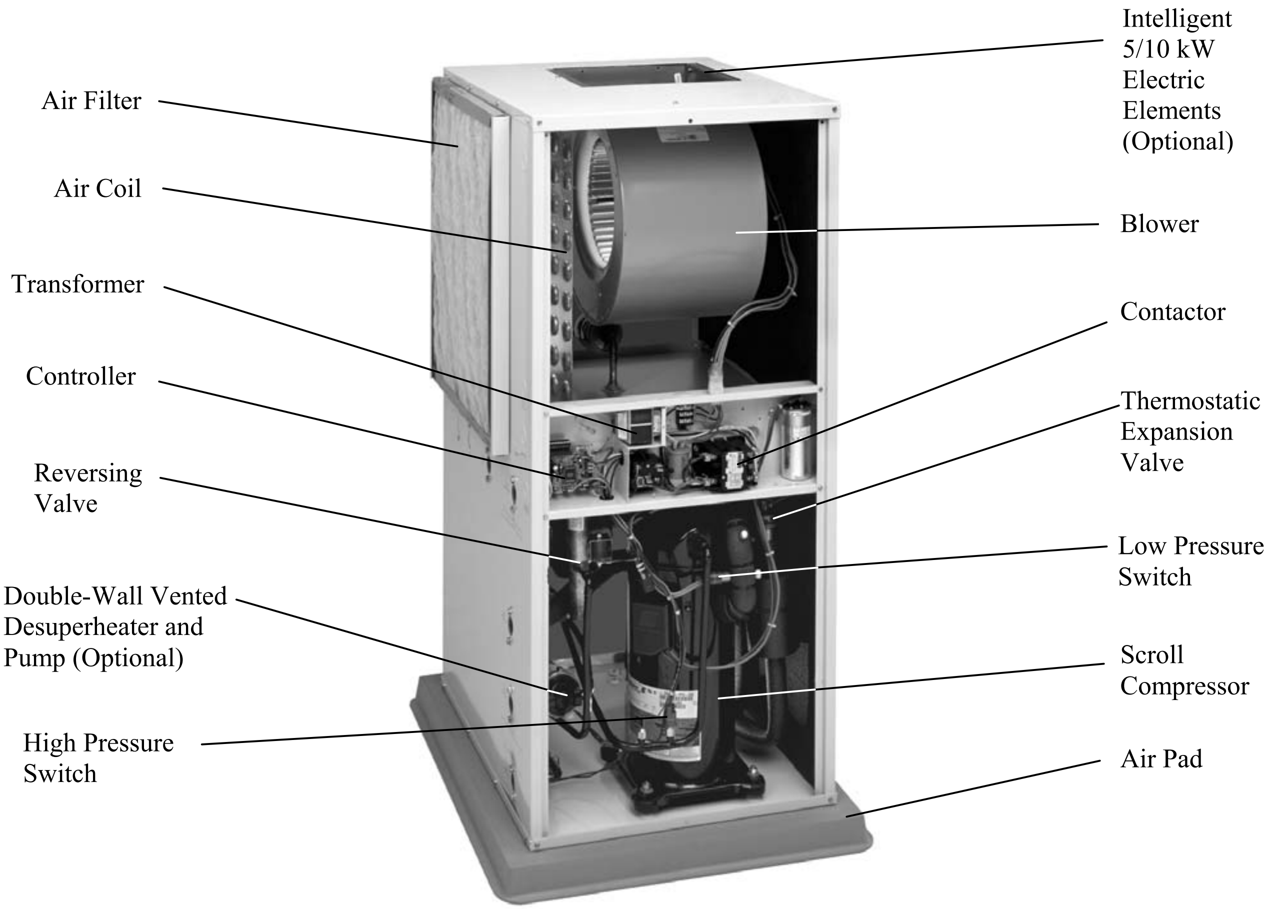
Installation and Operating Instructions

ECONAR®

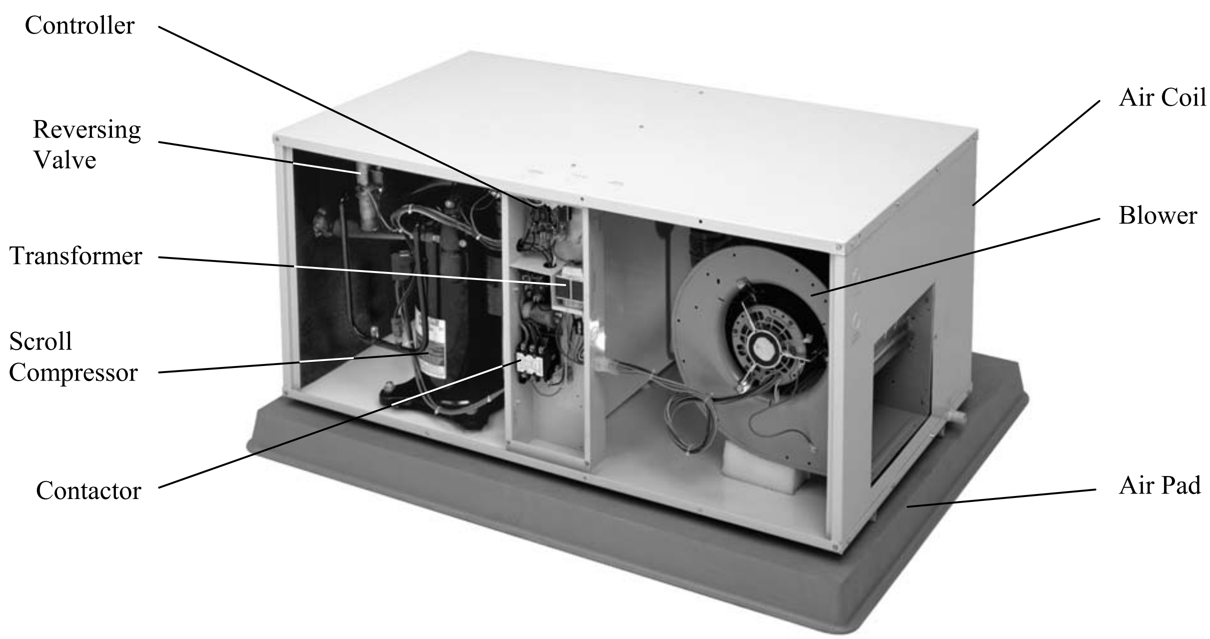
Vertical and Horizontal Forced Air
GV 17 Thru 77 and GH 17 Thru 110

GeoSource Ultra®

GeoSource Ultra® Vertical Unit



GeoSource Ultra® Horizontal Unit



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I. INTRODUCTION TO ECONAR HEAT PUMPS

ECONAR GeoSystems has been producing geothermal heat pumps in Minnesota for over twenty years. The cold winter climate has driven the design of ECONAR GeoSystems' heating and cooling equipment to what is known as a "Cold Climate" geothermal heat pump. This cold climate technology focuses on maximizing the energy savings available in heating dominated regions without sacrificing comfort. Extremely efficient heating, cooling, dehumidification and optional domestic hot water heating are provided in one neatly packaged GeoSystem.

Geothermal heat pumps get their name from the transfer of energy to and from the ground. The ground-coupled heat exchanger (geothermal loop) supplies the source energy for heating and absorbs the discharged energy from cooling. The system uses a compression cycle; much like your refrigerator, to collect the earth's energy supplied by the sun and uses it to heat your home. Since the process only moves energy and does not create it, the efficiencies are three to four times higher than the most efficient fossil fuel systems.

ECONAR produces three types of **GeoSource** heat pumps: hydronic heat pumps, which transfer energy from water to water; forced air heat pumps, which transfer energy from water to air; and combination heat pumps, which incorporate the hydronic heating of a water to water unit into a forced air unit. This guide discusses the **GeoSource Ultra® forced air** units. The **Ultra®** uses **R-410A** refrigerant, which is environmentally friendly to the earth's protective ozone layer.

Safety and comfort are both inherent to, and designed into ECONAR GeoSystems' geothermal heat pumps. Since the system runs completely on electrical energy, your entire home can have the safety of being gas-free. The best engineering and quality control is built into every ECONAR heat pump built. Proper application and correct installation will ensure excellent performance and customer satisfaction.

ECONAR's commitment to quality is written on the side of every heat pump we build. Throughout the build process, the technicians who build each unit sign their names to the quality assurance label after completing their inspections.

As a final quality test, every unit goes through a full run-test where the **performance and operation** is verified in both the heating and the cooling modes. No other manufacturer goes as far as to run a full performance check to ensure system quality.

☠**WARNING** – Service of refrigerant- based equipment can be hazardous due to elevated system pressures and hazardous voltages. Only trained and qualified personnel should install, repair or service. The installer is responsible to ensure that all local electrical, plumbing, heating and air conditioning codes are followed.

☠**WARNING – ELECTRICAL SHOCK CAN CAUSE PERSONAL INJURY OR DEATH.** Disconnect <u>all</u> power supplies before installing or servicing electrical devices. Only trained and qualified personnel should install, repair or service this equipment.

☠**WARNING** –Verify refrigerant type before servicing. The nameplate on the heat pump identifies the type and the amount of refrigerant. All refrigerant removed from these units <u>must</u> be reclaimed by following accepted industry and agency procedures.

✋**CAUTION** – Ground loops <u>must</u> be freeze protected. Insufficient amounts of antifreeze may cause severe damage and may **void warranty**. Never operate with ground loop flow rates less than specified. Continuous operation at low flow rates, or no flow, may cause severe damage and may **void warranty**.

✋**CAUTION** – R410A refrigerant requires extra precaution when service work is being performed. The operating pressures are approximately 150% higher than R-22 – which can cause personal injury. **Invasion into the refrigerant system <u>must be a last resort</u>**. Ensure all other diagnosis and methods have been used before attaching refrigerant instruments and before opening the refrigerant system. Synthetic oil (POE) is extremely hydroscopic, meaning it has a strong chemical attraction to moisture. Brief exposure to ambient air could cause POE to absorb enough moisture that a typical vacuum may not remove.

