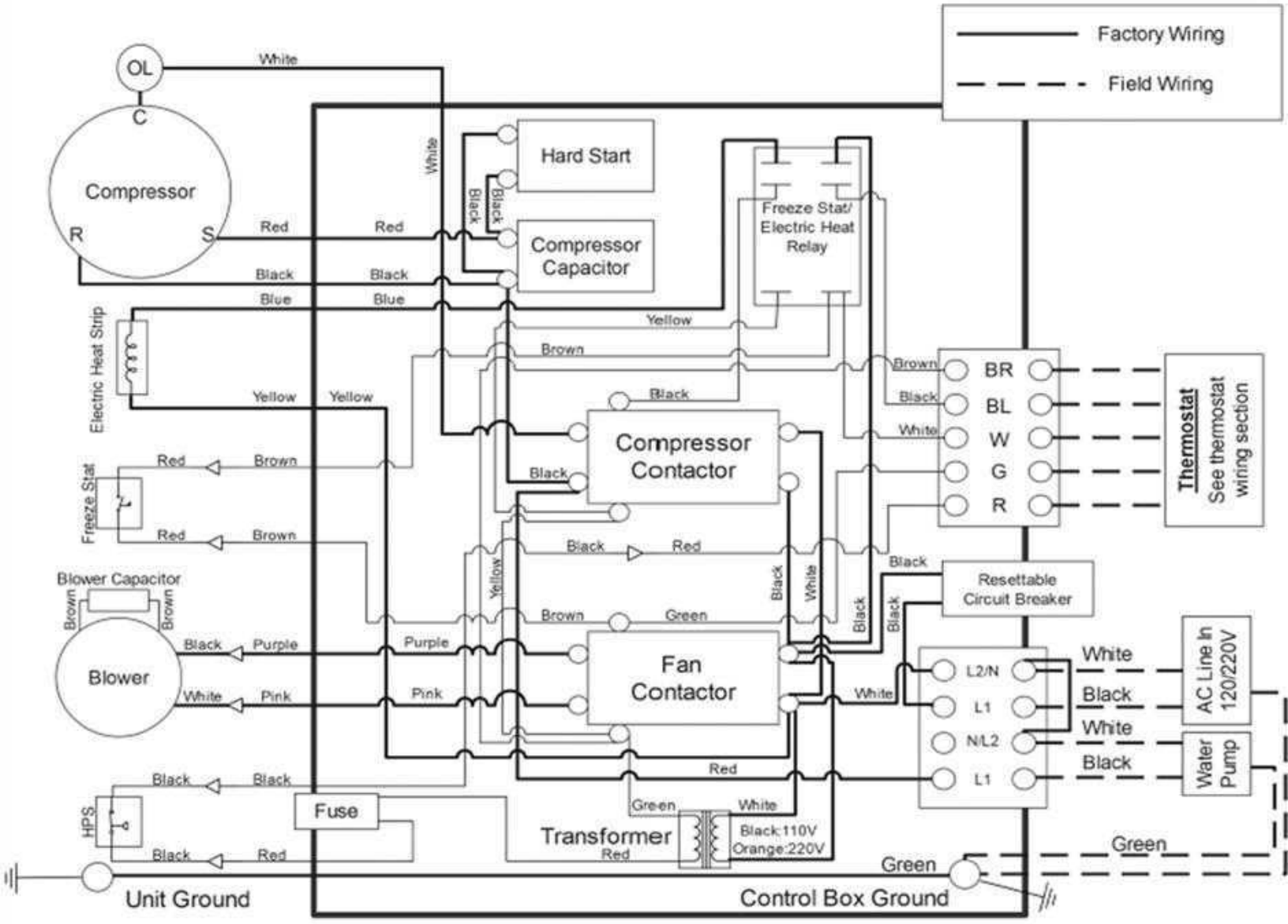
If the unit is not operating in any mode attempt the jumper method described previously to eliminate the thermostat and thermostat wiring as the cause. If the jumpers do not force the unit to operate proceed to turn off the power and remove the lid of the electrical box. Once inside the electrical box you will need to understand the pathways all the wires take in order to find where operation is being prevented. Review the following wiring diagrams for your model. If you have a cool only unit, the reverse cycle wiring diagram is the correct wiring to refer to. The only difference will be the absence of the reversing valve. Full size diagrams are available on our website or by request with our technical support team.