COMMON ACRONYMS

CFM	Cubic Feet per Minute
DHW	Domestic Hot Water
dP	Pressure Differential
EAT	Entering Air Temperature
ECM	Electronically Commutated Motor
EWT	Entering Water Temperature
GPM/gpm	Gallons per Minute
Ground Loop	Also known as Closed Loop
Ground Water	Also known as Open Loop
GTF	GeoThermal Transfer Fluid
HP	High Pressure
kW	Kilowatts
LP	Low Pressure
P/T	Pressure/Temperature
PSC	Permanent Split Capacitor
VA	Volt Amperes

II. UNIT SIZING

Selecting the unit capacity of a forced air geothermal heat pump requires three things:
A) Building Heat Loss/Heat Gain.
B) Ground Sources and Design Water Temperatures.
C) Temperature Limitations.

A. Building Heat Loss/Heat Gain

The space load must be estimated accurately for any successful HVAC installation. There are many guides or computer programs available for estimating heat loss and gain, including the ECONAR GeoSource Heat Pump Handbook, Manual J, and others. After the heat loss and gain analysis is completed, Entering Water Temperatures (EWT's) are established, and the heat pump can now be selected using forced air heat pump data in the Engineering Specifications. Choose the capacity of the heat pump based on both heating and cooling loads.

B. Ground-Sources and Design Water Temperatures

Ground sources include the Ground Water (typically a well) and the Ground Loop varieties. Water flow-rate requirements vary based on configuration. ECONAR's Engineering Specifications provide capacities at different loop water temperatures. **Note:** Table 1 shows the water-flow (GPM) requirements and water-flow pressure differential (dP) for the heat exchanger, and Table 2 shows the dP multiplier for various levels of freeze protection.

Table 1 – Ground-Side Flow Rate Requirements

Model	Ground Loop		50°F Ground Water	
	Flow (gpm)	dP* (psig)	Flow (gpm)	dP* (psig)
17 Series	5	2.2	3	0.9
27 Series	7	3.9	4	1.5
37 Series	8	2.8	5	1.2
47 Series	11	4.3	8	2.5
57 Series	13	6.1	9	3.1
67 Series	16	3.2	12	2.0
77 Series	16	5.6	12	3.2
87 Series	22	1.5	18	1.0
110 Series	30	2.6	20	1.2

* dP (psig) heat exchanger pressure drops are for pure water.
Note: dP values are for standard heat exchanger configurations. Cupro Nickel heat exchanger configurations for Ground Water applications have higher dP.

Table 2 – Heat Exchanger Pressure Differential (dP) Correction Factors for Freeze Protection (Typical)

Anti-Freeze	Percent Volume	Freeze Level	dP Multiplier			
			25°F	35°F	90°F	110°F
GTF[1]	50% GTF	12°F	125%	123%	N/a	N/a
Propylene Glycol	20%	18°F	136%	133%	118%	114%
	25%	15°F	145%	142%	N/a	N/a

[1] GTF = GeoThermal Transfer Fluid. 60% water, 40% methanol.

1. Ground Loop Systems

Loop systems use a high density polyethylene pipe buried underground to supply a tempered water solution back to the heat pump. Ground loops operate at higher flow rates than ground water systems because the entering water temperature (EWT) is lower. EWT affects the capacity of the unit in the heating mode, and loops in cold climates are normally sized to supply a wintertime EWT to the heat pump down to 25°F.

When selecting the heat pump, choose a unit that will supply the necessary heating or cooling capacity at the minimum and maximum ground loop EWT conditions respectively. Example; if a residential system requires 45,000 Btu/hr to heat a house on an earth loop system (designed for 32°F minimum winter EWT), and 40,000 Btu/hr to cool the house on an earth loop (designed for 77°F summer EWT), a GV47 **Ultra**® heat pump is required.

2. Ground Water Systems

☞**Note:** If a heat pump is installed with ground water, it should have a Cupro-Nickel water coil (GVxxx-x-Uxx**N**). Cupro-Nickel coils withstand well water much better than standard water coils.

The design water temperature will be the well water temperature in your geographic region for ground water systems. Typical well water temperatures are in the 50°F range in many cold climates. If well water temperatures are lower than 50°F (Canadian well water can be as low as 40°F) the flow rate must be increased to avoid leaving water temperatures below the freezing point. If well water temperatures are above 50°F (Some southern states are above 70°F) the flow rates may need to be increased to dump heat more efficiently in the cooling mode.

Varying well water temperatures will have little effect on unit capacity in the cooling mode (since the well is connected to the heat pump condenser), but can have large effects on capacity in the heating mode (since the well is connected to the evaporator). If well water temperatures exceed 70°F, special considerations, such as ground loop systems, should be considered.

C. Temperature Limitations

Be aware of the operating range of the geothermal system when sizing the particular heat pump to avoid premature equipment failure. Operating outside of these limitations may cause severe damage to the equipment and may **void warranty**.

✋**CAUTIONS;**
–The acceptable Ground Loop EWT is 15°F to 70°F for heating and 40°F to 95°F for cooling.
–The acceptable Ground Water EWT is 45°F minimum in heating and 70°F maximum in cooling.

III. UNIT LOCATION / MOUNTING

✋**CAUTION** – Units must be kept in an upright position during transportation and installation, or severe internal damage may occur. Bottom Discharge units are very "top heavy."

☞**Important** – To ensure easy removal and replacement of access panels, leave panels secured in place until the unit is set in place and leveled.

☞**Important** – Locate the unit in an indoor area where the ambient temperature will remain above 45^{o}F. Service is done primarily from the front. Top and rear access is desirable and should be provided when possible.

☞**Important** – A field installed drain pan is required under the entire unit where accidental water discharge could damage surrounding floors, walls or ceilings.

✋**CAUTION** – Do not use this unit during construction. Dust and debris may quickly contaminate electrical and mechanical components; resulting in damage.

✋**CAUTION** - Before driving screws into the cabinet, check on the inside of the unit to ensure the screw will not damage electrical, water, or refrigeration lines.

☞**Important** – Units must be mounted on a vibration-absorbing pad slightly larger than the base to provide isolation between the unit and the floor. Water supply pumps should not be hard plumbed directly to the unit with copper pipe; this could transfer vibration from the water pump to the refrigeration circuit, causing a resonating sound. Hard plumbing must be isolated from building structures that could also transfer vibration noise from the unit through the piping to the living space.

✋**CAUTION** – Always use plastic male fittings into plastic female or into metal female fittings. Never use metal male fittings into plastic female fittings. On metal-to-metal fittings, use pipe thread compound, do not use pipe thread tape, hand tighten first, and then only tighten an additional ½ turn with a tool if necessary. On plastic fittings, always use 2 to 3 wraps of pipe thread tape, do not use pipe thread compound, hand tighten first, and then only tighten an additional ½ turn with a tool if necessary. Do not over-tighten, or damage may occur.

IV. CONDENSATE DRAIN

Condensate traps are built into every **Ultra®** Vertical Top Discharge unit, so an external trap should not be installed.

☞**Important** – All Horizontal and Vertical units must be installed level to ensure proper condensate drainage.

✋**CAUTION** – Horizontal units have a ¾" FPT drain and require an external ¾" condensate vented trap in order to drain water from the heat pump.

✋**CAUTION** – Bottom Discharge (downflow) units have two ½" MPT drains; one for the condensate, and one for the cabinet. Each drain requires a separate external ¾" condensate-vented trap, and the unit must be elevated enough to provide clearance for the drain traps.

The line leaving the U bend of the condensate trap must be at least 3" below the base of the heat pump. This requires the U bend to be 6" below the unit to give the upward portion of the U bend a 3" lift (see Figure 1). The trap should be vented after the U bend. The line should be pitched away from the unit a minimum of 1/8" per foot. If the unit produces an odor in the cooling mode, the condensate trap or line may be plugged, or the unit may not be pitched correctly. Bleach may be poured down the condensate drain in the heat pump to kill any bacterial growth in the condensate line. Vented condensate traps are necessary to break the negative pressure in the air chamber and allow the condensate to flow. Construct condensate traps to the following diagram.

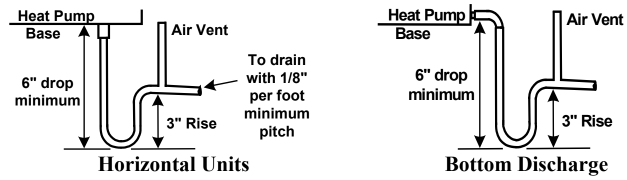


Figure 1 – Condensate Drain - Horizontal and Bottom Discharge Units Only

V. DUCT SYSTEM/BLOWER

Metal ductwork should be used, and flexible connectors are required for discharge and return air duct connections. An air inlet collar is provided on all **Ultra®** forced air units to connect the return duct. For acceptable duct sizes, see Table 3. If the duct is installed in an uninsulated space, it should be insulated on the outside to prevent heat loss, absorb noise, and prevent condensation from collecting on the ductwork.

☞**Important** – If the unit is connected to existing ductwork, the existing ductwork must have the capacity to handle the air volume required by the heat pump. Undersized ductwork will cause noisy operation due to high air velocity, poor operating efficiencies, and nuisance high, or low, pressure lockouts.

The **Ultra®** heat pump is standard with a 230 Volt three-speed Permanent Split Capacitor (**PSC**) blower motor. The motor can be set at three adjustment settings low, medium, or high at the fan terminal strip, located in the electrical box. The GH87 and GH110 have dual blowers. Refer to Table 4 for factory settings and CFM outputs.

The GV/H37-77 series is also available with an optional variable speed Electronically Commutated Motor (**ECM**) blower motor. The ECM motor converts 230 Volt AC to internal DC power and then modulates the DC power to turn the motor at various speeds. There are four different CFM outputs in each of the three blower speed ranges (Low, Medium, and High). Refer to Table 4 for factory settings and CFM outputs. ☞**Important** – The blower will not operate properly if ductwork is not attached. Ductwork supplies static pressure for the blower motor to work against. The blower compartment access door must be on for the unit to run properly. Blower motors may overheat if run for extended periods of time without a load. ☞Note – If problems occur, refer to the ECM Motor Troubleshooting Guide at the rear of this manual.

Table 3 - Duct Sizing Chart

	Acceptable Branch Duct Sizes		Acceptable Main or Trunk Duct Sizes	
CFM	**Round**	**Rectangular**	**Round**	**Rectangular**
100	6”	4x8, 4x6		
150	7”	4x10, 5x8, 6x6		
200	8”	5x10, 6x8, 4x14, 7x7		
250	9”	6x10, 8x8, 4x16		
300	10”	6x14, 8x10, 7x12		
350	10”	6x20, 6x16, 9x10		
400	12”	6x18, 10x10, 9x12	10”	4x20, 7x10, 6x12, 8x9
450	12”	6x20, 8x14, 9x12, 10x11	10”	5x20, 6x16, 9x10, 8x12
500			10”	10x10, 6x18, 8x12, 7x14
600			12”	6x20, 7x18, 8x16, 10x12
800			12”	8x18, 9x15, 10x14, 12x12
1000			14”	10x18, 12x14, 8x24
1200			16”	10x20, 12x18, 14x15
1400			16”	10x25, 12x20, 14x18, 15x16
1600			18”	10x30, 15x18, 14x20
1800			20”	10x35, 15x20, 16x19, 12x30, 14x25
2000			20”	10x40, 12x30, 15x25, 18x20
2200			22”	10x40, 15x25, 20x20
2400			22”	12x40, 16x25, 20x20
2600			22”	14x28, 15x25, 16x24, 20x20
2800			22”	14x30, 15x28, 16x25, 20x20
3000			24”	14x33, 15x30, 16x28, 20x22
3200			24”	16x30, 20x26

Tables calculated for 0.05 to 0.10 inches of water friction per 100’ of duct. At these duct design conditions, along with the pressure drop through the filter, the total design external static pressure is 0.20 inches of water.

Table 4 – PSC Fan Performance & Settings

		External Static Pressure – in WG				
Model	**Fan Speed**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**
17x-x-Uxxx Series	**Low** **Medium** **High***	550 610 675	520 580 650	490 550 625	460 530 600	445 510 580
27x-x-Uxxx Series	**Low** **Medium*** **High**	870 980 1090	825 935 1050	800 900 1000	775 870 965	750 845 940
37x-x-Uxxx Series	**Low** **Medium*** **High**	1005 1140 1210	965 1100 1150	935 1065 1110	890 1010 1070	855 965 1030
47x-x-Uxxx Series	**Low** **Medium** **High***	1325 1505 1685	1275 1450 1625	1235 1415 1550	1200 1375 1500	1165 1320 1435
57x-x-Uxxx Series	**Low** **Medium** **High***	1500 1700 1900	1450 1645 1850	1410 1595 1800	1360 1555 1740	1325 1500 1680
67x-x-Uxxx Series or 77x-x-Uxxx Series	**Low** **Medium** **High***	1900 2220 2410	1850 2185 2370	1800 2150 2325	1750 2110 2250	1690 2050 2200
87x-x-Uxxx Series	**Low** **Medium** **High**	2510 2840 3040	2390 2720 2920	2270 2600 2800	2200 2520 2730	2110 2430 2640
110x-x-Uxxx Series	**Low*[1]** **Medium** **High*[2]**	2510 3220 3530	2390 3140 3430	2270 3060 3340	2200 2970 3260	2110 2900 3170

*denotes factory setting. *[1]denotes factory setting for 1st stage. *[2]denotes factory setting for 2nd stage.

Table 5 – ECM Blower Speed Settings

Model	TAP	Low (G)	Medium(Y)	High (W/E)
37x-x-UxVx Series	D	485	1100	1210
47x-x-UxVx Series	C	680	1550	1705
57x-x-UxVx Series	B	790	1800	1920
67 or 77x-x-UxVx Series	A	940	2150	2300

Note: Adjust Tap set to "+" will increase these numbers by 10%.
Adjust Tap set to "-" will decrease these numbers by 10%.

VI. GROUND SOURCE DESIGN

Since water is the source of energy in the winter and the energy sink in the summer, a good water supply is possibly the most important requirement of a geothermal heat pump system installation.

A. Ground Loop Installation

A Ground Loop system circulates the same antifreeze solution through a closed system of high-density underground polyethylene pipe. As the solution passes through the pipe, it collects energy (in the heating mode) from the relatively warm surrounding soil through the pipe and into the relatively cold solution. The solution circulates to the heat pump, which transfers energy with the solution, and then the solution circulates back through the ground to extract more energy.

The **Ultra**® is designed to operate on either vertical or horizontal ground loop applications. Vertical loops are typically installed with a well drilling rig up to 200 feet deep, or more. Horizontal loops are installed with excavating or trenching equipment to a depth of about six to eight feet deep, depending on geographic location and length of pipe used. Loops must be sized properly for each particular geographic area, soil type, and individual capacity requirements. Contact ECONAR's Customer Support or the local installer for loop sizing requirements in your area.

Typical winter operating EWT to the heat pump ranges from 25°F to 32°F.
✋**CAUTION** – Ground Loops must be properly freeze protected. Insufficient amounts of antifreeze may result in a freeze rupture of the unit or can cause unit shutdown problems during cold weather operation. Propylene glycol and Geothermal Transfer Fluid (GTF) are common antifreeze solutions. GTF is a methanol-based antifreeze and should be mixed 50% with water to achieve freeze protection of 12°F. Propylene glycol antifreeze solution should be mixed 25% with water to obtain a 15°F freeze protection.
☞**Important** – Do not mix more than 25% propylene glycol with water in an attempt to achieve a lower than 15°F freeze protection, since more concentrated mixtures of propylene glycol become too viscous at low temperatures and cannot be pumped through the earth loop. Horizontal loops typically use GTF, and vertical loops typically use propylene glycol. **Note** – Always check State and Local codes for any special requirements on antifreeze solutions.

Flow rate requirements for ground loops are higher (see Table 1) than ground water systems because water temperatures are generally lower.
✋**CAUTION** – Never operate with flow rates less than specified. Low flow rates, or no flow, may cause the unit to shut down on a pressure lockout or may cause a freeze rupture of the heat exchanger.
☞**Important** – Figure 4 shows that Pressure/Temperature (P/T) ports must be installed in the entering and leaving water lines of the heat pump. A thermometer can be inserted into the P/T ports to check entering and leaving water temperatures. A pressure gauge can also be inserted into these P/T ports to determine the pressure differential between the entering and leaving water. This pressure differential can then be compared to the specification data on each particular heat pump to confirm the proper flow rate of the system.

An individually-sized ECONAR PumpPAK™ can supply pumping requirements for the Ground Loop fluid, and can also be used to purge the loop system. ☞**Note** – Refer to instructions included with the PumpPAK™ for properly purging the ground loop.
☞**Important** – the pump must be installed to supply fluid into the heat pump.

Filling and purging a loop system are very important steps to ensure proper heat pump operation. Each loop must be purged with enough water flow to ensure a two feet per second flow rate in each circuit on the loop. This normally requires a 1½ to 3 HP high head pump to circulate fluid through the loop to remove all the air out of the loop and into a purging tank. Allow the pump to run 10 to 15 minutes after the last air bubbles have been removed. After purging is completed, add the calculated proper amount of antifreeze to give a 12°F to 15°F freeze protection. After antifreeze has been installed and thoroughly circulated, it should be measured with a hydrometer, refractometer or any other suitable device to determine the actual freezing point of the solution.

The purge pump can be used to pressurize the system for a final static pressure of 30-40 psig after the loop pipe has had enough time to stretch. In order to achieve the 30 to 40 psig final pressure, the loop may need to be initially pressurized to 60-65 psig. This static pressure may vary 10 psig from heating to cooling season, but the pressure should always remain above 20 psig, so circulation pumps do not cavitate or pull air into the system. ☎Contact your local installer, distributor or factory representative for more information.

B. Ground Water Installation

A Ground Water system gets its name from the open discharge of water after it has been used by the heat pump. A well must be available that can supply all of the water requirements (see Table 1) of the heat pump for up to 24 hours/day on the coldest winter day plus any other water requirements drawing off that same well.

Figure 5 shows the necessary components for ground water piping. First, a bladder type pressure tank with a “draw down” of at least 1½ times the well pump capacity must be installed on the supply side of the heat pump. Shut off valves and boiler drains on the entering and leaving water lines are necessary for future maintenance.
☞**Important** – A screen strainer must be placed on the supply line with a mesh size of 40 or 60 and enough surface area to allow for particle buildup between cleanings.
☞**Important** – Pressure/Temperature (P/T) ports must be placed in the supply and discharge lines so that thermometers or pressure gauges can be inserted into the water stream.
☞**Important** – A visual flow meter must be installed to allow visual inspection of the flow to determine when maintenance is required. (If you can’t read the flow, cleaning is required. See Water Coil Maintenance for cleaning instructions.)

A solenoid control valve must be installed on the water discharge side of the heat pump to regulate the flow through the unit. Wire the solenoid to the “Plug, Accessory” connector on the controller. This valve opens when the unit is running and closes when the unit stops.

Schedule 40 PVC piping, copper tubing, polyethylene or rubber hose can be used for supply and discharge water lines. Make sure line sizes are large enough to supply the required flow with a reasonable pressure drop (generally 1” diameter minimum).