Reverse Cycle Wiring Diagram



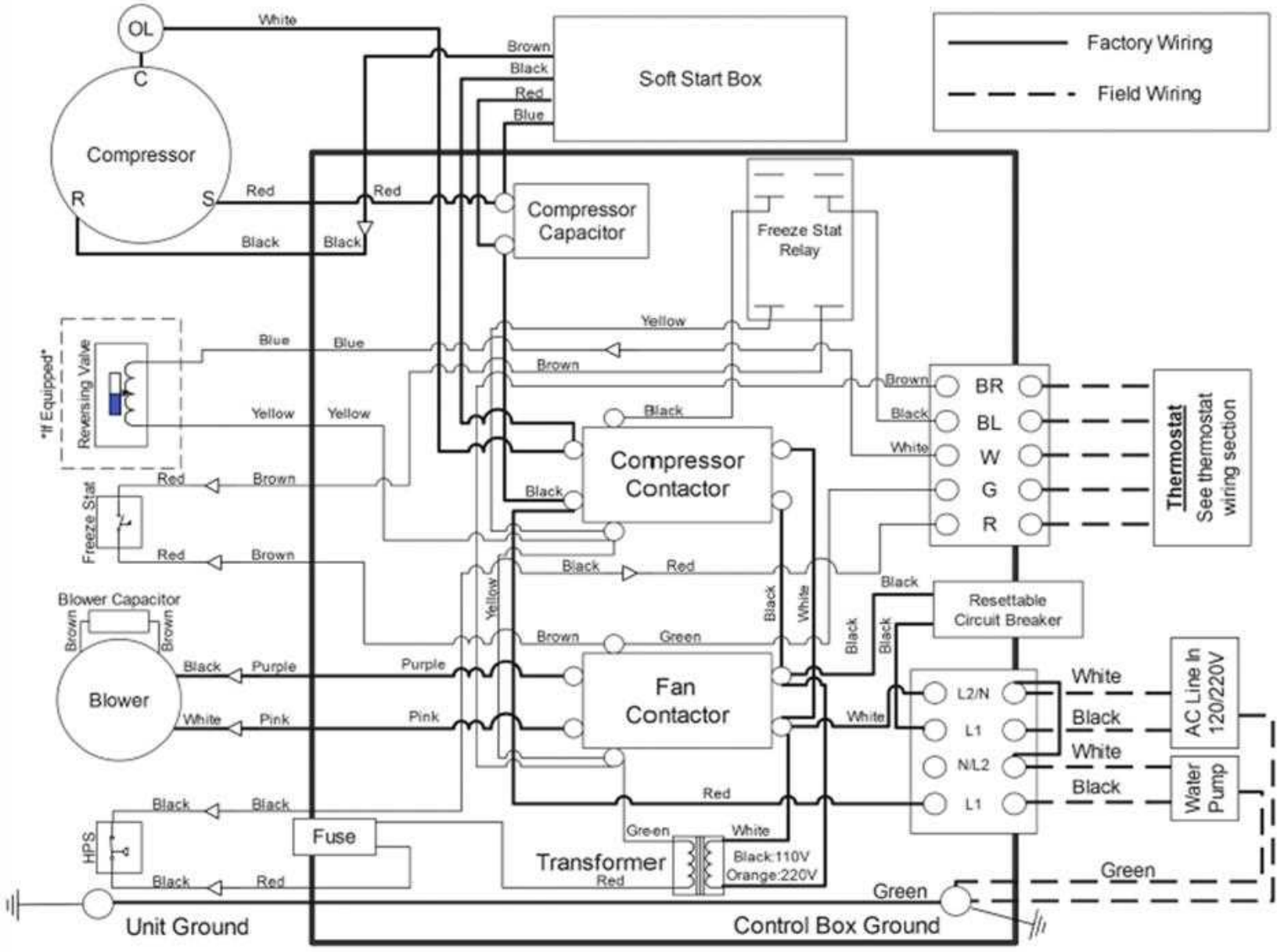
Theory Of Operation and Troubleshooting

Electric Heat Wiring Diagram



Theory Of Operation and Troubleshooting

Soft Start Wiring Diagram



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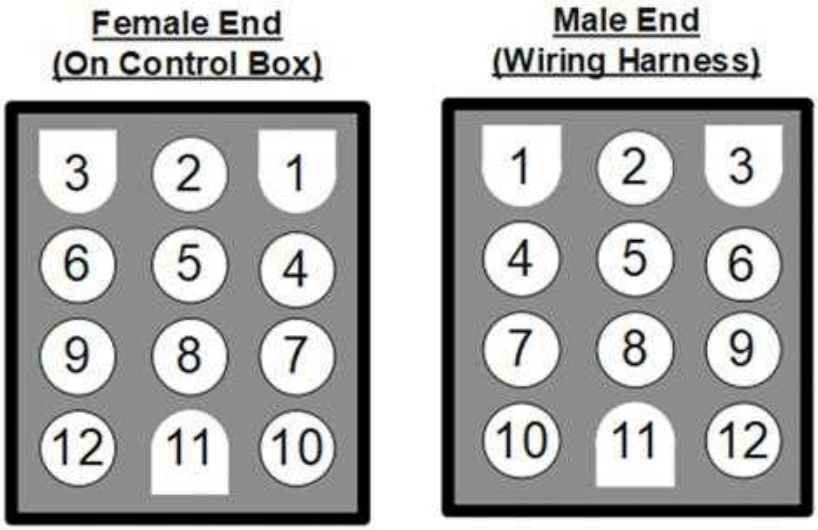
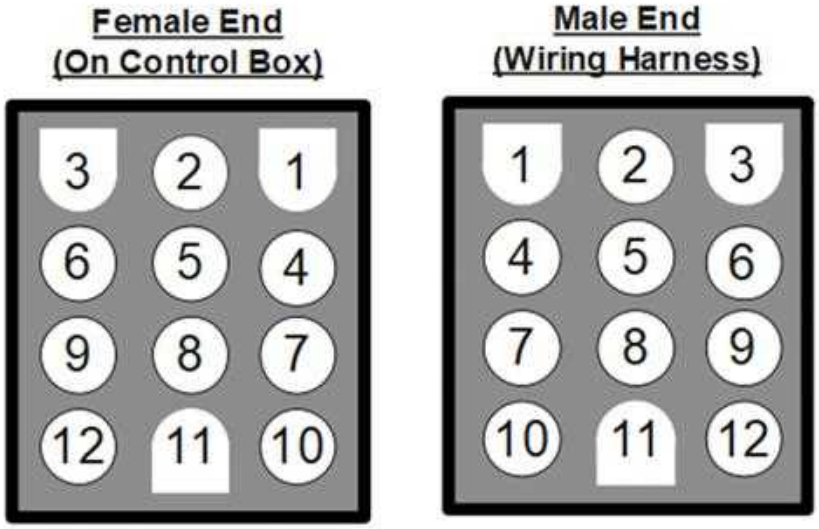
12 Pin Plug Wiring Harness Reverse Cycle



1: Reversing Valve (Yellow Wire)
2: Compressor S (Red Wire)
3: High Pressure Switch (Black Wire)
4: Compressor C (White Wire)
5: Reversing Valve (Blue Wire)
6: Ground (Green Wire)
7: High Pressure Switch (Red Wire)
8: Fan Power (Purple Wire)
9: Fan Neutral (Pink Wire)
10: Freeze Stat (Brown Wire)
11: Compressor R (Black Wire)
12: Freeze Stat (Brown Wire)

12 Pin Plug Wiring Harness Electric Heat



1: Heat Strip (Yellow Wire)
2: Compressor S (Red Wire)
3: High Pressure Switch (Black Wire)
4: Compressor C (White Wire)
5: Heat Strip (Blue Wire)
6: Ground (Green Wire)
7: High Pressure Switch (Red Wire)
8: Fan Power (Purple Wire)
9: Fan Neutral (Pink Wire)
10: Freeze Stat (Brown Wire)
11: Compressor R (Black Wire)
12: Freeze Stat (Brown Wire)

Theory Of Operation and Troubleshooting

Once you have familiarized yourself with the wiring diagram for your unit and have reviewed the wiring of the 12-pin plug that connects the control box to the unit make sure that the 12-pin plug is properly seated and connected to the control box and proceed with the diagnostic. Certain areas of troubleshooting are only possible with a multimeter and will be specified in the instructions. **Never place your multimeter in OHMS or CONTINUITY mode without shutting off the main power and verifying that no power is coming to the electrical box!**

With the electrical box exposed restore main power and place your multimeter in VAC mode. The first place to check for power is going to be on the power wires going from the terminal strip on the outside of the electrical box to the fan and compressor contactors. There are screw terminals that have black and white wires connected to them on the “power side” of the contactor. The other side of the contactor is called the “load side” and passes power to the component that it operates. Place one lead on the “power side” screw terminal with the black wire(s) and the other lead on the “power side” screw terminal with the white wire(s). You should have 115 or 220 VAC, do not be alarmed if it is not exactly that number but it must read close to the rated voltage. If the multimeter displays 0 VAC and the outside of the control box is reading proper voltage then the inline breaker/fuse may be faulty. If the voltage is correct at the “power side” of the contactor move on and check the transformer.