Water discharge is generally made to a drain field, stream, pond, surface discharge, tile line, or storm sewer.
☞**Important** – ensure the discharge line has a pitch of at least three inches per 12 feet, has a minimum 2 feet of unobstructed freefall at the end of the line, and has at least 100 feet of unobstructed grade sloping away from the discharge outlet.
✋**CAUTION** – A drain field requires soil conditions and adequate sizing to ensure rapid percolation. Consult local codes and ordinances to assure compliance. **DO NOT** discharge the water into a septic system.
✋**CAUTION** – Never operate with flow rates less than specified. Low flow rates, or no flow, may cause the unit to shut down on a pressure lockout or may cause a freeze rupture of the heat exchanger.

1. Ground Water Freeze Protection

✋**CAUTION** – Only specifically ordered equipment with a factory-installed 60 psig low-pressure switch can be used on ground water applications. (The low-pressure switch on a ground loop system has a 35 psig (previously 50) nominal cutout pressure.) If the water supply to the heat pump were interrupted for any reason, continued operation of the compressor would cause the water remaining in the heat exchanger to freeze, rupture the heat exchanger and may **void warranty**.

2. Water Coil Maintenance

Water quality is a major concern for ground water systems. Problems can occur from scaling, particle buildup, suspended solids, corrosion, pH levels outside the 7-9 range, biological growth, or water hardness of greater than 100-PPM. If poor water quality is known to exist in your area, a cupro-nickel water coil may be required when ordering the system; or installing a ground loop system may be the best application. Water coil cleaning on ground water systems may be necessary on a regular basis. Depending on the specific water quality, the water coil can be cleaned by the following methods **(Note** – always remember to clean the strainer.):

a. Chlorine Cleaning (Bacterial Growth)

1. Turn off all power to the heat pump during this procedure.
2. Close the shut-off valves upstream and downstream of the heat exchanger.
3. Connect a submersible pump to the hose bibs on the entering and leaving-water sides of the heat exchanger for reverse-direction flow.
4. Submerse the pump in a 5-gallon pail of water with enough chlorine bleach to kill the bacteria. Suggested mixture is 1 part chlorine bleach to 4 parts water.
5. Open the hose bibs to allow circulation of the solution.
   ✋**CAUTION** – DO NOT allow the chlorine mixture to stand idle in the heat exchanger.
6. Start the pump and circulate the solution through the heat exchanger for about 15 minutes with at least 150% of the normal rated flow rate. The solution should change color to indicate the chlorine is killing and removing the bacteria from the heat exchanger.
7. Flush out the used solution by adding a fresh water supply to the pail. Repeat until the leaving water is clear.

This procedure can be repeated annually, semiannually, or as often as it takes to keep bacteria out of the heat exchanger, or when bacteria appears in the visual flowmeter to the point the flow cannot be read.

Another alternative to bacteria problems is to shock your entire well. Shocking the well may give longer term relief from bacteria problems than cleaning the heat exchanger, but will probably need to be repeated, possibly every three to five years. ☎Contact a well driller in your area for more information.

b. Muratic Acid Cleaning (Difficult Scaling and Particle Buildup Problems)

1. ☠**WARNING** – Consult installer because of the dangerous nature of acids. Only an experienced and trained professional should perform this procedure. (**Note** – Use Oxalic Acid, CLR, Iron-Out or other de-scaling products before using Muratic Acid.)
2. Turn off all power to the heat pump during this procedure.
3. Close the shut-off valves upstream and downstream of the heat exchanger.
4. Connect a submersible circulating pump to the hose bibs on the entering and leaving water sides of the heat exchanger for reverse-direction flow. **Note** – these are corrosive chemicals. Use disposable or suitable pump.
5. Submerse the pump in a five-gallon pail of water with a small amount of muratic acid to create a final concentration of 5% muratic acid.
   ☠**WARNING** – Always add acid to water; never add water to acid.
6. Open the hose bibs to allow circulation.
7. Start the pump and circulate the solution through the heat exchanger for about 15-30 minutes with at least 150% of the normal rated flow rate.
8. Flush out the used solution by adding a fresh water supply to the pail. Repeat until the leaving water is clear. **Note** – observe local codes for disposal.

c. Freeze Cleaning (scale/particle buildup)

<u>This applies only to Cupro Nickel heat exchangers, cylinder shape, used on Ground Water Applications.</u>
☠**WARNING** – Never attempt this process on a braze plate heat exchanger. It could cause the braze plate heat exchanger to rupture and may **void warranty**.

I. Before using the freeze cleaning procedure, verify it needs to be done by answering the following questions.

1. Determine and verify that the required water flow rate in GPM is both present and correct.
2. Determine the temperature differential of the water. Under normal conditions in the cooling mode, there should be a temperature difference of about 10-15°F between the supply side and discharge side. If the temperature difference is 8°F or less, consideration should be given to cleaning the water coil.

II. If the water coil requires cleaning, <u>carefully</u> use the following steps for the freeze cleaning method.

1. Turn off the heat pump and its water supply.
2. Open a plumbing connection on the water supply side, if possible, to break the system vacuum and allow easier drainage of the system and water coil.
3. Drain the water out of the system and water coil via the boiler drains on the entering and leaving water lines, and the drain on the heat exchanger.

☠<u>**WARNING** – FAILURE TO</u> COMPLETELY DRAIN THE WATER COIL HEAT EXCHANGER COULD FREEZE RUPTURE THE HEAT EXCHANGER!

4. Set the thermostat to "Heat" to start the heat pump in the heating mode and quickly freeze the coil.
5. Allow the heat pump to run until it automatically shuts off on low pressure and then turn the thermostat to the "Off" position.
6. Recap the water coil drain and tighten any plumbing connections that may have been loosened.
7. If so equipped, open the field installed drain cock on the water discharge side of the heat pump, and install a short piece of rubber hose to drain into a drain or bucket. A drain cock on the discharge side allows water flow to bypass the solenoid valve, flow valve, flow meter, or any other item that may be clogged by mineral debris. Draining to a bucket helps prevent clogging of drains and allows observing effectiveness of the procedure.
8. Turn on the water supply to the heat pump to start the process of flushing any mineral debris from the unit.

9. Set the thermostat to "Cool" and start the heat pump in the cooling mode to quickly thaw out the water coil.
10. Run the heat pump until the water coil is completely thawed out and loosened scale, mineral deposits, or other debris is flushed completely from the water coil. Allow at least 5 minutes of operation to ensure that the water coil is thoroughly thawed out.
11. If the water still contains mineral debris, and if the flow through the unit did not improve along with an increase in the temperature difference between the water supply and water discharge, repeat the entire procedure.
12. Reset the heat pump for normal operation.

VII. ELECTRICAL SERVICE

☞**Note** – Always refer to the inside of the electrical box cover for the **correct wiring diagram**, and always refer to the nameplate on the exterior of the cabinet for the **correct electrical specifications**.

☠**WARNING – ELECTRICAL SHOCK CAN CAUSE PERSONAL INJURY OR DEATH.** Disconnect all power supplies before installing or servicing electrical devices. Only trained and qualified personnel should install, repair or service this equipment.

☠**WARNING – THE UNIT MUST BE PROPERLY GROUNDED!**

The main electrical service must be protected by a fuse or circuit breaker, and be capable of providing the amperes required by the unit at nameplate voltage. All wiring shall comply with the national electrical code and/or any local codes that may apply. Access to the line voltage contactor is through the knockouts provided on either side of the heat pump next to the front corner. Route EMT or flexible conduit with appropriate size and type of wire.

Ensure adequate supply wiring to minimize the level of dimming lights during compressor startup on single-phase installations. Some dimming is normal, and a variety of start-assist accessories are available if dimming is objectionable. ☞**Important** – some models already have a factory-installed start assist. Do not add additional start assists to those units.

✋**CAUTION** – Route field electrical wiring to avoid contact with electrically live bare metal parts inside the electrical box and to avoid contact with the surface of the factory-installed start assist (if provided).
✋**CAUTION** – Disconnect the power from the unit before removing or replacing any connectors, or servicing the blower motor.
✋**CAUTION** – When servicing an ECM blower motor, disconnect power and wait at least 5 minutes before opening the motor to avoid electric shock from the motor's internal capacitors.

✋**CAUTION** – Three-phase units must be wired properly to ensure proper compressor rotation. Improper rotation may result in compressor damage. An electronic phase sequence indicator must be used to check supply-wiring phases. Also, the "Wild" leg of the three-phase power must be connected to the middle leg on the contactor.
☞**Important** – Only the ECONAR PumpPAK™ is certified to be wired directly to the compressor contactor and can be grounded in the grounding lug for 208/230Vac. An alternative loop pump or a pump for a different supply voltage must be powered from a separate fused power supply and controlled through an isolation relay that has its coil wired to the contactor circuit.
☞**Important** – Units with internal installed Supplemental Electric Heat require a separate power supply for the Supplemental Electric Heat.

For units with the PSC blower motor, an internal relay provides the power through the 3-pole terminal block (BF) for the forced-air blower motor. To change blower speeds, move the blower motor wire on BF to the desired speed. The effect of changing the blower speed setting on CFM output is shown in Table 4.

VIII. 24 VOLT CONTROL CIRCUIT

☞**Note** – Always refer to the inside of the electrical box cover for the **correct wiring diagram**.

There are three basic sections of the low voltage circuit; transformer, thermostat, and controller.

A. Transformer

An internal transformer provides 24Vac for all control features of the heat pump. Even though the transformer is larger than the industry standard, it is in a warm electrical box and can be overloaded quickly. Table 5 shows the transformer usage.

Table 5 – Transformer Usage (VA)

Component	Usage (VA)			
	17-77 UxOx	**37-77 UxVx**	**87 UxOx**	**110 UxTx**
Contactor	7	7	16	7 (2)
Reversing Valve	8	8	8	8
Controller 20-1038	2	2	2	2
Thermostat	1	1	1	1
Blower Motor	---	2	---	---
Blower Relay	6	---	6	6 (2)
Elec. Heat Relay (2)	6	6	---	---
Plug Accessory (PA)	10	10	10	5
Total	**40 VA**	**36 VA**	**43 VA**	**42 VA**
Transformer VA size	**55**	**55**	**55**	**55**

☞**Important** - If the system's external controls require more than shown in table 5, an external transformer and isolation relays should be used.
☞**Important** – Miswiring of 24Vac control voltage on

system controls can result in transformer burnout.
☞**Important** – Units with a dual voltage rating (example, 208/230) are factory-wired for the higher voltage (example, 230). If connected to a power supply having the lower voltage, change the wiring to the transformer primary to the correct lead; otherwise premature failure, or inability to operate the control components may occur.

B. Thermostat

At a minimum, a 1-heat/1-cool heat pump thermostat must be used. If the unit is equipped with supplemental electric heat, a 2-heat/1-cool heat pump thermostat must be used. ☞**Note** – use a 2-heat/2-cool heat pump thermostat for stage control of the GH110; or, connect the Y and Y2 inputs together for use with a 1-heat/1-cool thermostat. The thermostat controls all stages of operation of the heat pump. Initiation of each stage is implemented based on the recovery rate of the actual temperature to the set point temperature. This means that switching to a higher stage will require time (sometimes 15 minutes or more) for the thermostat to calculate rate of change. Consult the instructions in the thermostat box for proper mounting, Installer Set-up, and operation.
☞**Important** – Be careful to select a thermostat location where external temperature sources will not affect sensed temperature.
☞**Important** – If a single thermostat controls multiple heat pumps, the control wiring of the heat pumps must be isolated from each other with isolation relays to avoid excessive voltages or overheating and premature failure of the control components.
☞**Important** – Thermostat cable with at least eight conductors must be run from the heat pump to the thermostat. Power is supplied to the thermostat by connecting the R and X (C) terminals to the heat pump terminal strip.

C. Controller

The controller receives a signal from the thermostat and initiates the correct sequence of operations for the heat pump. The controller performs the following functions:

1. Compressor Anti-Short-Cycle
2. Compressor Control
3. Ground Loop Pump / Ground Water Initiation
4. Compressor Staging
5. Blower Motor Control
   a. PSC Blower Operation and Speed Control (-UxOx
   b. ECM Blower Operation and Speed Contro (-UxVx)
6. Supplemental Electric Heat for 2nd Stage Heat
7. 4-Way Valve Control
8. Compressor Lockouts
9. Air Coil Defrost
10. System Diagnostics
11. 24Vac Fuse
12. Plug Accessory
13. Alarm Output

1. Compressor Anti-Short-Cycle

An Anti-Short-Cycle (ASC) is a delay period between the time a compressor shuts down and when it is allowed to come on again. This protects the compressor and avoids nuisance lockouts for these two conditions;

1. A 70 to 130-second random time-out period occurs before a re-start after the last shut down.
2. A 4-minute/25-second to 4-minute/45-second random-start delay occurs immediately after power is applied to the heat pump. This occurs only after reapplying power to the unit. To reduce this timeout delay while servicing the unit, apply power, disconnect and reapply power very quickly to shorten the delay.

☞**Note** - The thermostat supplied with the heat pump may also have a five-minute delay period after compressor shutdown before it will start again. A "Wait" indicator on the thermostat shows this delay. This delay can be reprogrammed to be from zero to 5 minutes.

2. Compressor Control

When 24Vac is applied to the Y terminal on the controller wiring block, the controller decides, based on lockout and anti-short-cycle periods, when to turn on the compressor contactor. The M1 output of the controller energizes the contactor until 24Vac is removed from the Y terminal.

3. Ground Loop Pump / Ground Water Initiation

On ground loop systems, a M1 output from the controller energizes the contactor to start the compressor and the ground loop pump. For Ground Water systems, the M1 output will also energize the ground water solenoid valve through the "Plug Accessory" connector.

4. Compressor Staging (-UxTx)

The GH110 has staged compressors controlled with separate Y and Y2 inputs. The M1 output of the 20-1038 controller energizes the first compressor contactor and the time delay (adjustable 10 to 1000 seconds; factory set at 10). After the time-out delay, a Y2 input can energize the 2nd compressor contactor. ☞**Note** – Ensure there is always a delay time between the operation of the two compressors to avoid nuisance low-pressure lockouts.

5.a. PSC Blower Operation and Speed Control (-UxOx)

When 24Vac is applied to the G terminal on the controller wiring block, the controller passes this 24Vac power directly to the blower motor relay. The GH87 has dual blowers controlled by one blower relay. The GH110 has dual blowers controlled by one blower relay for on/off at low speed when one compressor runs and by a second relay for speed change when both compressors run.

5.b. ECM Blower Operation and Speed Control (-UxVx)

When 24Vac is applied to the G terminal on the controller wiring block, the controller will energize the blower to operate at Low(G) speed. If 24Vac is applied to both G and Y (during 1st-stage operation), the controller will energize the blower to operate at Medium(Y) speed. An input to W2 (2nd stage heat) or E (Emergency heat) from the thermostat energizes the blower in High speed. These blower speeds are shown in Table 5.

The CFM outputs are factory set, and should not be changed in the field. There is an Adjust setting, which allows the blower to be operated at +/-10% of the factory setting. For example, if the Adjust tap is set to the "-", all the speeds will operate at 90% of the factory setting. If the Adjust tap is set to the "+", all the speeds will operate at 110% of the factory setting. The Adjust tap is the only tap on the Blower Speed Controller that should ever be moved from the factory setting.

☞**Important** – Power to the unit has to be interrupted for a few seconds to enable new ECM speed settings. The blower motor has internal circuitry that will maintain the selected CFM when changes occur in the external static pressure, such as the filter getting dirty. The motor does this by increasing its torque output to compensate for external duct static pressure resistance changes.

☞**Important** – The ECM motor is Factory programmed with soft start and soft stop speed profiles to ensure the blower motor softly ramps to the proper CFM. Ramping provides quieter operation and increased comfort. It may take a few seconds for the blower to start when the thermostat initially calls for heating or cooling, and for the blower to stop after the thermostat is satisfied.

6. Supplemental Electric Heat for 2nd Stage Heat and for Emergency Heat Mode

The **Ultra® Top Discharge** vertical units have the option of factory-installed electric supplemental heat. Use a separate duct-installed heater for Bottom Discharge and Horizontal applications.) This provides an extra 5 kilowatts (approximately 17,000 BTU/hr) of supplemental heat when the room thermostat calls for auxiliary heat and provides 10 kilowatts (approximately 34,000 BTU/hr) of backup heat when the room thermostat is set to the emergency heat mode. The heater can also be wired to supply the full 10kW during either supplemental or emergency heat modes.

☞**Important** – A jumper plug on the 20-1038 controller (marked J2) ties W2 signal to E. This jumper plug must be removed for 5 kW of supplemental heat and 10 kW of emergency heat. If the J2 jumper is not removed, the heater will supply the full 10 kW during either supplemental or emergency heat modes.

7. 4-Way Valve Control

When 24Vac is applied to the O terminal on the wiring block, the controller energizes its O output to provide 24Vac power to the 4-way reversing valve to switch the refrigerant circuit to the cooling mode.

8. Compressor Lockouts

The controller will lock out the compressor if either the high-pressure 600 psig or the low-pressure 35 psig (previously 50) on ground loop or 60 psig on ground water switch opens. This lockout condition means that the unit has shut down to protect itself, and will not come back on until power has been disconnected (via the circuit breaker) to the heat pump for one minute. Problems that could cause a lockout situation include:

1. Low water flow or extreme water temperatures
2. Low air flow or extreme air temperatures
3. Cold ambient air temperature conditions
4. Internal heat pump operation problems.

☎If a lockout condition exists, the heat pump should not be reset more than once; **and a service technician should be called immediately.**

✋**CAUTION** – Repeated reset may cause severe damage to the system and may **void warranty**. The cause of the lockout <u>must</u> be determined and corrected.

9. Air Coil Defrost

Restricted airflow in the cooling mode, caused by a dirty air filter or airside heat exchanger, may result in an iced up air coil and/or low suction pressure. The controller will automatically switch the heat pump to defrost mode if the low-pressure switch opens during the cooling mode: the O output will be de-energized to run the unit in heating, the blower will continue to run, and the Low Pressure indicator light will blink. This defrost mode will last for approximately 80 seconds, then the unit will go to the 70-130-second time-out re-start delay. After the delay times out, the heat pump will resume normal operation.

✋**CAUTION** – If the heat pump continually goes to the air coil defrost mode, a service technician should be called immediately.

10. System Diagnostics

The controller is equipped with diagnostic LED lights that indicate the system status at any particular time. The lights indicate the following conditions:

1.	24 Volt system power	GREEN
2.	Fault or Lockout	YELLOW
3.	Anti-short-cycle mode	RED

If a room thermostat installed with the heat pump system has a lockout indicator, the controller will send a signal from L on the terminal strip to a LED on the thermostat to indicate a lockout condition.

11. 24 Vac Fuse

The controller has a glass-cartridge fuse located on the circuit board adjacent to the 24Vac power connector. The green system power LED will be off if this fuse is open. A spare fuse is located in the saddle attached to the side of the 24Vac power connector.☞**Note** – Ensure the new fuse fits tightly in the fuse clips after replacement.

12. Plug Accessory (PA)

The Plug Accessory output is internally connected to the M1 output and is energized whenever M1 turns on the compressor contactor. The maximum rating of this output is 10VA sealed and 20VA inrush and is typically intended to power a 24Vac ground water solenoid valve.

13. Alarm Output

This output is a 2-position screw terminal connector identified as "Fault Test" on the controller board and as DO on the wiring diagram. It is an isolated dry contact output (0.1 ohm resistance) that closes during a controller lockout and is intended for use as an input to a dial-out type of monitoring system. The maximum electrical rating is 2mA up to 30Vac or 50mA up to 40Vdc.