The transformer high voltage wires are connected to the “power side” of the fan contactor. On the opposite side of the transformer are a RED and GREEN wire of smaller gauge. Those supply 24 VAC to the thermostat so that the rest of the control box can be operated. The RED wire passes into a fuse holder containing a 5 AMP glass fuse. Verify the fuse is intact with the power off. With the power on place one lead of your multimeter in VAC mode on the terminal of the RED wire and place your other lead either directly on the end of the GREEN wire by removing it from its terminal location or on the terminal that the GREEN wire is connected to. Your multimeter should be displaying 24 to 28 VAC. If it is showing 0 VAC then the transformer has failed and needs to be replaced. It can be replaced with a transformer from any HVAC supply store or a replacement can be aquired from the FMMS factory. If it is reading 24 to 28 VAC at the RED wire perform the same check on the terminal leaving the fuse holder. If there are 0 VAC the fuse or fuse holder are faulty. If you have 24 to 28 VAC leaving the fuse holder and heading to the 12-pin plug but 0 VAC on the “R” terminal for the thermostat, then the high pressure switch is preventing voltage from passing through.

The high pressure switch interrupts all 24 VAC power coming from the transformer to the thermostat. To test whether it has failed cut the wires going to the high pressure switch and wire-nut them together to temporarily bypass the high pressure switch for diagnostic purposes. It is not recommended to run the unit long without the high pressure switch installed and is only meant to verify if it is faulty. If the bypass restores power and operation to the unit a replacement high pressure switch needs to be installed.

Theory Of Operation and Troubleshooting

Compressor Comes On, No Fan (Cooling or heating mode):

Attempt the jumper method for activating the fan by itself explained previously before diagnosing further. If the jumper does not activate the fan move on to the next step by removing the cover on the electrical box with the main power turned off. Review the previous wiring diagrams to familiarize yourself with the electrical setup.

Because the compressor comes on we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, and because the jumper did not activate the fan we can rule out the thermostat and its wiring as the culprit.

With either the fan jumper installed of the thermostat in “fan on” mode place your multimeter in VAC mode and restore the main power. Follow the green wire from the “G” terminal to the fan contactor. Place one lead on the green wire from the “G” terminal and one lead on ground. Your meter should read 24 to 28 VAC. If it does not read 24 to 28 VAC then there is an issue with the wire going from “G” to the fan contactor. Replace the wire and test again. If it reads 24 to 28 VAC then place one lead on the terminal with the purple wire on the “load side” of the fan contactor and the other lead on the terminal with the pink wire on the “load side” of the fan contactor. It should read 115 or 220 VAC and if it does not the contactor is faulty and needs to be replaced. If there is proper voltage between the purple and pink terminals move on to the unit itself as the contactor is passing power to the blower motor.

At the unit follow the purple and pink wires to the blower motor. Visually inspect along the way and look for compromises to the wiring. If your multimeter has a “Non Contact Voltage Testing” mode place the meter in that and scan along the wires making sure the power makes it the full way to the blower motor. Turn off the main power and make sure the purple and pink wires are properly connected to the black and white wires of the blower motor. If you are able to verify with a multimeter in VAC mode that 115 or 220 VAC are present on the purple and pink wires restore the power and verify the voltage. If the wires have 0 VAC present check the 12 pin plug for proper connection and/or replace the purple and pink wires with the power off. If 115 or 220 VAC is present on the purple and pink wires then the blower motor is at fault.

With the power off make sure that the blower wheel spins freely and does not impact anything as it spins. If the motor is located on the back of the blower housing it may have a capacitor that looks like a small black box with a grey and brown wire going to it. Remove it and use a multimeter in “microfarad” mode to test if the capacitor is within spec. The capacity will be written on the side and the multimeter should read +/- 5% from that spec. If the capacitor is out of spec, replace it and test the fan again. If the motor is located inside the housing and there is no motor outside the housing check the control wires of the motor. The motor has a second set

of wires next to the black and white wires connected to the purple and pink wires. The red and yellow wires of this second set should be connected together in order for the fan to operate. If everything checks out the blower needs to be replaced.

Fan runs but no compressor or pump (cooling or heating mode)

If the unit was previously running and suddenly the compressor and pump shut off while the fan continued to run, the freeze stat may have activated. This component is located on the suction line that is covered in insulation going into the compressor. Its purpose is to prevent the unit from freezing. Low airflow in cooling mode or low water flow in heat mode may result in the freeze stat activating and preventing the unit from operating for several minutes. Wait 5 to 10 minutes for the freeze stat to reset before proceeding. If you would like to bypass it and confirm that the freeze stat has shut down the compressor, remove one lead of the freeze stat that is connected to one of the brown wires going to it from the 12-pin plug. If the compressor and pump begin to operate the freeze stat has either not reset or is faulty. The unit will operate properly without the freeze stat installed for extended periods of time. Be cautious not to run in water that is too cold or preventing the unit from having proper airflow.

Attempt the jumper method explained previously before diagnosing further. If the jumper does not activate the compressor or pump move on to the next step by removing the cover on the electrical box with the main power turned off. Review the previous wiring diagrams to familiarize yourself with the electrical setup.

Because the fan runs we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, and because the jumper did not activate the compressor or pump we can rule out the thermostat and its wiring as the culprit.