IX. STARTUP / CHECKOUT

Before applying power to the heat pump, check the following items:

- Water supply plumbing to the heat pump is completed and operating. Manually open the water valve on well systems to check flow. Make sure all valves are open and air has been purged from a loop system. Never operate the system without correct water flow.
- All high voltage and low voltage wiring is correct and checked out, including wire sizes, fuses and breakers. Set thermostat to the "OFF" position.
- The heat pump is located in a warm area (above 45^{o}F). Starting the system with low ambient temperature conditions is more difficult. Do not leave until the space is brought up to operating temperatures.

You may now apply power to the unit. A 4-minute/35-second delay on power up is programmed into the heat pump before the compressor will operate. During this time you can verify airflow with the following procedure:

- Place the thermostat in the "FAN ON" position. The blower should start in low speed. Check airflow at the registers to make sure that they are open and that air is being distributed throughout the house. When airflow has been checked, move the thermostat to the "FAN AUTO" position. The blower should stop.

The following steps will ensure the system is heating and cooling properly. After the initial time-out period, the red indicator light on the controller will shut off. The heat pump is now ready for operation.

- With the thermostat in the "HEAT" mode, turn it up to its highest temperature setting. The compressor should start, with the blower starting a few seconds later. The thermostat may have its own compressor delay (shown by "Wait" on the thermostat), but the compressor will start after all delays.
- After running the unit for 5 minutes, check the airside return and supply temperatures. An air temperature rise of 20^{o}F to 30^{o}F is normal in the heating mode, but variations in water temperature and water flow rate can cause variations outside the normal range. Use a single pressure gauge to check the fluid pressure drop through the ground-side heat exchanger to ensure proper flow for the system.
- Turn the thermostat to the "OFF" mode. The compressor will shut down in a few seconds, with the blower stopping shortly after.
- Next, set the thermostat to "COOL" and turn down to its lowest setting. The compressor will start after an anti-short cycle period of 70 to 130 seconds from it's last shutdown, and the blower will start a few seconds later. The anti-short cycle period is indicated by the red light (labeled ASC) on the controller.
- After the unit has run in cooling for 5 minutes, check the airside return and supply temperatures. An air temperature drop of 15^{o}F to 20^{o}F is normal in the cooling mode but airflow and humidity can affect temperature drop.
- Set the thermostat for normal operation.
- Instruct the owner on the correct operation of the entire heat pump system. The unit is now operational.

X. SERVICE and LOCKOUT LIGHTS

Properly installed, the ECONAR **Ultra**® heat pump requires only minor maintenance, such as periodic cleaning of the air coil, air filter, and the ground water heat exchanger on a Ground Water system. Setting up regular service checkups with your ECONAR dealer should be considered. Any major problems with the heat pump system operation will be indicated on the lockout lights.

✋**CAUTION** – During evacuation of refrigerant of a system not having antifreeze protection of a water-side heat exchanger, water in the unprotected heat exchanger must be removed or continuously flowing to avoid a potential heat exchanger failure caused by freeze rupture.

✋**CAUTION** – Service on systems using R410A refrigerant requires special consideration (Refer to ECONAR Instruction 10-2016 for more detail.). Always install a new filter/dryer after replacing a refrigeration component (compressor, etc.) and evacuate down to 150 microns.

A. Lockout Lights

The heat pump controller and room thermostat will display a system lockout. If lockout occurs, follow the procedure below:

1. Determine and record which indicator lights on the Controller are illuminated. (Refer to Section XIII for more information on possible causes of Lockout Conditions.)
2. Check for a clean air filter, correct air-flow, and correct water supply from the ground loop or ground water system.
3. Reset the system by disconnecting power at the circuit breaker for one minute, and then reapplying power.
4. If shutdown reoccurs, ☎ call your ECONAR dealer. **Do not continuously reset the lockout condition or damage may occur. ☞Note – Improper fluid flow, incorrect airflow, or incorrect antifreeze levels are the cause of almost all lockouts.**

B. Air Filter

The **Ultra**® forced air heat pump includes a disposable air filter. This filter should normally be replaced once a month during normal usage, or more frequently during extreme usage or if system performance has decreased.

A dirty filter will increase static pressure to the system and decrease the amount of airflow (CFM) for a PSC blower motor. If a variable speed ECM blower is being used, an increase in static pressure will cause the variable speed blower to increase its speed in order to maintain airflow levels. In extreme cases, the blower will not be able produce the correct amount of airflow. These system changes will cause the unit to consume more power than normal, reducing the efficiency of the system. In the heating mode, reduced airflow may increase the cost of operation and, in extreme cases, cause system lockout due to high refrigerant pressures. In the cooling mode, reduced airflow may reduce cooling capacity and, in extreme cases, ice the air coil over causing system shutdown due to low refrigerant pressures.

If a different filter is used in place of the factory-supplied filter, it should also be cleaned or changed in a timely manner. Be careful in selecting optional filters so that excessive external resistance to airflow does not occur.

C. Preseason Inspection

Before each season, the air coil, drain pan, and condensate drain should be inspected and cleaned as follows:

- Turn off the circuit breakers.
- Remove the access panels.
- Clean the air coil by vacuuming it with a soft-brush attachment.
- Remove any foreign matter from the drain pan.
- Flush the pan and drain tube with clear water.
- Replace the access panels and return power to the unit.

D. Ground Water Heat Exchanger

Refer to Section VI.B.2 for details.

XI. ROOM THERMOSTAT OPERATION

Installations may include a wide variation of available electronic room thermostats, and most of them require to be configured by the Installer (according to the Installation Guide included with the thermostat) and checked out after being installed.

☞**Important** – At a minimum:

1. Ensure the thermostat is set up for the “System Type” it is installed on.
2. Ensure the thermostat is configured for “Manual Heat/Cool Changeover.”
3. Change other Installer Settings only if necessary.
4. Remember to press “Done” to save the settings and to exit “Installer Setup.”
5. Run the system through all modes of operation in the thermostat instructions to ensure correct operation.

If you have additional questions, please refer to the installation manual that was sent with the thermostat.

XII. DESUPERHEATER (OPTIONAL)

A **Ultra**® heat pump equipped with a double-wall vented desuperheater can provide supplemental heating of a home’s domestic hot water by stripping some energy from the superheated gas leaving the compressor and transferring it to a hot water tank. A desuperheater pump, manufactured into the unit, circulates water from the domestic hot water tank, heats it and returns it to the tank. The desuperheater only provides supplemental heating when the compressor is already running to heat or cool the conditioned space. Because the desuperheater is using some energy from the heat pump to heat water, the heat pump's capacity in the winter is about 10% less than a unit without a desuperheater. During extremely cold weather, or if the heat pump cannot keep up with heating the space, the desuperheater fuse may be removed to get full heating capacity out of the unit.

☠**WARNING** – Do not remove the desuperheater's high temperature cutout switch, or tank temperatures could become dangerously high. The desuperheater's high temperature cutout switch is located on the return line from the water heater and is wired in series with the desuperheater pump to disable it from circulating at entering water temperatures above 140°F. If the tank temperatures become uncomfortably hot, move this switch to the leaving water line, which will reduce the tank maximum temperatures 10°F to 15°F.

✋**CAUTION** – Running the desuperheater pump without water flow will damage the pump. **A fuse is attached to the fuseholder and must be inserted in the fuseholder after the desuperheater is purged and operational.**

☞**Important** – Do not insert the fuse until water flow is available and the desuperheater is completely purged of air, or the pump may be damaged. Remove the fuse to disable the pump if the desuperheater isn't in operation.

All air must be purged from the desuperheater plumbing before the pump is engaged. To purge small amounts of air from the lines, loosen the desuperheater pump from its housing by turning the brass collar. Let water drip out of the housing until flow is established, and re-tighten the brass collar. Using 1/2-inch copper tubing from the tank to the desuperheater inlet is recommended to keep water velocities high, avoiding air pockets at the pump inlet. An air vent in the inlet line can also help systems where air is a problem. If one is used (recommend Watts Regulator brand FV-4 or Spirovent), mount it near the desuperheater inlet roughly 2-1/2 inches above the horizontal pipe. Shutoff valves allow access to the desuperheater plumbing without draining the hot water tank. Keep the valves open when the pump is running.

Desuperheater maintenance includes periodically opening the drain on the hot water tank to remove deposits. If hard water, scale, or buildup causes regular problems in hot water tanks in your area, it may result in a loss of desuperheater effectiveness. This may require periodic cleaning with Iron Out or similar products.

✋**CAUTION** – Insulated copper tubing must be used to run from the hot water tank to the desuperheater connections on the side of the unit.

The built-in desuperheater pump can provide the proper flow to the desuperheater if the total equivalent length of straight pipe and connections is kept to a maximum of 90 feet of ½-inch type L copper tubing (or a combination of approximately 60 feet with typical elbows and fittings). This tubing can be connected to the water tank in two ways:

METHOD 1

Using a desuperheater tee installed in the drain at the bottom of the water heater (See Figure 6). This is the preferred method for ease of installation, comfort and efficiency. The tee eliminates the need to tap into the domestic hot water lines and eliminates household water supply temperature variations that could occur from connecting to the hot water pipes. Poor water quality may restrict the effectiveness of using the desuperheater tee by plugging it with scale or buildup from the bottom of the tank, restricting water flow.

METHOD 2

Taking water from the bottom drain and returning it to the cold water supply line (See Figure 7). This method maintains the same comfort and efficiency levels but increases installation time and costs.

☞**Important** – This method requires a check valve in the return line to the cold water supply to prevent water from flowing backwards through the desuperheater when the tank is filling. Water passing through the pump backwards damages the rotor's bearing, which reduces pump life and causes noise problems in the pump.

☞**Note -** A spring-type check valve with a pressure-drop rating of 1/2 psig or less is recommended.

XIII. TROUBLESHOOTING GUIDE FOR LOCKOUT CONDITIONS

If the heat pump goes into lockout on a high or low pressure switch, the cause of the lockout can be narrowed down by knowing the operating mode and which pressure switch the unit locked out on. The following table will help track down the problem once this information is known. ☞**Note**- A lockout condition is a result of the heat pump shutting itself off to protect itself, never bypass the lockout circuit. Serious damage can be caused by the system operating without lockout protection.

	INDICATOR LIGHTS				
CONDITION	**PWR**	**ASC**	**LP**	**HP**	**COMMENTS**
AC power applied	Off	Off	Off	Off	Blown fuse or power removed or loose fuse clips.
AC power applied	X	X			ASC indicator on for 4' 35" on power initialization.
AC power applied	X				Power applied - unit running or waiting for a call to run.
Run cycle complete	X	X			ASC indicator ON for 70 to 130 seconds after compressor shutdown.
LOW PRESSURE INDICATOR					
Heating or Cooling – before Y call	X	X	Flash		-Check if Low Pressure switch is open. -Check electrical connections between Low Pressure switch and Controller.
Heating - during Y call	X	X	X		-Loss/lack of flow through ground-side heat exchanger. -Low fluid temperature operation in ground-side heat exchanger. -Freezing fluid in ground-side heat exchanger (lack of antifreeze). -Dirty (fouled) ground-side heat exchanger (on ground water systems). -Low ambient temperature at the heat pump. -Undercharged / overcharged refrigerant circuit. -Expansion valve / sensing bulb malfunction. -Excessive low return air temperature.
Cooling - during Y call	X	Cycle On and Off every few min.	Blink		-Freezing air coil (dirty air filter or air coil, undercharged refrigerant circuit) -Missing blower compartment access panel. -Loss/lack of airflow (dirty filter, closed vents, blower, restricted ductwork, etc.) -Low return air temperature. -Low ambient temperature at the heat pump. -Undercharged / overcharged refrigerant circuit. -Expansion valve / sensing bulb malfunction. -Excessively low fluid temperature in the ground side heat exchanger.
HIGH PRESSURE INDICATOR					
Heating or Cooling – before Y call	X			X	-Check if High Pressure switch is open. -Check electrical connections between High Pressure switch and Controller.
Heating - during Y call	X	X		X	-Missing blower compartment access panel. -Loss/lack of airflow (dirty filter, closed vents, blower, restricted ductwork, etc.) -High return air temperatures. -Overcharged refrigerant circuit. -Expansion valve / sensing bulb malfunction. -Dirty (fouled) air coil.
Cooling – during Y call	X	X		X	-Loss/lack of flow through the ground-side heat exchanger. -High fluid temperature in the ground-side heat exchanger. -Dirty (fouled) ground-side heat exchanger (on ground water systems). -Overcharged refrigerant circuit. -Expansion valve / sensing bulb malfunction.

XIV. TROUBLESHOOTING GUIDE FOR UNIT OPERATION

PROBLEM	POSSIBLE CAUSE	CHECKS AND CORRECTIONS
Entire unit does not run	Blown Fuse/Tripped Circuit Breaker	Replace fuse or reset circuit breaker. (Check for correct size fuse or circuit breaker.)
	Blown Fuse on Controller	Replace fuse on controller. (Check for correct size fuse.) Check for loose fuse clips.
	Broken or Loose Wires	Replace or tighten the wires.
	Voltage Supply Low	If voltage is below minimum voltage on data plate, contact local power company.
	Low Voltage Circuit	Check 24-volt transformer and fuse for burnout or voltage less than 18 volts.
	Room Thermostat	Set thermostat on “Cool” and lowest temperature setting, unit should run. Set thermostat on “Heat” and highest temperature setting, unit should run. If unit does not run in both cases, the room thermostat could be faulty or incorrectly wired. To prove faulty or miswired thermostat, disconnect thermostat wires at the unit and jumper between “R”, “Y” and “G” terminals and unit should run. Replace thermostat only with correct heat pump thermostat. A substitute may not work properly.
	Interruptible Power	Check incoming supply voltage.
Unit will not operate on “heating”	Dirty Filter	Check filter. Clean or replace if found dirty.
	Thermostat Improperly Set	Is it below room temperature? Check the thermostat setting.
	Defective Thermostat	Check thermostat operation. Replace if found defective.
	Incorrect Wiring	Check for broken, loose, or incorrect wires.
	Blower Motor Defective	If it does not operate the compressor will go off on high head pressure.
Evaporator (air coil) ices over in cooling mode	Dirty Air Filter or Air Coil	Check filter. Clean or replace if found dirty. Clean air coil if found dirty.
	Airflow	Lack of adequate airflow or improper distribution of air. Check the motor speed and duct sizing. Check the filter, it should be inspected every month and changed if dirty. Check for closed registers. Remove or add resistance accordingly.
	Blower Speed Set too Low	Verify blower speed jumpers are in factory settings.
	Low Air Temperature	Room temperatures below 65°F may ice over the evaporator.
Blower motor runs but compressor does not, or compressor short cycles	Room Thermostat	Check setting, calibration, and wiring.
	Wiring	Check for loose or broken wires at compressor, capacitor, or contactor.
	Blown Fuse	Replace fuse or reset circuit breaker. (Check for correct size fuse or circuit breaker.)
	High or Low Pressure Controls	The unit could be off on the high or low-pressure cutout control. Check water GPM, air CFM and filter, ambient temperature and loss of refrigerant. If the unit still fails to run, check for faulty pressure controls individually. Replace if defective.
	Voltage Supply Low	If voltage is below minimum voltage specified on the data plate, contact local power company. Check voltage at compressor for possible open terminal.
	Low Voltage Circuit	Check transformer and fuse for burn out or voltage less that 18 volts. With a voltmeter, check signal from thermostat at Y to X, M1 on controller to X, check for 24 volts across the compressor contactor. Replace component that does not energize.
	Compressor Overload Open	In all cases an “internal” compressor overload is used. If the compressor motor is too hot, the overload will not reset until the compressor cools down.
	Compressor Motor Shorted to Ground	Internal winding grounded to the compressor shell. Replace the compressor. If compressor burnout, replace inline filter drier.
	Compressor Windings Open	Check continuity of the compressor windings with an ohmmeter. If the windings are open, replace the compressor.
	Seized Compressor	Try an auxiliary capacitor in parallel with the run capacitor momentarily. If the compressor still does not start, replace it.
Unit short cycles	Room Thermostat	Improperly located thermostat (e.g. near kitchen, inaccurately sensing the comfort level in living areas). Verify Install Set-up configuration.
	Wiring and Controls	Loose wiring connections, or control contactor defective.
	Compressor Overload	Defective compressor overload, check and replace if necessary. If the compressor runs too hot, it may be due to insufficient refrigerant charge.

PROBLEM	POSSIBLE CAUSE	CHECKS AND CORRECTIONS
Unit does not cool (Heats Only)	Reversing Valve does not Shift	Defective solenoid valve will not energize. Replace solenoid coil.
	Room Thermostat	Ensure that it is properly configured according to their own instructions for the "System Type" they are installed on.
	Reversing Valve does not Shift, the Valve is Stuck	The solenoid valve is de-energized due to miswiring at the unit or thermostat - correct wiring. Replace if valve is tight or frozen and will not move. Switch from heating to cooling a few times to loosen valve.
Insufficient cooling or heating	Water	Lack of sufficient pressure, temperature and/or quantity of water.
	Unit Undersized	Recalculate heat gains or losses for space to be conditioned. If excessive, rectify by adding insulation, shading, etc.
	Loss of Conditioned Air by Leaks	Check for leaks in ductwork or introduction of ambient air through doors/windows
	Room Thermostat	Improperly located thermostat (e.g. near kitchen, not sensing the comfort level in living areas). Verify Install Set-up configuration.
	Airflow	Lack of adequate airflow or improper distribution of air. Check the motor speed and duct sizing. Check the filter, it should be inspected every month and cleaned if dirty. Remove or add resistance accordingly.
	Refrigerant Charge	Low on refrigerant charge causing inefficient operation. Adjust only after checking CFM,GPM, and inlet/outlet temperatures.
	Compressor	Check for defective compressor. If discharge pressure is too low and suction pressure is too high, compressor is not pumping properly. Replace compressor.
	Desuperheater	The desuperheater circuit (in-line fuse) should be disconnected during cold weather to allow full heating load to the house.
	Reversing Valve	Defective reversing valve creating bypass of refrigerant from discharge to suction side of compressor. When it is necessary to replace the reversing valve, wrap it with a wet cloth and direct the heat away. Excessive heat can damage the valve.
Water drips from unit	Unit not Level	Level vertical units.
	Condensate Drain Line Kinked or Plugged	Clean condensate drain. Make sure external condensate drain is installed with adequate drop and pitch.
Noisy Operation	Compressor	Make sure the compressor is not in direct contact with the base or sides of the cabinet. Cold surroundings can cause liquid slugging, increase ambient temperature.
	Blower and Blower Motor	Blower wheel hitting the casing, adjust for clearance and alignment. Bent blower, check and replace if damaged. Loose blower wheel on shaft, check and tighten.
	Contactor	A "clattering" or "humming" noise in the contactor could be due to control voltage less than 18 volts. Check for low supply voltage, low transformer output, or transformer tap setting. If the contactor contacts are pitted or corroded or coil is defective, repair or replace.
	Rattles and Vibrations	Check for loose screws, panels, or internal components. Tighten and secure. Copper piping could be hitting the metal surfaces. Carefully readjust by bending slightly. Check that hard plumbing is isolated from building structures.
	Water and Airborne Noises	Undersized ductwork will cause high airflow velocities and noisy operation. Excessive water through the water-cooled heat exchanger will cause a squealing sound. Check the water flow, ensuring adequate flow for good operation but eliminating the noise.
	Cavitating Pumps	Purge air from ground loop system.
	Squealing Sound from Inside the Cabinet	Purge air from the water side of the desuperheater heat exchanger or defective desuperheater heat exchanger.