With either the compressor jumper installed or the thermostat in cooling or heating mode place your multimeter in VAC mode and restore main power. Follow the black wire going from the “BL” terminal to the freeze stat relay and the compressor contactor. Place one lead on ground and the other lead on the black wire going to the freeze stat relay. Your meter should read 24 to 28 VAC. If it has 0 VAC the wire is faulty going from “BL” to this point and needs to be replaced. If there is 24 to 28 VAC keep one lead on ground and place the other lead on the black wire leaving the freeze stat relay. You should also have 24 to 28 VAC. If it has 0 VAC the freeze stat is either activated or the freeze stat relay is faulty. To verify this remove either the yellow or brown wire going to the freeze stat relay and see if the voltage reads correctly. If it reads 24 to 28 VAC the freeze stat was activated and either needs time to reset or is faulty and needs to be replaced. If it reads 0 VAC the freeze stat relay is faulty and needs to be replaced. If voltage leaving the freeze stat relay is correct keep one lead on ground and follow the black wire from

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the freeze stat relay to the compressor contactor and place the other lead on that connection. If the meter reads 0 VAC then the wire from the freeze stat relay to the compressor contactor is faulty and needs to be replaced. If the meter reads 24 to 28 VAC the contactor must be checked.

To check the compressor contactor verify that there is 115 or 220 VAC present at the “power side” of the contactor by placing one lead on each screw terminal at the “power side” connection. If there is 0 VAC present the wires from either the terminal block outside the control box or from the fan contactor to the compressor contactor are faulty and need to be checked and replaced. Next check to see if there is power present on the “load side” of the contactor going to the pump and compressor. Place one lead on each screw terminal on the “load” side of the contactor. If there is 0 VAC the contactor is faulty and needs to be replaced. If there is 115 or 220 VAC present then the wire connections need to be checked and repaired if they are compromised.

Fan and pump are running but no compressor (cooling or heating mode):

Because the fan and pump are running no jumper is needed and we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, the thermostat is operating correctly, the freeze stat is not tripped, and the compressor contactor is operating correctly.

Before removing the cover to the electrical box turn off the main power and move to the unit itself and check the compressor. Remove the screw holding the black plastic cap on top of the compressor. Underneath will be (3) terminals arranged in a circle and on some compressors there will be a small circular component with a short wire connected to one of the (3) terminals in a circle and a terminal on top of itself that has either a black or white wire connected to it. Check the terminals for compromised wiring and repair as needed. Restore main power and wait for the fan and pump to begin running. There are (3) wires coming from the 12-pin plug to the compressor, a RED wire, a WHITE wire, and a BLACK wire. Place your multimeter in VAC mode and place one lead on the black wire and one lead on the white wire. If there is 0 VAC present the wires from the 12-pin plug are faulty and need to be checked and replaced. If there is 115 or 220 VAC present the compressor windings, overload, and capacitor must be checked.

The first thing to check is the compressor overload. The overload is a temperature and current device that prevents the compressor from operating if it overheats or pulls too much power. The overload may be internal or external to the compressor. If an internal overload is tripped while the compressor is cool, it is faulty and the compressor must be replaced. If the compressor is extremely hot to the touch and the internal overload is tripped the compressor needs to cool down before verifying the operation of the overload. An external overload is a small circular

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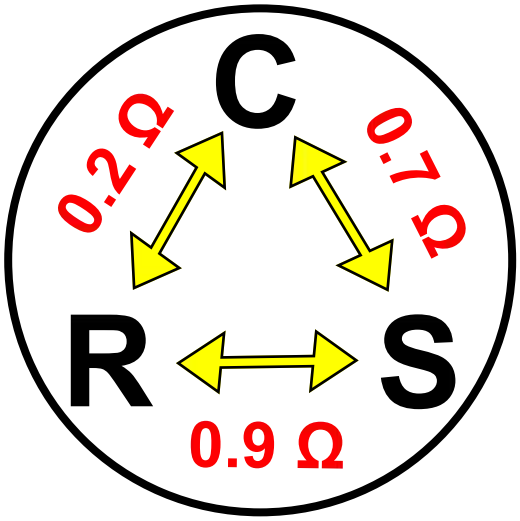
device located underneath the plastic cap of the compressor and is right next to the (3) terminals on top of the compressor. If an external overload is tripped while the compressor is cool it may be faulty. Wait up to 10 minutes for it to reset and if it does you should hear an small audible “click”. If it has not reset after 10 minutes with the compressor cool then the overload is faulty and can be replaced without replacing the compressor. If the compressor is extremely hot it may take a little longer for the overload to reset but with the plastic cover off and main power turned off the overload should still reset within 10 minutes. To see if the overload is tripped for an external overload, remove the white or black white attached to the top of the overload. Place your multimeter in OHMS or CONTINUITY mode and place one lead on top of the overload and the other lead on the compressor “C” terminal. If there is no continuity “beep” or the meter reads “OL” then the overload is tripped and if deemed faulty will need to be replaced. If the multimeter “beeps” or displays 0 OHMS then go to the next sections for testing the compressor terminals and capacitor. To see if an overload is tripped for an internal overload, remove the BLACK, RED, and WHITE wires connected to the “R”,”S”, and “C” terminals. Take note of what color goes to what terminal, taking a picture beforehand is a great way to make sure they are not hooked up incorrectly. Place your multimeter in OHMS mode and place one lead on the compressor “C” terminal and one on the compressor “R” terminal. If the multimeter reads “OL” then the internal overload is tripped and if deemed faulty will need to be replaced. If the multimeter reads a number go to the next sections for testing the compressor terminals and capacitor.

Testing the compressor terminals is verifying the resistance values between the windings of the compressor motor. Every electric motor has a designed amount of resistance when it is built to determine how it will operate. With a multimeter set to OHMS mode each terminal needs to be tested in regards to the others. The value between “R” and “C” will be the lowest, the value between “S” and “C” will be in the middle, and the value between “R” and “S” will be the highest and will also be the sum of the previous two values. See the diagram below:



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All values measured by the multimeter should be lower than 3 OHMS typically, even for the highest value. If any combination of terminals reads higher than that the compressor may be deemed faulty and need to be replaced. If any value reads 0 OHMS that indicates a short and will typically trip the breaker/fuse at the control box or main electrical panel, the compressor will be deemed faulty and need to be replaced. A reading should also be taken from each of the compressor terminals to the ground located on the air conditioner base or control box. For each terminal the multimeter should read “OL” and if it reads any number (E.G. 14.5K Ω or 0 Ω) the compressor has a ground fault short and will need to be replaced. After the terminals are tested replace the wires to their respective positions.

Warning

Before proceeding make sure the main power has been switched off and you are comfortable and confident in your abilities to test a capacitor. If you are not comfortable or confident in your abilities please contact FMMS technical support for assistance or a certified repair technician! Improper handling can result in an electrical shock that can cause injury or death!

Testing the compressor capacitor requires the main power to be off and the electrical box lid to be removed. The capacitor will be a silver cylinder with two groups of terminals on one end. Capacitors are like a battery and are how a camera flash and a taser both are able to charge and rapidly discharge to match their function. On a compressor the capacitor is essential for operation and efficiency. Put simply the capacitor gives the compressor motor both torque and direction to spin. If the capacitor has failed the compressor often will not operate at all and will just hum and cycle the overload on and off.

The capacitor must first be discharged before any work is performed to it! Capacitors can hold a large amount of charge and are able to discharge very rapidly! To properly discharge a capacitor, place a multimeter in VAC mode and place one lead on each group of terminals at the one end of the capacitor. If your meter reads 115 or 220 VAC the box is live and power has not been turned off! As the capacitor discharges the meter will slowly begin to read lower and lower values until it reads 0 VAC. At this time remove the leads and then re-apply them to the capacitor. If the meter shows 0 VAC the capacitor is safe to handle. If the meter shows any value above 0 VAC it may still be holding a small amount of charge. Continue to hold the leads of the multimeter on the capacitor until it reads 0 VAC and repeat the removal and re-application of the leads until the capacitor is consistently reading 0 VAC.

Once the capacitor is properly discharged remove any wires attached to the two groups of terminals at the one end. Taking a picture to make sure the wires return to their proper place is advised before disconnecting the capacitor from the circuit. Once all the wires are removed

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place the multimeter into MICROFARAD mode and place one lead on each group of terminals on the capacitor. The meter should be showing a value (E.G. 44.6 µF or 51.2 µF) and this value should be within +/- 5% of the rating on the side of the capacitor (E.G. a 50 µF capacitor can read 47.5 µF to 52.5 µF and still be considered good). If the multimeter reads a 0, an “OL”, or a value outside the 5% range of the capacitor, the the capacitor is faulty and needs to be replaced. It must be replaced with an identically rated capacitor in order for the compressor to function properly. Installing a different size capacitor can cause the compressor to fail prematurely and will void the warranty. Once the capacitor has been tested or the replacement has been installed, reconnect the wires to their designated positions they were removed from.

If after these steps the compressor is still not operating contact FMMS technical support for assistance.

Fan and compressor operate but no pump (cooling or heating mode):

Because the fan and compressor are running no jumper is needed and we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, the thermostat is operating correctly, the freeze stat is not tripped, and the compressor contactor is operating correctly.