XV. TROUBLESHOOTING GUIDE FOR ECM BLOWER

PROBLEM	CHECKS AND CORRECTIONS
Motor rocks slightly when starting	•This is normal start-up for ECM.
Motor won't start •No movement	•Wait for completion of ramp-up at start. •Check power at motor. •Check low voltage (24 VAC R to X) at motor. •Check low voltage connections (G, Y, W2, R, X) at motor. •Check for unseated pins in connectors on motor harness. •Test with a temporary jumper between R and G. •Check motor for a tight shaft. •Perform Moisture Check*.
Motor rocks, but won't start	•Check for loose or compliant motor mount. •Make sure blower wheel is tight on shaft.
Motor starts, but runs erratically •Varies up and down or intermittent	•Is ductwork attached? •Check line voltage for variation or "sag". •Check low voltage connections (G, Y, W2, R, X) at motor, unseated pins in motor harness connectors. •Check out system controls, thermostat. •Perform Moisture Check*.
"Hunts" or "puffs" at high CFM (speed)	•Does removing panel or filter reduce puffing? Reduce restriction.
Stays at low CFM despite call for higher speed	•Check low voltage wires and connections. •Verify fan is not in delay mode; wait until delay complete. •"R" missing/not connected at motor.
Stays at high CFM	•Verify fan is not in delay mode; wait until delay complete. •"R" missing/not connected at motor.
Blower won't change CFM after adjusting the speed control setting.	•Power to the unit must be reset to enable the new settings. •Verify fan is not in delay mode; wait until delay complete. •"R" missing/not connected at motor.
Blower won't shut off	•Current leakage from controls into G, Y, or W?
Excessive noise	•Determine if it's air noise, cabinet, duct or motor noise.
Air noise	•High static creating high blower speed? - Does removing filter cause blower to slow down? Check filter. - Use low-pressure drop filter. Check/correct duct restrictions.
Noisy blower or cabinet	•Check for loose blower housing, panels, etc. •High static creating high blower speed? - Check for air whistling through seams in ducts, cabinets, or panels. Check for cabinet/duct deformation.

***Moisture Check**
•Connectors are oriented as recommended by equipment manufacturer?
•Is condensate drain plugged?
•Check for low airflow (too much latent capacity)
•Check for undercharged conditions.
•Check and plug leaks in return ducts, cabinet.

****Comfort Check**
•Check proper airflow settings.
•Low static pressure for low noise.
•Set low continuous-fan CFM.
•Thermostat in good location?

XVI. ADDITIONAL FIGURES

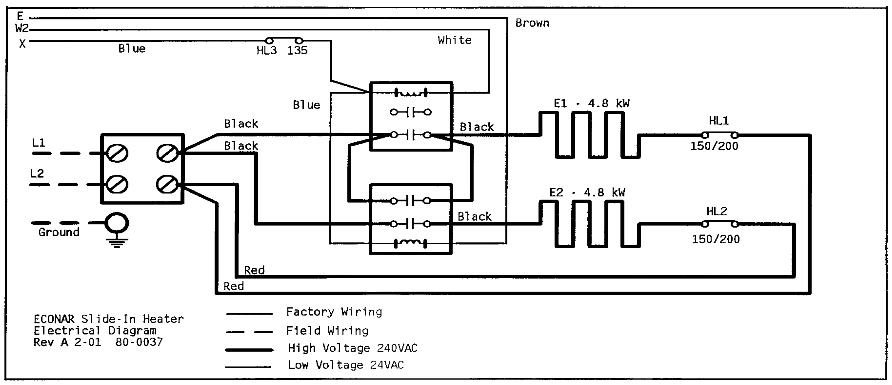


Figure 2 – Electrical Diagram for optional ECONAR Intelligent Slide-In-Heater

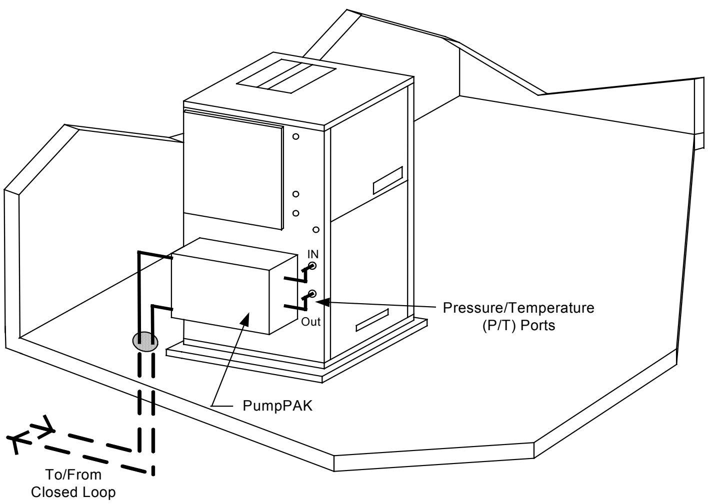


Figure 3 – Ground Loop Water Plumbing

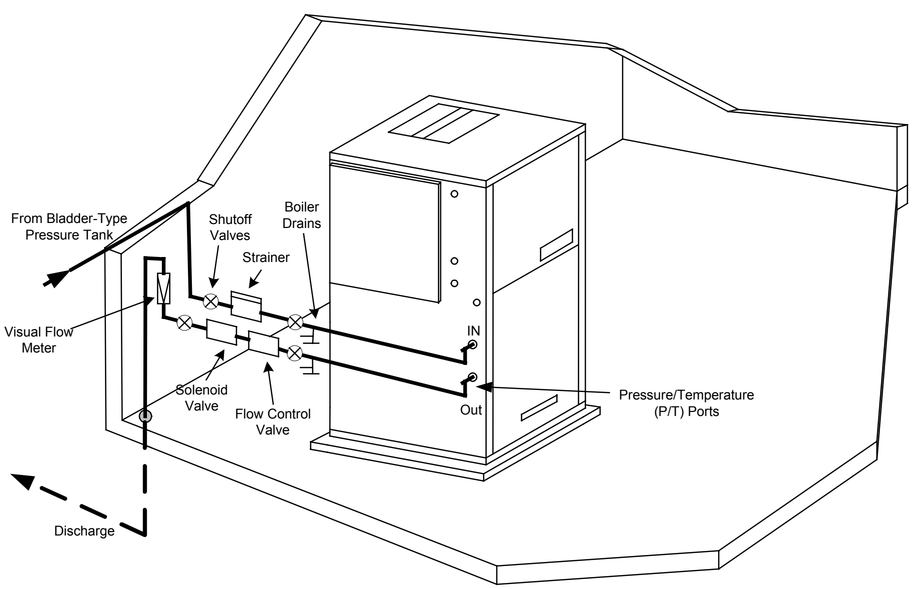
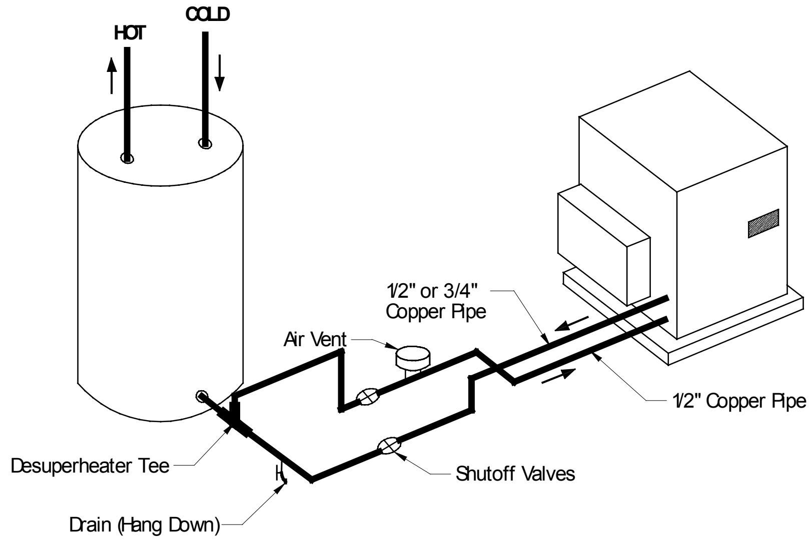
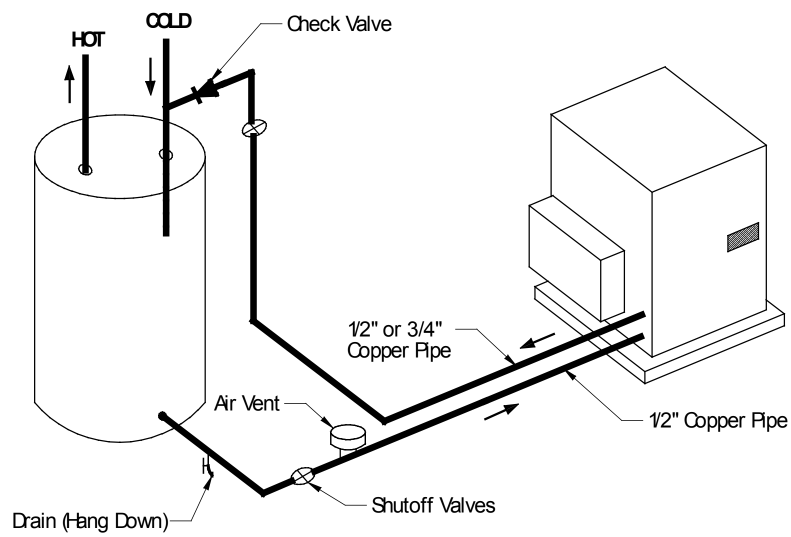


Figure 4 – Ground Water Plumbing



☞**Note** – Always use copper pipe. Check local codes and use proper plumbing procedures.

Figure 5 – Preferred Desuperheater Installation



☞**Note** – Always use copper pipe. Check local codes and use proper plumbing procedures.

Figure 6 – Alternate Desuperheater Installation

NOTES

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