Before any electrical diagnostic is performed, inspection of the pump and water piping components should be performed first. Check all ball valves or shutoffs and make sure they are in the “open” position. Check the pump strainer for a blockage and ensure there is water in the strainer basket for the pump to operate with. Make sure the pump has not lost its prime and become air locked. Attempt to prime the pump or bleed it using a bleed off valve. If the water connections and piping checks out move on to electrical troubleshooting.

The first thing to check is the pump wiring at the electrical box. Make sure the wiring is intact and connected properly. If not perform repairs with the main power turned off and try to run the unit again. If the wiring is good take a multimeter and place it in VAC mode. Put one lead on the “PUMP BLACK” terminal and the other lead on the “PUMP NEUTRAL” terminal. If the meter reads 0 VAC the main power needs to be turned off and the cover removed. The wiring going from the compressor contactor “load side” to the pump terminals needs to be inspected and repaired. If the meter reads 115 or 220 VAC then the pump has either mechanically or electrically failed and needs to be replaced.

Because cooling water is not flowing while the troubleshooting is performed the air conditioner may go out on high pressure or freeze protection depending on the mode it is in and the conditions of the environment. Allow the unit several minutes between attempts to troubleshoot the pump not working properly.

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Cooling mode works but heating mode does not (reverse cycle):

Because the cooling mode is working we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, the thermostat is operating correctly, the freeze stat is not tripped, and the compressor contactor is operating correctly. Try the jumper method described previously for heat mode. If the jumper method makes heat operate the issue is the thermostat wiring or programming. Refer to the thermostat wiring and programming section for more information.

To electrically troubleshoot electric heat on a reverse cycle unit there is only one component in the circuit and that is the reversing valve coil. The circuit begins at the “W” terminal of the control box and goes straight to the 12-pin plug blue and yellow wires to the reversing valve coil. Follow the blue and yellow wires to the reversing valve coil from the 12-pin plug. Make sure the wires did not get knocked off the reversing valve coil during installation or from vibrations. Remove the blue and yellow wires from the coil and place your multimeter in VAC mode. Place one lead on the blue wire and one on the yellow wire. If the meter reads 0 VAC then the thermostat or jumper is not allowing power to pass through the “W” terminal to the reversing valve coil. Turn off the main power, remove the electrical box cover, and inspect the wiring from “W” to the reversing valve coil and back to the electrical box. Perform repairs as needed and restore power to test again. If the meter reads 24 to 28 VAC the reversing valve coil may be faulty. Turn off main power and place multimeter in OHMS mode. Put one lead on each side of the reversing valve coil and measure the resistance. If the meter reads “OL” then the reversing valve coil is faulty and needs to be replaced. If the reading is a number (E.G. 14.7K Ω) then the coil is intact. If the coil is intact and it is receiving 24 to 28 VAC then the reversing valve is faulty and needs to be replaced or there is a refrigerant problem. Contact FMMS technical support for assistance.

Cooling mode works but heating mode does not (electric heat):

Because the cooling mode is working we can assume several things. The main power is arriving at the electrical box, the breaker/fuse is not tripped, the transformer is working, the high pressure switch is not tripped, the thermostat is operating correctly, the freeze stat is not tripped, and the compressor contactor is operating correctly. For electric heat if a jumper is tested the “R” must be jumpered to both “G” and “W” otherwise the electric heat strip could burn up without the blower running. If the jumper method makes heat operate the issue is the thermostat wiring or programming. Refer to the thermostat wiring and programming section for more information.

To electrically troubleshoot electric heat units, the same steps must be followed as the previous

Theory Of Operation and Troubleshooting

section about troubleshooting the reverse cycle heat. The difference is the “W” terminal will operate the electric heat relay which sends 115 VAC through the blue and yellow wires to the electric heat strip. Using a multimeter verify that the electric heat relay is receiving 24 to 28 VAC from the jumper or thermostat and that 115 VAC is being sent out the yellow and blue wires to the 12-pin plug. With the power off the electric heat strip can be tested for resistance in the OHMS mode and if it reads “OL” the electric heat strip has failed or the fuse has blown on the heat strip. Contact the FMMS technical support for assistance.

Unit is operating but no water out (cooling or heating mode):

See previous section on unit running but no pump operation

Condensation pan is overflowing:

Drain nipple is plugged with debris, the drain hose is blocked or kinked, or the unit is tilted away from the drain and cannot drain properly. Fix or clear the hose and correct the tilt if needed.

If using a FMMS Condensator Kit check strainer for debris, hose for kinks or blockages, and dissasemble the Condensator Kit body and clean the orifice located inside as needed.

Evaporator is freezing:

Every FMMS unit is now equipped with a freeze stat to prevent evaporator freezing, however this is not meant to be a fix for freezing. If an evaporator is freezing there is a problem that needs to be addressed or the unit is being run in non-ideal conditions. Freezing can occur in both heating and cooling mode on the reverse cycle units.

If the evaporator is freezing it is usually an airflow problem. Make sure supply air vents are open and the correct size ductwork and number of vents are being used. Open vents and add additional ones as needed. If the fan is having issues like running too slowly or not running at all the evaporator will freeze due to reduced air flow. Make sure the filter is clean and the return air is not obstructed in any way.

On new installs an uncommon mistake made is one of the vents is pointed towards the return air or crosses over the air entering the return grill. If the unit is blowing its own cold air back into itself the air will get colder and colder until the unit has no choice but to freeze. This can happen over the course of a couple minutes to a few hours depending on how much air is being sent back into the return grill.

Theory Of Operation and Troubleshooting

In the cooling mode it is not recommended to go below 70 degrees F on the thermostat. The lower the air temperature the colder the refrigerant has to be in the unit to continue removing heat. At 70 degrees the evaporator is at roughly 40 degrees to remove sufficient heat and humidity from the air. The water temperature also has an effect on the air conditioner in cooling mode. If the water temperature is 50 to 60 degrees that will cause the air conditioner refrigerant to run much colder than at 70 to 80 degrees. If you are in cooling mode at 70 degrees on the boat and 55 degree water, a small amount of frost formation on the unit is normal. At any time a block of ice or the whole unit covered in ice is not normal.

In heating mode the freezing effect will be focused on the water flow. If the pump fails or the water flow slows or stops for any reason the water coil can very rapidly freeze and crack causing unit failure. The freeze stat is installed to prevent this from happening but it is still not recommended to run the heat mode in water below 45 degrees F and the danger zone begins at 40 to 42 degrees F water.

High pressure switch activates (cooling mode):

When the high pressure switch activates the entire unit will stop operating. The fan, compressor, and pump will be turned off while the unit resets. Once the high pressure switch resets the thermostat should go into a brief delay mode to prevent short cycling the compressor. This can take up to 10 minutes to reset the cycle. The high pressure switch is automatically resetting but it should not be ignored.

In cooling mode if the high pressure switch is activating there is a water issue. The pump may have failed, the strainer plugged, the thru hull may have debris, etc. There are many reasons for the water flow to slow or stop. If the water flow is not adequate enough the unit will cycle on high pressure every time it runs which can cause damage to the air conditioner over an extended period of time. Check the pump and water circuit and maintain on a regular basis to keep water flow steady for the air conditioner.

If the water flow is strong and the unit is still going out on high pressure there may be build up and debris in the water coil which prevents the heat from being transferred from the refrigerant to the water. Periodically the water circuit and water coil need to be washed out and cleaned. The best way to do this is a mixture of “Barnacle Buster” and water in a bucket with a pump that you attached to the inlet side of the water loop or air conditioner and the flow leaves the water loop and air conditioner back into the bucket. Let this cycle for up to an hour to remove all the buildup and debris that has become lodged in the water coil. Do not let chemicals sit inside the water coil as they may damage the materials over time and create weak points. Once the flush has been completed rinse the circuit with water to clean out any chemical residue.

Theory Of Operation and Troubleshooting

High pressure switch activates (heating mode):

Same as the cooling mode, if the high pressure switch activates in the heating mode the fan, compressor, and pump will all shut off and allow the unit to reset. This can take up to 10 minutes before the unit will begin operating again.

In heat mode the unit is relying on airflow to prevent high pressure from occurring. If the filter is dirty, the ductwork is too small, there are too few vents, the blower is not working properly, etc. the unit will go off on high pressure. It is not recommended to run the heat mode when the air temperature is 80 degrees F or above and the water temperature should be lower than 80 degrees F down to 45 degrees F as a safe zone. Below 40 degrees F water is a danger zone for freezing. If the unit is ran in water that is too hot or the air is too hot the high pressure switch will activate quickly to prevent the unit from operating. Take note that an airflow problem may not present itself right away. Many systems can run with improper airflow for several hours before an issue will present itself. Please contact FMMS technical support for more assistance.

California Proposition 65 warning: California Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1996, requires that all products sold within the state of California must provide a warning if the product contains any of the current list of chemicals known to cause cancer, birth defects or other reproductive harm. Our units use solder to braze piping connections within the unit, and our optional installation kits include a bronze foot scoop and a bronze sea cock. Solder and bronze contain traces of lead, a chemical on the list of toxic substances. It is believed that the amount of exposure to lead is so minimal that it poses no significant risk. However in the spirit of the disclosure act, be advised that there are trace quantities of lead used in the manufacture of this product. The company has not undertaken the cost to demonstrate and prove that a exposure can occur at a level to pose no significant risk.

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